Santa Cruz County Regional Conservation Investment Strategy

DRAFT

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SCCRTC
Santa Cruz County Regional Transportation Commission

RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

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Executive Summary

Introduction

The Santa Cruz County Regional Conservation Investment Strategy (RCIS) is a voluntary, non-binding, non-regulatory regional plan for the conservation of natural communities, species, and related biodiversity conservation values within Santa Cruz County (the RCIS Area). It was developed to facilitate regional, early, and advance mitigation planning, and to direct conservation investments to the highest priority areas through science-based, collaborative, and voluntary actions to achieve more effective conservation outcomes.

The RCIS was developed by the Santa Cruz County Regional Transportation Commission (RTC) and the Resource Conservation District of Santa Cruz County (RCD) through a multi-stage process between 2020 and 2022. The RCIS synthesizes and builds upon prior conservation research and plans and was developed with extensive input from the community including: local, state, and federal resource agencies and organizations; stakeholders from a variety of sectors including representatives from conservation and transportation; technical advisors with expertise in biological system and species in the RCIS Area; and the broader public. The RCIS was prepared following the guidelines for the RCIS program (CDFW 2018), which is administered by the California Department of Fish and Wildlife (CDFW) to help California's declining and vulnerable species by protecting, creating, restoring, and reconnecting habitat and may contribute to species recovery and adaptation to climate change and resiliency (CDFW 2021).

The RCIS describes the document and its purpose (Chapter 1), characterizes the RCIS Area (Chapter 2), describes the conservation framework including conservation elements (Chapter 3), assesses the pressures and stressors, including climate change (Chapter 4), presents conservation strategies for the 23 conservation elements (Chapter 5), and then identifies how the RCIS can be implemented, monitored, and updated over time (Chapter 6).

Regional Setting

The 285,261-acre RCIS Area (Santa Cruz County) features varied topography, geology, soils, and hydrology that give rise to a mosaic of biologically rich communities. These include globally rare terrestrial communities such as old-growth redwood forests, Santa Cruz sandhills, karst caves, coastal prairie grasslands, and maritime chaparral; they also include coastal streams and their associated riparian corridors, ponds, sloughs, and other wetlands, and rocky seashore, dunes, and coastal bluffs. These dynamic systems were historically maintained through natural disturbance regimes, including fire and floods, which create and maintain habitat for rare species and promote biodiversity.

These rare communities, along with the more widespread communities which include oak woodlands and redwood forests, support 1,000 native plant species (Neubauer 2013) including 17 that are found only within the county, such as Santa Cruz wallflower (*Erysimum teretifolium*)

and Scotts Valley polygonum (*Polygonum hickmanii*). The RCIS Area also supports a diverse fauna including endemic invertebrate species such as the Zayante band-winged grasshopper (*Trimerotropis infantilis*) and Ohlone tiger beetle (*Cicindela ohlone*), and other critically endangered species including Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*), Santa Cruz kangaroo rat (*Dipodomys venustus* venustus), coho salmon (*Oncorhynchus kisutch*), and marbled murrelet (*Brachyramphus marmoratus*). The RCIS Area contains large patches of intact habitat and important aquatic and terrestrial landscape linkages, including those connecting the Santa Cruz Mountains and the adjacent Gabilan and Diablo ranges; this habitat connectivity is essential to the persistence of wide-ranging species including the mountain lion (*Puma concolor*), and to facilitating species migration in response to climate change.

The RCIS Area's natural systems occur within a landscape that features iconic working lands that play an important role in regional biodiversity conservation, including: prime farmlands in the Pajaro Valley, productive coastal farmlands on the North Coast, scenic rangelands of the Pajaro Hills, and the redwood and Douglas-fir forests that blanket the mountains and produce timber (Section 2.2.3). Development in the RCIS Area is concentrated along the coast between City of Santa Cruz and the unincorporated village of Aptos, and in Watsonville, Scotts Valley, and the San Lorenzo Valley; the mountains support variable density of rural residential (exurban) development (Section 2.2.2).

The RCIS also evaluates assesses foreseeable impacts that may occur due to implementation of major planned infrastructure and development projects within the next 10 years (Section 2.2.4). A small suite of residential, mixed use, commercial, and other development projects are planned in the cities of Capitola, Santa Cruz, Scotts Valley, and Watsonville, the unincorporated county, where most projects are proposed for existing developed areas (Section E.4). The RCIS Area will also see a suite of transportation, water, and other infrastructure improvement and maintenance projects, which are similarly concentrated in the existing developed areas (Sections 2.2.4.1 and Appendix E).

Conservation Framework and Elements

To create a comprehensive conservation strategy to protect biodiversity and sustain natural ecological systems, this RCIS addresses five types of conservation elements: natural communities, other conservation elements, focal species, non-focal species, and co-benefitted species (Table 3-1). To develop comprehensive and cohesive strategies for the landscape that benefit entire assemblages of species and support ecosystem functions in ways often not achieved in developing strategies for single species (Section 3.2), this RCIS developed conservation strategies for 13 **natural communities** (Table 3-2). To complement the natural communities-based approach to address other important facets within the landscape, the RCIS addresses three **other conservation elements**: habitat connectivity, working lands, and bat habitat. Habitat connectivity is essential to goals for communities and species, while working lands (i.e., timber, grazing, and cultivated lands) play an important role in landscape-scale

conservation in the region. Bat habitat, which occurs throughout the RCIS Area including developed areas, requires unique strategies.

Recognizing the value of natural community-based, landscape-scale planning for native species conservation, the RCIS also presents conservation strategies for seven **focal species** (Table 3-3) which were selected to include listed species, wide-ranging species, climate-vulnerable species, and provide taxonomic representation. The conservation strategies for focal species build upon these community-level strategies and address unique objectives, actions, and priorities that are specific to the focal species and do not directly benefit the related community or communities.

Non-focal species are 30 additional listed species (or Fully Protected) species (Table 3-4) that will benefit from the conservation strategies, as identified in the RCIS strategies. Finally, the RCIS lists 157 **co-benefited species:** other rare species that are not state or federally listed, but may be recognized as sensitive under the California Environmental Quality Act, California Coastal Act, or other state or local regulations, are anticipated to benefit from the conservation strategies (Table 3-5).

Pressures and Stressors

The conservation elements are influenced by both anthropogenic and natural pressures, that create degraded ecological conditions known as stressors (Chapter 4). The primary pressures in the RCIS Area include development, incompatible working lands, mining and quarrying, water use, altered disturbance regimes, exotic species, incompatible recreation, unauthorized activities, and climate change. The pressures and associated stressors impact the communities, species, and other conservation elements by reducing, fragmenting, and degrading habitat, and reducing genetic diversity. Table 4-1 lists the pressures and associated stressors impacting aquatic communities and species, while Table 4-2 provides those for terrestrial systems. Details about the unique pressures and stressors impacting each conservation element are provided in the conservation strategies (Section 5.3).

Conservation Strategies

Chapter 5 provides the conservation strategies for the 13 natural communities, three other conservation elements, and seven focal species. Strategies for the natural communities are designed to promote focal and non-focal species by conserving habitat that they rely upon for key aspects of their life history and addressing their pressures and stressors. The RCIS voluntary strategies are designed to complement protection measures afforded by existing policies and regulations, which play an essential role in protecting biological systems in Santa Cruz County.

The strategies are outlined in tables that features four main components: goals, objectives, actions, and priorities (GOAP). The **goals** reflect broad, desired outcomes—what the strategy is designed to achieve in the RCIS Area—and generally include: 1) promoting persistence and integrity of the conservation element; 2) connecting the conservation element within the landscape; 3) protecting biodiversity and rare species; 4) promoting water quality; and 5)

promoting water quantity. The objectives identify the general ways the goals can be achieved, including: 1) protecting habitat, 2) restoring and enhancing habitat, 3) creating and expanding habitat, and 4) conducting individual species (or population) actions (e.g., reintroductions). The **actions** list steps that can be taken to achieve the objective, while the **priorities** reflect the specific activity or location where investments should be emphasized. The goals and objectives are sequenced in the orders listed above, which do not necessarily reflect their priority within the strategy, and instead are for consistency**.** The RCIS explicitly does not prioritize between goals and objectives and instead recognizes that conservation requires multiple co-equal goals that function at different spatial and temporal scales and different locations.

The links between the conservation strategies and the focal and non-focal species benefited are made through three methods: 1) a list of the species associated with the conservation element before each GOAP table, 2) a column in the GOAP table that identifies the focal and non-focal species that will benefit from each action, and 3) Table 5-2, which summarizes the key ecological requirements for each of the focal and non-focal species, and identifies the conservation elements with which they are associated. Recognizing many of the conservation strategies will benefit multiple conservation elements, each strategy identifies the other conservation strategies that will benefit the conservation element (e.g., strategies for Riparian and Riverine Communities will benefit coho salmon).

Each of the strategies is preceeded by background information including (Table 5-1): rarity and status, citations for detailed descriptions, a summary of the key ecological elements, a list of the key pressures and stressors, and a climate change vulnerability assessment. The quantitative habitat protection targets were developed through a gap analysis (Section 5.2), which sets 30-year and 10- year habitat protection targets based on overall targets and the percentage of habitat in existing protected lands (Section 2.2.5) Section 5.2.4 outlines important factors to consider in using the gap analysis and resulting quantitative targets to inform conservation actions through the RCIS.

Implementation

As a voluntary, non-binding guidance document, the RCIS will be implemented through the actions of many agencies, organizations, and individuals seeking to conduct conservation projects through a variety of mechanisms. Coordinated implementation of the RCIS can enhance effectiveness of the strategy toward achieving its goals, and can be facilitated through existing conservation collaboratives and new initiatives (Section 6.1.2).

The RCIS actions can be funded through a variety of existing mechanisms, including: mitigation, government grants and other public funds, private philanthropy, and tax incentives (e.g., for conservation easements; Section 6.1.3). In addition, the RCIS provides a strong foundation for developing a dedicated and sustained source of local conservation funding that can match state, federal, and private funding and greatly enhance the ability of conservation agencies and organizations working in the region to achieve the goals and objectives of the RCIS.

Achievement of the RCIS goals and objectives can be facilitated by taking steps to overcome existing barriers to implementation of conservation projects including permitting, liability issues, lack of skilled labor, and economic trade-offs within working lands (Section 6.1.4). To maximize efficiency, projects that achieve multiple-benefits for the conservation elements should be prioritized, to protect, restore, and/or otherwise conserve multiple communities and species. The maps and spatial database used to develop the RCIS can help site projects in areas that can achieve multiple objectives of the RCIS to enhance cost effectiveness of implementation (Section 6.1.5).

Monitoring and adaptive management are designed to ensure that the conservation actions and habitat enhancement actions achieve the RCIS goals and objectives (Section 6.2). Such adaptive management programs are required as part of a mitigation credit agreement (MCA): agreements developed in collaboration with CDFW to create mitigation credits by implementing RCIS conservation or habitat enhancement actions. Credits generated through MCAs are transferable and can be used as compensatory mitigation for impacts under the California Environmental Quality Act (CEQA), the California Endangered Species Act (CESA), and the Lake and Streambed Alteration Program (LSA). Additional resource agencies could potentially elect to have credits generated through MCAs be applicable to compensatory mitigation needs under other local, state, or federal regulations.

As the RCIS proponent, the RTC will monitor overall effectiveness of the conservation actions and habitat enhancement actions at achieving the goals and objectives for the conservation elements by assessing the extent to which they offset the effects of identified pressures and stressors (Section 6.3). The RCIS strategies identify the specific metrics that will be used to monitor progress toward the goals and objectives (e.g., acres of habitat restored). The RTC and RCD, with support and input from the RCIS Steering Committee, Technical Advisory Committee, and Stakeholder Committee, will facilitate a 10-year evaluation of the RCIS, and complete the 10-year update of the RCIS provided it is achieving the intended purposes (Section 1.6).

1 Introduction

1.1 Santa Cruz County RCIS Overview

The Santa Cruz County Regional Transportation Commission (RTC) partnered with the Resource Conservation District of Santa Cruz County (RCD) to develop the Santa Cruz County Regional Conservation Investment Strategy (RCIS). The RCIS is a voluntary, non-binding, non-regulatory regional plan for the conservation of natural communities, species, and related biodiversity conservation values. The RCIS provides a comprehensive regional conservation strategy to safeguard Santa Cruz County's unique biodiversity and ecological communities and promote resilience to foreseeable pressures and stressors. It was developed to support efforts to align demands for infrastructure improvements, climate change resiliency and adaptability, and conservation, by helping to prioritize voluntary conservation investments, identify high-value conservation and habitat enhancement opportunities, inform regional advance mitigation planning and compensatory mitigation, develop projects to address legacy infrastructure impacts, and focus project mitigation on the highest conservation priorities.

The RCIS, which addresses the land and water within the geographic area of Santa Cruz County (Section 1.3), integrates the abundant existing, available scientific information, plans, and analyses to identify and develop strategies for a series of conservation elements: natural communities, other conservation elements, focal species, non-focal species, and co-benefited species (Section 3.2). Rather than focusing on species, the strategy emphasizes natural communities and other important aspects of the landscape, including habitat connectivity, working lands, and bat habitat, which collectively support rare as well as common species in Santa Cruz County.

The RCIS was developed through the engagement of technical advisors, stakeholders, and the broader community (Section 1.7). Through this outreach, the wealth of local knowledge was synthesized with prior conservation plans to develop a comprehensive regional strategy to protect Santa Cruz County's rare and unique species, biodiversity, and ecological communities and to sustain the landscape processes that support them, including by promoting resilience to identified pressures and stressors.

1.2 RCIS Program

Administered by the California Department of Fish and Wildlife (CDFW), the RCIS Program is a non-regulatory, and non-binding conservation program that uses a science-based approach to identify conservation and enhancement opportunities that, if implemented, will help California's declining and vulnerable species by protecting, creating, restoring, and reconnecting habitat and may contribute to species recovery and adaptation to climate change and resiliency (CDFW 2021). Once an RCIS is in place, public and private entities may enter into Mitigation Credit Agreements (MCAs), which create mitigation credits in advance of anticipated impacts resulting from projects including, maintenance of existing infrastructure and new infrastructure and development projects. An MCA allows agencies implementing projects to obtain mitigation

credits, by implementing habitat conservation or enhancement actions that achieve the goals and strategies outlined in the RCIS (Section 6.1.3.2.3; CDFW 2021).

Though focused on biodiversity conservation, the RCIS actions can help sustain other important ecosystem services such as recreation, water protection, wildfire risk reduction, and flood risk reduction. Although the RCIS program was developed by CDFW, the RCIS addresses local, state, and federal natural resource regulatory agency mandates and needs to provide a unified strategy to guide conservation investment within the county.

1.3 The RCIS Area

This RCIS addresses land and water resources within the geographic area encompassed by Santa Cruz County, which is the jurisdiction of the RTC (Figure 1-1), and is referred to hereafter as the "RCIS Area". Present-day Santa Cruz County is located within the homeland of the Achistaca, Aptos, Cajastaca, Cotoni, Sayanta, and Uypi tribes, who spoke the Awaswas and Mutsun languages: two of six Ohlone languages. Today's Ohlones continue to honor their legacy through their cultural and tribal work, advocacy for the preservation of ancestral cultural sites and landscapes, and practice of traditional ecological knowledge (Native Land Digital 2021). The RCIS seeks to honor their traditions and practices as the original and current stewards of the land and support revitalization efforts of all indigenous tribes.

Santa Cruz County is a biodiversity hot spot known and valued for its globally rare natural communities such as old-growth redwood forests, Santa Cruz sandhills, karst caves, coastal prairie grasslands, and maritime chaparral, which feature 35 endemic species such as the Ben Lomond wallflower and Ohlone tiger beetle. Santa Cruz County also features sensitive aquatic habitats including ponds, wetlands, and coastal streams that support steelhead and coho salmon, and rare amphibians including Santa Cruz long-toed salamander.

Land within Santa Cruz County plays an important role in maintaining biological systems within the Santa Cruz Mountains bioregion and maintaining landscape connectivity within the broader Central Coast Ecoregion (Mackenzie et al. 2011). The county's biological systems provide a wealth of goods and services that support quality of life including crop pollination, water infiltration, flood protection, carbon sequestration, climate change adaptation, working lands production, recreation, and tourism (Schmidt et al. 2015).

The RCIS was developed to complement RCISs that have been recently adopted by Santa Clara (ICF 2019) and Monterey (AECOM 2021) counties, which are contiguous with the RCIS Area (Section 1.5.5). Collectively, these RCISs can be used to identify high-value conservation and habitat enhancement opportunities and to inform and facilitate comprehensive, cohesive, and connected regional conservation outcomes.

The RCIS was developed using available information for the planning area, which oftentimes included regional spatial data (Appendix B). While these data are appropriate for planning

purposes, they may not always accurately depict conditions at the site level, where additional assessments and planning may be required during implementation of the RCIS.

Figure 1-1: Santa Cruz County RCIS Area

1.4 RCIS Planning Framework and Contents

The RCIS was developed through a stepwise conservation planning framework (Figure 1-2), which is reflected in the contents of the RCIS contains as outlined below:

- **Introduction (Chapter 1):** This introduction provides background about the RCIS, including its origins, relationship to prior plans, purpose, public development process, planning framework, and uses.
- **Regional Setting (Chapter 2):** The Regional Setting characterizes the RCIS Area (Santa Cruz County), in terms of its: 1) natural systems, including ecoregions, watersheds, vegetation and other land cover; 2) its human activities, including land use and infrastructure; and 3) existing conservation plans. It guided selection of the conservation elements, and provided essential information for evaluating their pressures and stressors (Chapter 4) and developing the conservation strategies (Chapter 5).
- **Conservation Elements (Section 3):** This section identifies the communities, focal species, non-focal species, and other conservation elements selected for analysis in the RCIS and the criteria used to select them to create a comprehensive and cohesive conservation strategy for the RCIS Area.
- **Pressures and Stressors (Section 4):** This section identifies and briefly describes the anthropogenic or natural drivers (pressures) that create degraded ecological conditions (stressors) for the conservation elements. This analysis informed development of the conservation strategies (Chapter 5) which were designed to address the anthropogenic pressures and stressors.
- **Conservation Strategies (Section 5):** For each of the 23 conservation elements, Chapter 5 provides the conservation strategies. Each strategy includes: background information about the elements, including key ecological requirements, summary of primary pressures and stressors, and their climate change vulnerability, followed by a table listing the goals, objectives, actions, and priorities (i.e., the strategy). To make links between the conservation elements, each of the conservation strategies lists the other conservation elements, including focal and non-focal species, that will benefit from the strategy; they also list the other conservation element strategies that will benefit each conservation element.
- **Implementation (Section 6):** This section outlines approaches and guidance for implementing the RCIS, including methods of collaborating and funding the conservation strategy. It also outlines how the RCIS can changed over time, including through updates to maintain it as current.
- **Appendices:** Additional information to aid use of the RCIS and understanding of how it was developed, including a glossary (Appendix A), list of GIS data sources (Appendix B), letters of support for the RCIS (Appendix C), details of public participation (Appendix D),

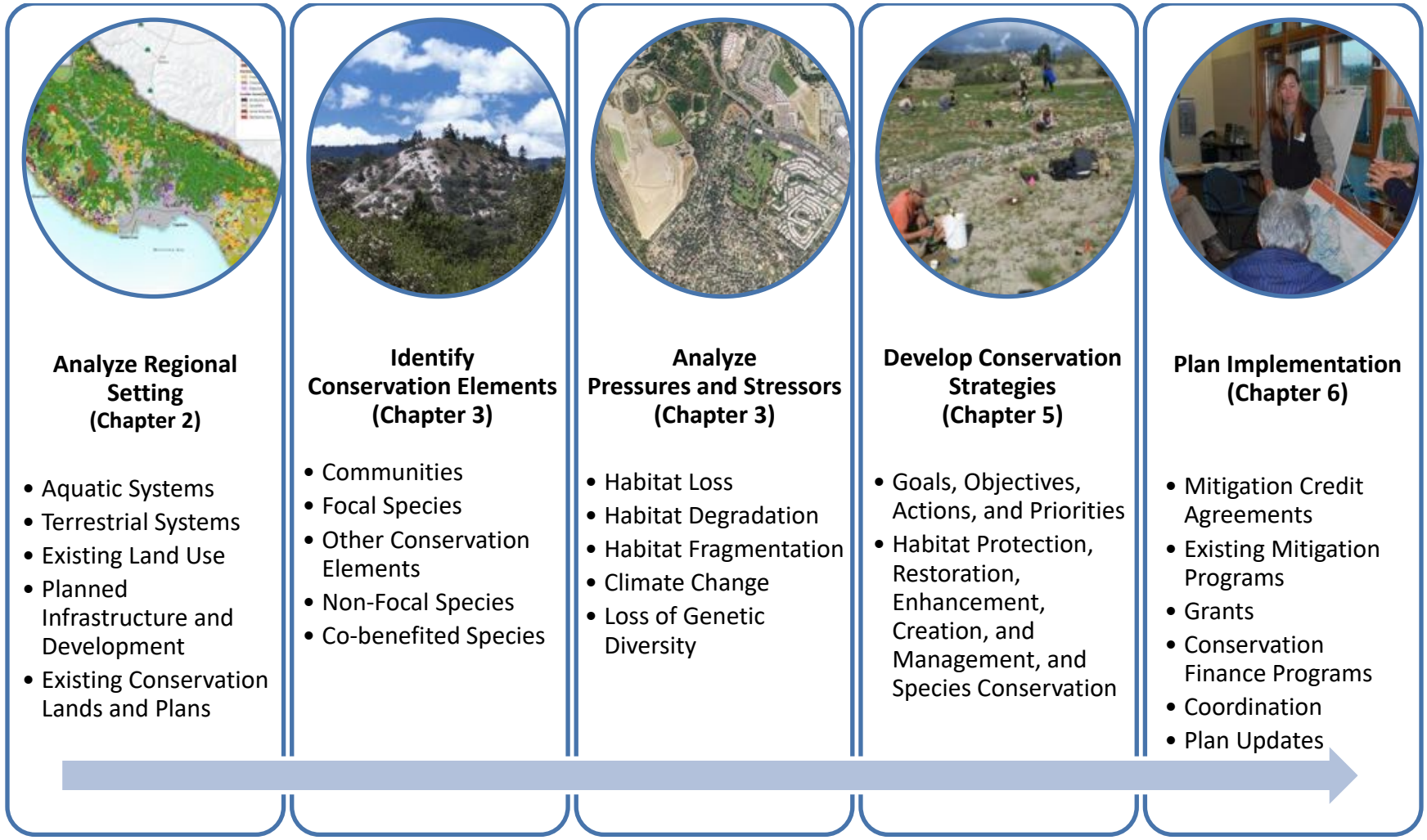

Figure 1-2: The RCIS Conservation Planning Framework and Contents

infrastructure plans and projects (Appendix E), methods used to assemble the species database (Appendix F), and a table identifying the sections of the plan that address the RCIS requirements as identified in the Fish and Game Code (Appendix G).

1.5 Relationship of RCIS to Prior Plans, Programs, and Agreements

The RCIS builds upon a unique foundation of collaborative conservation planning and action, which are the hallmark of conservation in Santa Cruz County. Prior conservation planning efforts focused on protecting and restoring important lands, biological systems, and watersheds, and recovering rare species (Section 2.3). In addition, many of the prior plans developed goals and strategies to safeguard the region's other conservation values including working lands and water resources, while allowing orderly development and maintenance of essential infrastructure.

The RCIS leverages the Integrated Watershed Restoration Program, the Conservation Blueprint for Santa Cruz County (Mackenzie et al. 2011), and the Early Mitigation Planning for Transportation Improvements in Santa Cruz County Memorandum of Understanding as foundational pillars for both collaborative conservation and the identification and pursuit of priority conservation strategies and actions across the county. The RCIS builds upon, and will help implement, numerous other conservation and recovery plans, and was developed to be compatible with the region's habitat conservation plans.

1.5.1 Integrated Watershed Restoration Program

The Integrated Watershed Restoration Program (IWRP) grew out of a series of watershed assessments and plans in the late 1990s and early 2000s and has evolved to meet the recognized need for a coordinated, regional process for identifying, funding, and developing key projects to improve fish and wildlife habitat and water quality. IWRP was conceived in 2003 through a partnership between the RCD, the California Coastal Conservancy, CDFW, the City of Santa Cruz, the County of Santa Cruz, and the Coastal Watershed Council. Through its Technical Advisory Committee (TAC), IWRP brings together federal, state, and local natural resource regulatory and funding agencies to identify and oversee the design and implementation of high priority projects to restore watersheds. Though initially focused on Santa Cruz County, IWRP now also includes neighboring San Mateo and Monterey counties.

Over the past decades IWRP has implemented critical projects and developed a culture of trust and collaboration among participants. IWRP has won national and statewide recognition and continues to be the go-to program for coordinated regional recovery planning, resilience planning, innovating and testing new techniques and technologies, as well as mediation and facilitation to resolve difficult and complex resource problems. As of 2020, the State Coastal Conservancy's cumulative $9.3 million investment in developing IWRP and designing and permitting projects through IWRP has leveraged well over $41 million in implementation investment to complete over 180 restoration projects. The RCIS engaged the IWRP TAC for

technical advising to inform the strategy including identification of priority conservation actions. IWRP is anticipated to provide a key forum to facilitate implementation of the RCIS (Section 6.1.2).

1.5.2 Conservation Blueprint for Santa Cruz County

The RCIS was informed by the Conservation Blueprint for Santa Cruz County—a comprehensive conservation plan developed by the Land Trust of Santa Cruz County, that identifies important areas to conserve and provides recommendations for their protection in Santa Cruz County (Mackenzie et al. 2011). The Conservation Blueprint was developed through a multi-year process that included a thorough assessment of the region, based on a synthesis of existing information and new research and analyses, and extensive community engagement to identify the conservation values and goals. These efforts informed the development of comprehensive and integrated strategies to protect biological resources, water resources, and working lands, and to create healthy communities by facilitating compatible recreation.

In addition to informing the RCIS strategies, this foundational document provided a key source of information about the conservation values, including spatial data, that was instrumental in the RCIS. Implementation of conservation strategies in the RCIS can further implementation of the Conservation Blueprint.

1.5.3 Early Mitigation Memorandum of Understanding

In 2018, the RTC, RCD, and 11 other transportation and natural resource regulatory agencies entered into the Santa Cruz Early Mitigation Partnership Memorandum of Understanding (EMP MOU). The EMP MOU leverages the collaborative relationships established through IWRP to foster early and collaborative engagement among transportation and natural resource regulatory agencies to improve predictability and effectiveness of transportation project mitigation to meet regional conservation priorities. Signatories to the EMP MOU include: the California Coastal Commission (Commission), California State Coastal Conservancy (Conservancy), CDFW, California Department of Transportation (Caltrans), Central Coast Regional Water Quality Control Board (CCRWQCB), National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS), RCD, Santa Cruz County Planning Department, Santa Cruz County Public Works, RTC, San Francisco District of the United States Army Corps of Engineers (USACE), and Region 9 of the United States Environmental Protection Agency (EPA).

1.5.4 Other Conservation Plans

The RCIS was developed to align with and incorporate additional applicable conservation plans. These include state and federal plans such as the State Wildlife Action Plan (CDFW 2015), species recovery plans, and habitat conservation plans, as well as conservation plans developed by various local public and private land managers. It addresses relevant goals and elements from related water use plans, such as the Sustainable Groundwater Management Plan and

Integrated Regional Water Management Plans. Section 2.3 provides further details on these plans, while Section 5.4 analyzes consistency of the RCIS with the recovery plans and HCPs.

1.5.5 Other RCISs

The RCIS was developed to complement RCISs adopted by the Santa Clara Valley Open Space Authority (OSA) for Santa Clara County in 2019 (ICF 2019) and by the Transportation Agency of Monterey County (TAMC) for Monterey County in 2021 (AECOM 2021). As such, this RCIS along with the adjacent RCISs collectively provide a comprehensive strategy for the region's 3,738,700 acres (5,842 square miles). These RCISs identify the importance of protecting critical wildlife linkages identified between the Santa Cruz Mountains and the Diablo Range in Santa Clara County and the Gabilan Range in Monterey County and adjacent San Benito County (Section 2.4.6). Section 5.4 describes how this RCIS was developed to complement these prior RCISs.

1.5.6 Land Use Plans and Regulations

There are numerous federal, State, and local land management plans and regulations that apply to and/or operate in the RCIS Area. As a voluntary, non-binding document, the RCIS does not create, modify, or impose regulatory requirements or standards, regulate land use, establish land use designations, or affect the land use authority of a public agency. The RCIS strategies are designed to complement protection measures afforded by existing policies and regulations, which play an essential role in protecting biological systems in Santa Cruz County.

The RCIS includes provisions ensuring compliance with all applicable state and local requirements and does not preempt the authority of the State. As a non-regulatory document, an RCIS does not preempt or the authority of local agencies to implement or regulate infrastructure and urban development within their jurisdiction. Additionally, the preparation or approval by CDFW of an RCIS does not alter the requirements of the California Environmental Quality Act (CEQA), the California Endangered Species Act (CESA), the Natural Community Conservation Planning Act (NCCPA), or the California Department of Fish and Wildlife's (CDFW's) Lake and Streambed Alteration (LSA) and Conservation and Mitigation Bank programs (Appendix C) or any applicable State or federal laws and regulations. During development of the RCIS, planning department staff and officials with the local land use agencies (Santa Cruz County and the four incorporated cities therein) were consulted along with staff from CDFW, the CCRWQCB, Coastal Commission, USFWS, and NMFS.

1.6 Purpose

The RCIS provides a scientifically rigorous, comprehensive regional conservation strategy to protect Santa Cruz County's unique biodiversity and ecological communities. It was developed to:

- Facilitate regional, early, and advance mitigation planning; and

- direct conservation investments to the highest priority areas through science-based, collaborative, and voluntary actions to achieve more effective conservation outcomes.

The RCIS can also be assist with regional and project planning.

1.6.1 Regional Advance Mitigation Planning

As noted in Section 1.4.3, the RCIS was born out of a partnership between the RTC, RCD, and numerous transportation and natural resource regulatory agencies who have a shared commitment to regional, early, and advance mitigation planning outlined in the Santa Cruz County EMP MOU. Advance mitigation is a science-based approach to identify mitigation opportunities to support regional conservation priorities. By considering mitigation development early in the planning process prior to design and permitting phases, proponents can identify higher-quality mitigation opportunities. The RCIS can support the desired regional and early mitigation planning efforts by partner agencies and advance mitigation programs such as Mitigation Credit Agreements and Caltrans Advanced Mitigation Program (AMP) by:

- providing a roadmap of conservation strategies and priority actions to direct regional advance mitigation planning and investment to achieve the greatest conservation outcomes on the ground; and
- by laying the natural-resource related groundwork for CDFW.

Regional advance mitigation can be facilitated through MCAs, which are legal agreements between a project proponent and CDFW to implement conservation or habitat enhancement actions in the RCIS. These agreements generate credits that can be used as compensatory mitigation for impacts to special-status species and sensitive habitats under California Environmental Quality Act, the California Endangered Species Act, and the Lake and Streambed Alteration Program. Additional resource agencies could potentially elect to have MCA credits satisfy the mitigation needs under other local, state, or federal regulations (Section 6.1.3.2.3).

Senate Bill 1 (2017) also established the Advanced Mitigation Program (AMP) within Caltrans to oversee the planning and implementation of advanced mitigation projects funded through the Advance Mitigation Account (AMA), a revolving account. The AMP is designed to supply high-quality compensatory mitigation credits (or values) that will be available to satisfy future SHOPP and STIP transportation project compensatory mitigation needs, as defined in natural resource regulatory agency conditions on transportation projects. Under the AMP, Caltrans is authorized to (1) purchase credits created through a Mitigation Credit Agreement (MCA), in bulk, and (2) fund the preparation of a MCA with CDFW, where a Regional Conservation Investment Strategy (RCIS) has been approved by CDFW. Caltrans or another party can be the MCA sponsor.

The RCIS contains information that could guide Caltrans' advance mitigation project development under Article 2.5(b) of Chapter 4 of Division 1 of the Streets and Highway Code. In addition, compensatory mitigation credits purchased in bulk or created in accordance with an MCA tiered off the RCIS and funded through the AMA may be usable by, and hence increase the

delivery efficiency of, Caltrans' future SHOPP transportation projects and/or STIP transportation projects.

To understand where there are opportunities for early coordination and advanced mitigation may occur, the RTC is preparing a transportation mitigation needs assessment modeled after the Caltrans Advanced Mitigation Needs Assessment completed in 2019. The assessment evaluates the 2045 RTP project list for their potential to require compensatory mitigation based on the project scope and proximity to sensitive resources[1]. The projects with off-pavement disturbance that could potentially require mitigation are included in Appendix E (Table E-1).

1.6.2 Promoting Other Voluntary Conservation Investments

In addition to facilitating the alignment of mitigation with conservation, the RCIS can increase other voluntary conservation investments in the region. The RCIS proponents envision future public and private investment programs, such as public and private grants or other philanthropic endeavors, will be developed to support implementation of this strategy (Section 6.1.3).

1.6.3 Regional Planning

The RCIS can inform planning and provides project proponents with information that can assist with project prioritization and justification. For example, the RCIS may be used to assist in land use planning by identifying areas that are most important for biological resource conservation; it should be used in conjunction with other land use planning tools to address other factors not addressed in this document, such as physical geography, social, economic, and risk-reduction considerations.

1.7 RCIS Development Process

The RCIS was developed through the engagement of local experts and stakeholders as well as the broader public. The following summarizes the community outreach used to develop the RCIS, which is further detailed in Appendix D.

1.7.1 Engagement of Experts and Stakeholders

Local interests and expertise were actively engaged throughout the RCIS planning process, through participation in the groups described below. The respective groups were engaged in development of: 1) data and other resources to develop the RCIS; 2) description of the regional setting; 3) selection of the RCIS conservation elements; and 4) the conservation strategies including goals, objectives, actions and priorities for habitat protection, restoration, and enhancement projects.

[1] RTC staff has initiated development of the 2045 RTP, for which a list of projects was compiled in April of 2020. The 2045 RTP is expected to be adopted by the Summer 2022.

- **Steering Committee:** Development of the RCIS was guided by a Steering Committee comprised of the RTC, RCD, consultant team, CalTrans (Headquarters and District 5), CDFW, Land Trust of Santa Cruz County, and State Parks.
- **Stakeholder Group:** To obtain broad input on the RCIS, over 100 individuals were invited to participate in a stakeholder group, comprised of natural resource planners, transportation planners, land owners and land managers, tribal representatives, state, federal and local natural resource and transportation agency representatives, as well as representatives from the neighboring RCIS regions (Santa Clara and Monterey counties). This group included representatives of nearly all the EMP signatory agencies (Section 1.4.3).
- **Technical Advisory Committee:** To ensure that the RCIS reflected the best available scientific information, the RCIS team engaged over 70 individuals with extensive, relevant technical expertise and local experience. In addition to many local non-governmental experts, the Technical Advisory Committee also included technical experts from many of the state and federal natural resource regulatory agencies.

1.7.2 Additional Community Outreach

To ensure robust community participation and provide opportunity for input and review, the RCIS project team conducted direct engagement with staff from natural resource regulatory agencies including the CCRWQCB, Coastal Commission, California State Parks, NMFS, NOAA's Southwest Fisheries Science Center, and the USFWS. In addition, presentations on the RCIS were provided at public meetings held by the Santa Cruz County Fish and Wildlife Advisory Commission and the Santa Cruz County Commission on the Environment, which act as advisory bodies to the County Board of Supervisors, and for the Santa Cruz Weed Management Area—a local collaboration of resource managers focused on addressing invasive plant issues in the RCIS Area.

The project team also outreached directly to tribal representatives to facilitate tribal engagement and to solicit indigenous community knowledge and conservation priorities for inclusion in the RCIS.

1.7.3 Opportunities for Public Input

The RCIS was also developed through input from the public, which was solicited through the RCIS website (https://sccrtc.org/funding-planning/environmental/rcis/) and public workshops and meetings.

1.7.3.1 Development of the Draft RCIS

Public input was solicited on key components of the RCIS early in its development by way of a virtual public workshop between January 11 and February 19, 2021, and an online public meeting/webinar on January 21, 2021. Input was solicited from the public on the following

aspects of the RCIS: 1) the draft regional setting (Section 2), 2) the proposed conservation elements (Section 3), and 3) the types of conservation and enhancement actions that should be addressed in the conservation strategies (Section 5). Feedback through the workshop was received through a variety of methods including:

1. Completion of online surveys during the six-week period; and
2. Public comments submitted following a webinar held via Zoom on January 21, which provided participants with an overview of the draft components outlined above; and
3. Submittal of written comments including through the RCIS email address (rcis_santacruzcounty@sccrtc.org).

A notice of public meeting was posted December 22, 2020, 30 days prior to the meeting, on the RCIS project website (www.sccrtc.org/rcis), and in the Santa Cruz Sentinel (local newspaper). The notices were also sent directly to: 1) each city, and county within or adjacent to the RCIS Area, 2) the implementing entity for each natural community conservation plan or federal regional habitat conservation plan that overlaps with the RCIS Area; 3) each public agency, organization, or individual who filed a written request with CDFW for notices of all regional conservation investment strategy public meetings; and 4) to each public agency, organization, or individual who has filed a request with RTC to receive notices of RTC programs and projects. Oral and written input received, and the responses to all comments received with an explanation for how the comments were addressed in the RCIS is provided in Appendix D.

1.7.3.2 Review of the Draft RCIS

The RTC will host a second virtual public workshop and online meeting to solicit input on the draft RCIS. The meeting will occur when the RCIS has been submitted to CDFW for public review which is anticipated to be early 2022.

2 Regional Setting

This section provides background information about the environmental conditions, existing and planned development, and existing conservation plans in Santa Cruz County. The information led to selection of the conservation elements (Section 3), analysis of the pressures and stressors affecting them (Section 4), and development of the conservation strategies (Section 5).

2.1 Overview

The RCIS Area is the 285,261 acres (446 square miles) located within Santa Cruz County, which is in Central California on the Pacific Coast (Figure 1-1). It is generally bounded by the Pacific Ocean to the west, the north and east by the ridge of the Santa Cruz Mountains, and the Pajaro River to the south. The RCIS Area features varied topography, geology, soils, and hydrology that give rise to a mosaic of biologically rich communities. These include globally rare terrestrial communities such as old-growth redwood forests, Santa Cruz sandhills, karst caves, coastal prairie grasslands, and maritime chaparral; they also include coastal streams and their associated riparian corridors, ponds, sloughs, and other wetlands, and rocky seashore, dunes, and coastal bluffs. These dynamic systems were historically maintained through natural disturbance regimes, including fire and floods, which create and maintain habitat for many rare species and promote biodiversity within the landscape.

These rare communities, along with the more widespread communities which include coastal scrub, oak woodlands, and redwood forests, support rich assemblages of plants and animals. The RCIS Area is an important part of the California Floristic Province, which is a global biodiversity hotspot identified for its abundance of native and endemic plants (Myers et al. 2000). The RCIS Area supports more than 1,000 native plant species (Neubauer 2013) including 17 that are found only within the county, such as Santa Cruz wallflower (*Erysimum teretifolium*) and Scotts Valley polygonum (*Polygonum hickmanii*). The RCIS Area also supports a diversity of animal species, including endemic invertebrate species such as the Zayante band-winged grasshopper (*Trimerotropis infantilis*) and Ohlone tiger beetle (*Cicindela ohlone*), and other rare species that are endemic to the Monterey Bay Area region, such as the Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) and Santa Cruz kangaroo rat (*Dipodomys venustus* venustus). It also supports more widespread rare species such as the southern extent of the critically endangered coho salmon (*Oncorhynchus kisutch*) and marbled murrelet (*Brachyramphus marmoratus*).

Intact habitat within the RCIS Area also supports more wide-ranging terrestrial species, such as American badger (*Taxidea taxus*) and mountain lion (*Puma concolor*). These species rely on habitat permeability within the Santa Cruz Mountains, as well as habitat linkages between the Santa Cruz Mountains and both the Gabilan and Diablo Range mountains. This habitat connectivity is essential to maintaining genetic diversity within populations and can facilitate species' adaptation to climate change.

The unique and diverse biological systems are not only essential to conservation of biodiversity, but they also provide a wealth of goods and services, including crop pollination, water filtration, flood protection, carbon sequestration, climate change adaptation, recreation, and tourism (Mackenzie et al. 2011). Santa Cruz County's natural capital provides at least $800 million to $2.2 billion in benefits to people and the local economy each year (Schmidt et al. 2015).

The RCIS Area's species and biological systems occur within a landscape that features extensive existing protected lands, including primarily parks, reserves, and other protected open space areas, which cover an estimated 91,365 acres or 32% of the RCIS Area (Section 2.2.5). The RCIS Area features one conservation bank, as well as land within the service area of several additional conservation and mitigation banks (Section 2.2.6). The RCIS Area also features developed areas, working lands used for cultivation, livestock grazing, and timber production (Section 2.2.3), and lands supporting public infrastructure including transportation corridors, energy transmission facilities, and water supply infrastructure (Section 2.2.4).

The RCIS Area has been the subject of several conservation plans designed to protect and restore biological systems and promote rare species persistence while safeguarding the region's other conservation values, including working lands and water resources, while allowing orderly development and maintenance of essential public infrastructure (Section 2.2.4).

This section provides additional details on these facets of the RCIS Area, which informed the selection of the RCIS conservation elements (Section 3) and analysis of pressures and stressors (Section 4), which was used to develop the conservation strategies (Section 5).

2.2 Land Use

This section describes the land use jurisdictions (Section 2.2.1) and designations (Section 2.2.2), the region's working lands (Section 2.2.3), and planned major infrastructure and development projects anticipated during the next 10 years (Section 2.2.4), which the RCIS considered essential for informing the conservation strategy. It then describes existing protected lands (Section 2.2.5) including conservation and mitigation banks (Section 2.2.6).

Santa Cruz County is currently home to more than a quarter million people, and the population is expected to increase 12% between 2015 and 2040 (RTC 2018). The population and urban land uses are clustered primarily along the coast between the City of Santa Cruz and the unincorporated village of Aptos, and in Watsonville, Scotts Valley, and the San Lorenzo Valley. Agricultural land uses are concentrated primarily in the low-lying valleys including the Pajaro Valley, and on the lower coastal terraces north of the City of Santa Cruz (the North Coast).

2.2.1 Jurisdictions

Local land use jurisdiction is held by five local government entities within the RCIS Area (County of Santa Cruz 2020a). The County of Santa Cruz governs land use in 268,808 acres (94.2%) of the 285,261-acre RCIS Area located outside of the four incorporated cities, which are:

- City of Santa Cruz, which is 8,072 acres (2.8% of the RCIS Area);
- City of Watsonville, which is 4,390 acres (1.5%);
- City of Scotts Valley, which is 2,950 acres (1.0%); and
- City of Capitola, which is 1,039 acres (0.4%).

The RCIS Area also features several unincorporated towns including Aptos, Boulder Creek, Corralitos, Davenport, Felton, Freedom, Live Oak, and Soquel; land use in these areas is governed by the County of Santa Cruz.

Land use in the RCIS Area follows the current general plans of the five land use jurisdictions:

- *County of Santa Cruz 1994 General Plan and Local Coastal Program Land Use Plan* (County of Santa Cruz 1994);
- *General Plan 2030* (City of Santa Cruz 2019);
- *City of Scotts Valley General Plan 1994* (City of Scotts Valley 1994);
- *Watsonville 2005 General Plan* (City of Watsonville 1990); and
- *Capitola General Plan* (City of Capitola 2014).

Within the County of Santa Cruz, town plans address land use in accordance with the General Plan within the unincorporated community centers (County of Santa Cruz 1994). The *2040 Metropolitan Transportation Plan and Sustainable Communities Strategy* (AMBAG 2018) also discusses land use in the RCIS Area, with an emphasis on the four cities and the unincorporated towns.

Within the RCIS Area, 72,515 acres are in the designated coastal zone (Figure 2-1), which includes 64% (703 acres) of the City of Capitola, 30% (2436 acres) of City of Santa Cruz, 6% (299 acres) of the City of Watsonville (Santa Cruz County 2020a), and 26% (69,077 acres) of the unincorporated area in the County of Santa Cruz. In these areas, land use must be consistent with local coastal plans (LCPs), which identify the appropriate location, type, and scale of new or changed uses of land and water resources to guide conservation, ensure public access, and maintain consistency with the California Coastal Act of 1976. The local coastal plans provide protection for environmentally sensitive habitat areas (ESHA), which include sensitive communities and habitat for rare and endangered species.

2.2.2 Land Use Designations

The RCIS Area contains five general land uses: agricultural, commercial, public facility/institutional, residential, and open space/recreational (Table 2-1, Figure 2-1). To depict these land uses in this document, the land use (place type) data from the City of Santa Cruz (2020a), County of Santa Cruz (2020a) and the Sustainable Communities Strategy (AMBAG 2018), which synthesized data for the other cities, were aggregated into these five general land use categories which occur within the RCIS Area as follows:

- **Residential:** Over half (57%, or 163,035 acres) of the RCIS Area is designated as residential, which ranges from high-density urban residences in the heart of the City of Santa Cruz, to the very low-density rural and mountain residential areas of the unincorporated county;
- **Open Space/Recreational**: 21.3% (60,669 acres) of the RCIS Area is designated as open space or used for recreational purposes. This land is comprised primarily of large state parks such as Big Basin, Henry Cowell Redwoods, and Nisene Marks state parks, but also includes County and city parks, private conservation lands, and beaches; and
- **Agriculture:** 18% (51,444 acres) of the RCIS Area, concentrated along the north coast and in the Pajaro Valley, is zoned for farming, grazing, animal husbandry, vineyards, nurseries, Christmas tree farms, and other related agricultural uses;
- **Public Facility/Institutional:** 2.5% (6,994 acres) of the RCIS Area is designated for civic or public facilities, educational campuses, hospitals, cemeteries, airports, utilities, and wastewater treatment plants, highways, and major roads; and
- **Commercial:** 1.1% (3,119 acres) of the RCIS Area, which is concentrated in the city cores, is zoned for commercial uses include retail, service, office, industrial, and manufacturing. Vertical mixed-use areas such as a residence located above a ground-floor retail store was considered commercial for the purposes of this RCIS.

The land use designations do not depict actual current land use; rather, the general land uses designated in the general plans. Some designated *Agriculture* lands feature natural communities that have been protected from cultivation and development, and are instead managed for open space and recreation; likewise, many of the designated *Residential* parcels are not developed and are protected from development (Section 2.2.5). Within these various land use types, the land use jurisdictions have zoning designations that regulate specific uses of the land. Importantly, the area designated *Residential* includes 71,000 acres of land zoned for timber production, where residential development is limited in order to maintain productive forests (Section 2.2.3.3).

Table 2 1: General Land Use Designations within each Jurisdiction

General Land Use Designations	City of Santa Cruz		City of Capitola		City of Scotts Valley		City of Watsonville		Unincorporated Santa Cruz County		Entire RCIS Area	
	Acres[1]	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Agriculture	8.4	<0.1%		0.0%	0.5	<0.0%	2.5	<0.0%	52,234	18.3%	**52,245**	**18.3%**
Commercial	952	0.3%	205	0.1%	287	0.1%	843	0.3%	821	0.3%	**3,108**	**1.1%**
Open Space/ Recreational	2,018	0.7%	142	<0.1%	442	0.2%	527	0.2%	56,325	19.7%	**59,454**	**20.8%**
Public Facility/ Institutional	1,646	0.6%	260	0.1%	642	0.2%	1,547	0.3%	2,837	1.0%	**6,931**	**2.4%**
Residential	3,448	1.2%	432	0.2%	1,579	0.6%	1,471	0.5%	156,592	54.9%	**163,521**	**57.3%**
Total	**8,072**	**2.8%**	**1,039**	**0.4%**	**2,950**	**1.0%**	**4,390**	**1.5%**	**268,808**	**94.2%**	**285,261**	**100.0%**

[1] Acreages and percentages may not sum correctly due to rounding error

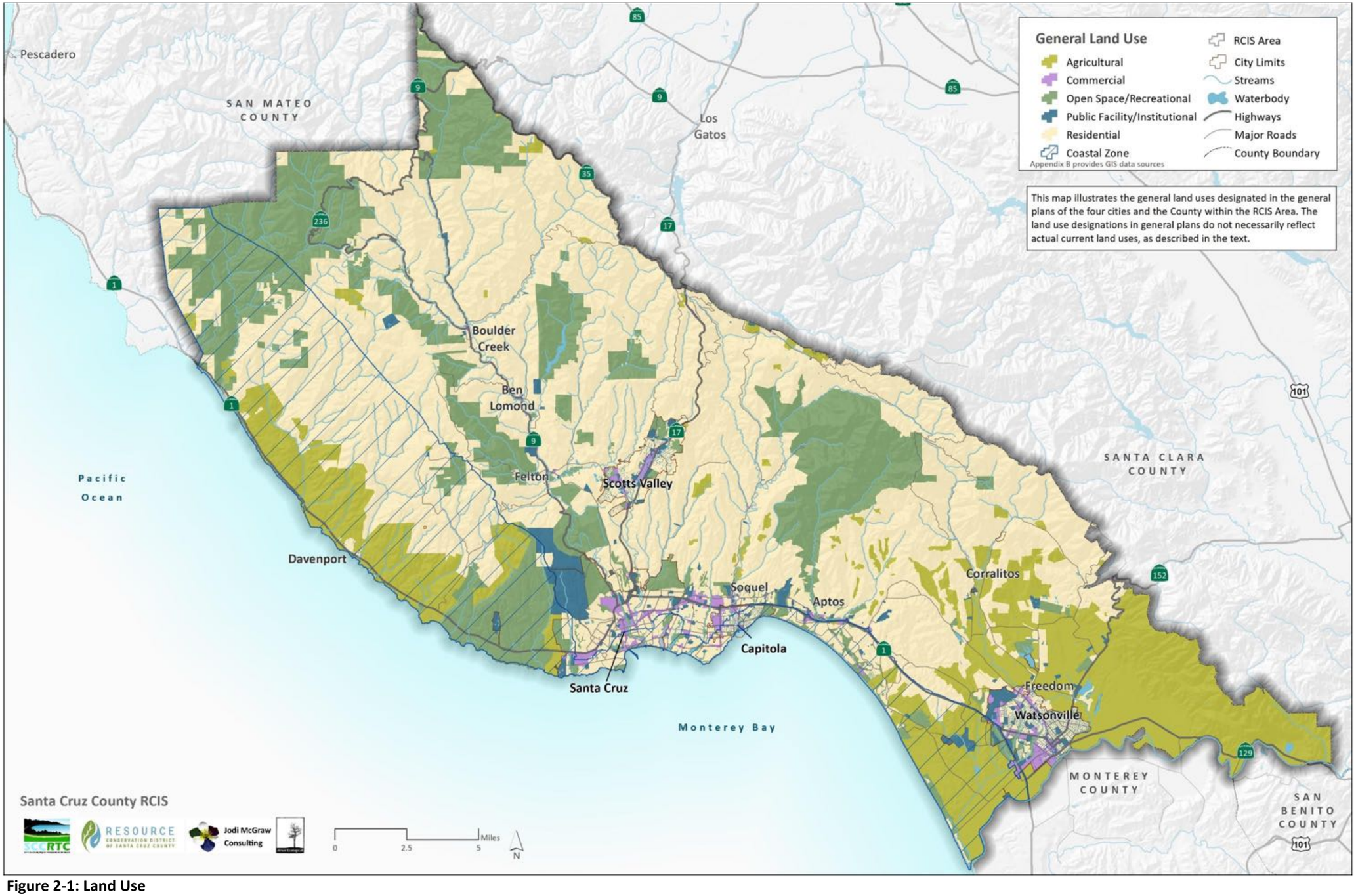

Figure 2-1: Land Use

2.2.3 Working Lands

The RCIS Area features important and iconic working landscapes, including prime farmlands in the Pajaro Valley, productive coastal farmlands on the North Coast, the scenic rangelands of the Pajaro Hills, and the redwood and Douglas-fir forests that blanket the mountains and produce timber (Figure 2-2). These lands not only have high economic value, generating $636,032,000 in gross production value in 2020 (County of Santa Cruz Agricultural Commissioner 2020c; Table 2-2), they can also provide substantial ecological value when managed with sustainable practices. Working lands can produce (as well as rely on) ecosystem services including wildlife habitat, groundwater recharge, carbon sequestration, flood risk reduction, and biodiversity. Collaborating with landowners and land managers to protect and improve the provisioning of ecosystem services and ecological functions while sustaining working lands is a priority for conservation.

Table 2-1: Agricultural Production in Santa Cruz County in 2020 (County of Santa Cruz Agricultural Commissioner 2020c)

Product	Acres[1]	Estimated Value ($)	% of Total Value
Berries	5,236	397,139,000	62%
Apples, Wine Grapes, and Misc. non-Berry Fruit	2,030	16,247,000	3%
Vegetables	7,722	89,462,000	14%
Nursery Crops (incl. cut flowers and potted plants)	862	119,661,000	19%
Livestock	19,244	7,166,000	1%
Timber (10,171 Board feet)	9,895	6,357,000	1%
Total	**46,215**	**636,032,000**	**100%**

[1] Does not include all acreages in cultivation, which total 26,414 (DOC 2016)
Livestock acreages are those designated as suitable for grazing (DOC 2016); this value likely overestimates actual livestock grazing areas.
The timber acres reflect the acres harvested from 2011-2019 (CalFire 2020). Additional areas are suitable for harvest.

2.2.3.1 Cultivated Land

Berries, orchards, vineyards, and vegetables are produced on an estimated 14,998 acres in the RCIS Area (Table 2-2). Legal cannabis cultivation occurs on an additional 36 acres in the RCIS Area, where operations are typically small (<1 acre) and include an estimated 1,800 sites in the RCIS Area (County of Santa Cruz 2017).

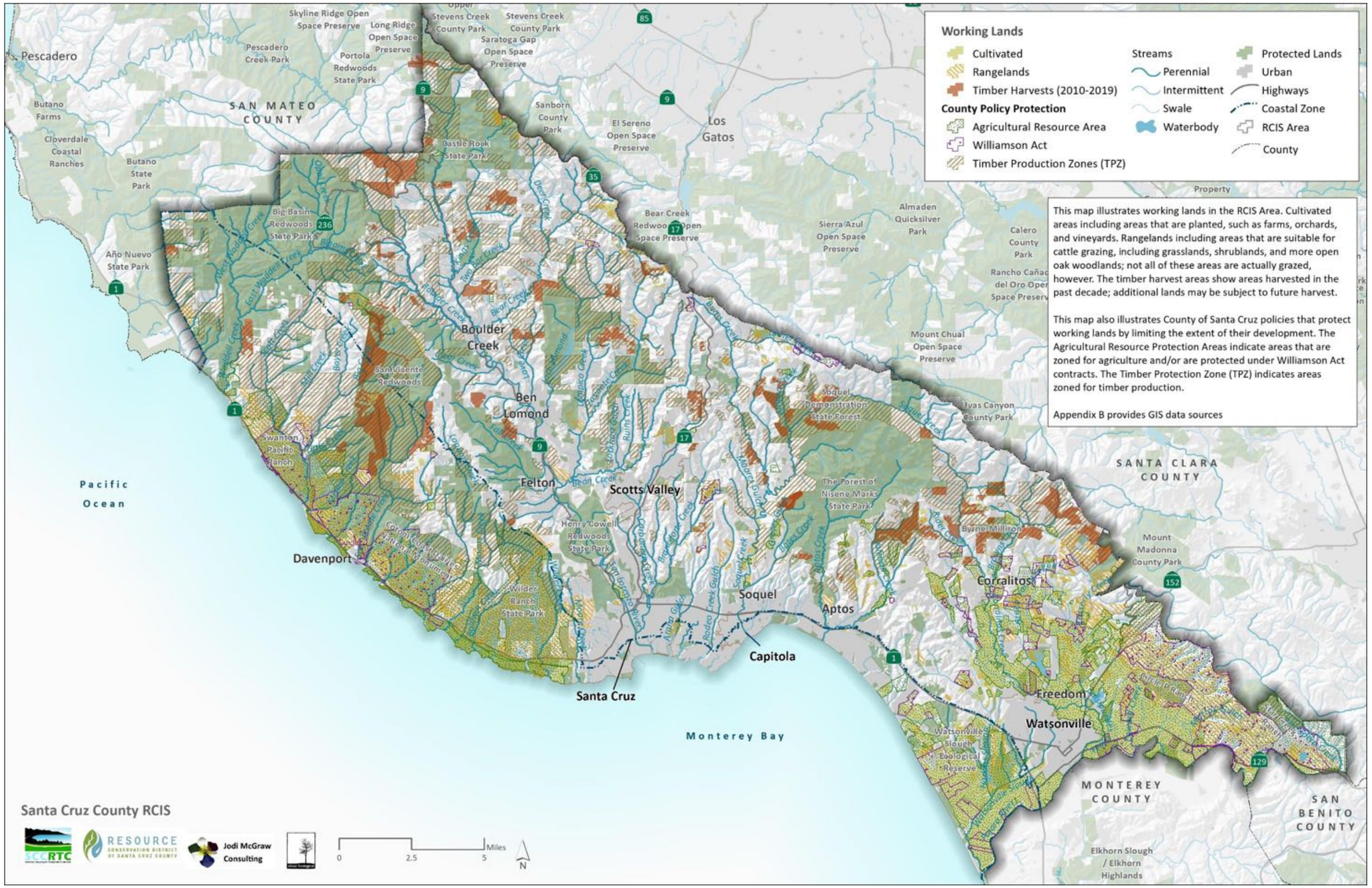

Figure 2-2: Working Lands

Agricultural crop production depends on healthy soil, pollinators, water supply, and a stable climate (Schmidt et al. 2015). Some farms provide hedgerows of trees and shrubs that provide cover, food (e.g., fruit, pollen), or other resources, and may help promote animal movement through fragmented landscapes (Davies and Pullin 2007). Depending on location and management, agricultural lands can provide critical movement corridors for wildlife between adjacent natural communities and open spaces. However, certain activities in agricultural landscapes such as tilling, pest control, use of plastics, clearing of riparian vegetation, erecting high fences, and use of bait stations, can pose significant challenges to the conservation of biological resources in these landscapes. Conservation of wildlife habitat on and adjacent to working agricultural lands is further complicated by conflicting food safety guidelines that auditors may enforce on growers in order to access markets. Local agricultural and conservation leaders have been working for over a decade to reconcile and promote the "co-management" of food safety and conservation on farms (Lowell and Stuart 2010).

2.2.3.2 Rangelands

Rangelands cover approximately 19,244 acres in the RCIS Area (DOC 2016). Grasslands and oak woodlands used as rangelands evolved under the influence of prehistoric herbivores including herds of deer, elk, and other grazing animals. In the absence of large herbivores, appropriate livestock grazing of cattle, sheep, and goats is a valuable management tool in grasslands and other non-grazing sensitive communities, that can reduce invasive plant dominance, and wildfire fuel loads and thus promote healthy populations of native plants and animals (Jackson and Bartolome 2007).

2.2.3.3 Timberlands

While the timber industry is a relatively small part of the local agricultural economy (Table 2-2), 68,306 acres within the RCIS Area are zoned for Timber Production (TPZ; County of Santa Cruz 2020c) and timber harvests have occurred on approximately 9,895 acres over the past decade (CalFire 2020). State and County of Santa Cruz (County) regulations in the RCIS Area subject timber harvest to a unique and restrictive set of regulations designed to protect environmental resources, including requiring selective harvest (rather than clear cutting) and protection of stream corridors (Mackenzie et al. 2011).

Redwood and Douglas-fir forests can be harvested to produce timber products, using techniques that can also promote biodiversity conservation by: 1) protecting and buffering remaining old-growth stands and other sensitive habitats, including streams and riparian corridors; 2) retaining important trees for native animals, and 3) promoting late-seral forest conditions characterized by fewer, more widely spaced trees (O'Hara et al. 2010, Plummer et al. 2012). Such conservation and restoration forest practices can increase the size and thus resiliency of redwood trees, and the resiliency of the entire forest to drought, fire, pests, pathogens, or other indirect effects of climate change, while limiting the impacts of the treatments on natural resources. Such forest management projects to reduce fuel loads and promote forest health can be important given the widespread practice of fire exclusion, which

can otherwise increase fuel loads and lead to catastrophic (large, intense, and severe) wildfires that may have negative effects on even fire adapted species and communities. Such projects can also help maintain native plant communities and promote landscape connectivity with the RCIS Area, while supporting jobs, and tax base and protecting ecosystem services such as reliable and safe water supply, wildlife habitat, biodiversity, and carbon sequestration (Schmidt et al. 2015).

2.2.4 Planned Infrastructure and Development Projects

Santa Cruz County's public agencies conduct infrastructure projects to provide public services to existing residents, and support emergency preparedness and emergency repair, environmental sustainability, economic development, future population growth, and to incorporate technological advancements. Projects may include improvements and maintenance of transportation, water and wastewater treatment facilities, storm drains, utilities, landfills and recycling facilities, park and other public facilities managed by each jurisdiction. Private developers can also undertake large infrastructure projects within the county including housing and commercial development and other public/private partnerships.

This RCIS evaluates foreseeable development of major planned infrastructure and development projects within the next approximately 10 years to help inform the RCIS conservation strategies, including to identify conservation priorities that are reasonably implementable.

2.2.4.1 Infrastructure

This section summarizes the major planned transportation, water, and energy infrastructure projects, and major planned commercial and residential development projects. Figure 2-3 illustrates planned transportation infrastructure projects and the locations of existing infrastructure based on available spatial data; Section E.1 describes the transportation projects in greater detail. Figure 2-3 also illustrates the boundaries of the primary water resource management agencies[2], which depict general areas of water infrastructure (e.g., pipelines, wells, diversions). As spatial data were not available for all existing infrastructure or planned improvements, this map is not comprehensive; nonetheless, it helps visualize the general areas within the RCIS Area where infrastructure occurs and thus may require maintenance, and where future improvements are anticipated.

There is new investment in transportation infrastructure as a result of the passage of Measure D, a local sales tax for multi-modal transportation improvements in Santa Cruz County (2016), and approval of Senate Bill 1 (2017) the California Road Repair and Accountability Act (2017). These funds are used to deliver transportation projects through the RTC's Strategic

[2] Small water suppliers not depicted include but are not limited to: Forest Springs, Big Basin Water Company, Mount Hermon Association, and Forest Lakes Mutual Water Company.

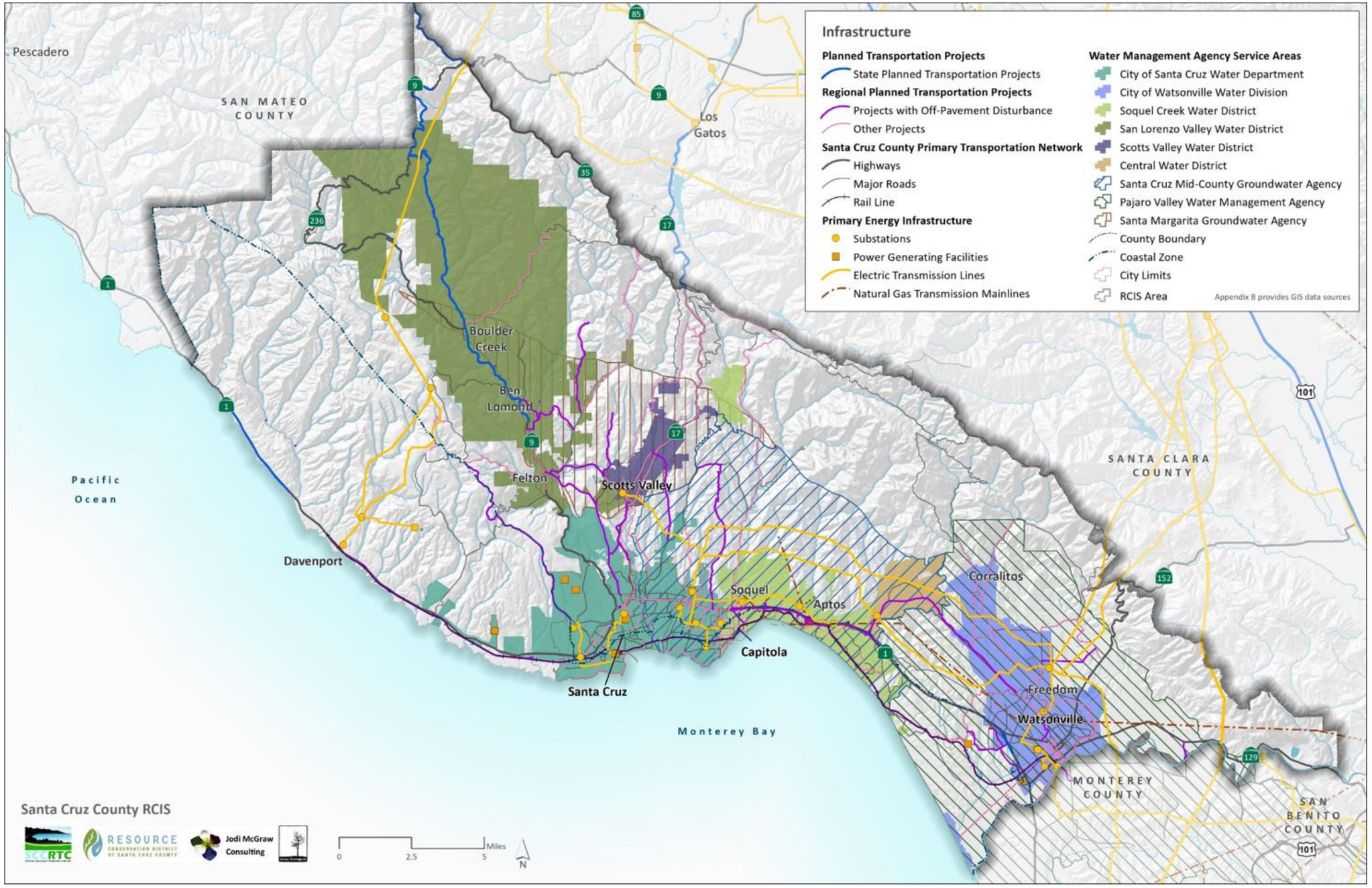

Figure 2-3: Infrastructure Areas

Implementation Plan, the State Highway Operation Protection Program (SHOPP), State Transportation Improvement Program (STIP), and other programs.

The following major transportation and water projects are included in the Capital Improvement Programs (CIPs) prepared by local jurisdictions and the Strategic Implementation Plan (SIP) for Measure D, a 2016 countywide transportation funding measure (Section E.1), and were identified as potentially requiring compensatory mitigation:

- Airport water tank installation (City of Watsonville);
- Airport runway extension (City of Watsonville);
- Stockton Avenue Bridge Rehabilitation (City of Capitola);
- Bridge Replacements (Quail Hollow, San Lorenzo Way, Green Valley, Forest Hill Drive, Rancho Rio Avenue, Either Way, Fern Drive, Larkspur, Swanton Road, Lompico Road) [County of Santa Cruz];
- Highway 1 Bridge at San Lorenzo Bridge Replacement (City of Santa Cruz);
- Watsonville Trails: Pajaro Valley Connector, Lee Road and Slough Trails (City of Watsonville);
- Monterey Bay Sanctuary Scenic Trail Network (Coastal Rail Trail);
- Highway 1 Auxiliary Lane Projects (Soquel Drive/Avenue to 41st Avenue Bay Porter to Park Avenue, State Park Drive to Freedom Boulevard);
- Santa Cruz Branch Rail Line Maintenance and Repairs;
- College Lake Integrated Resources Management Project;
- Watsonville Slough System Managed Aquifer Recharge and Recovery Projects; and
- San Lorenzo Valley Water District Capital Improvement Projects.

The 2045 RTP provides additional information about the transportation plans and programs and the Capital Improvement Programs for the respective jurisdictions include the complete list of planned infrastructure projects within each jurisdiction over the specific time period. Additional transportation and related infrastructure improvements will likely also be needed in response to storm-related damage, and other emergency repairs which cannot be individually planned but are likely to occur.

Large-scale energy infrastructure within the RCIS Area is limited to transmission lines, distribution lines, small-scale power generation plants, and substations operated by Pacific Gas and Electric (PG&E; Figure 2-3). The region imports electricity from Central Coast Community Energy, a community choice energy agency that procures energy for Santa Cruz, Monterey, and San Benito counties. There are no anticipated new large-scale energy development projects planned for the RCIS Area. Operations and maintenance of existing energy infrastructure,

including vegetation management, is anticipated to occur primarily in the locations of PG&E's existing facilities in the RCIS Area, and will be covered under PG&E's *Multiple Region Operation and Maintenance Habitat Conservation Plan* (Section E.3; PG&E 2020).

2.2.4.2 Development

A suite of pending residential, mixed use, commercial, and commercial cannabis (county only) applications are planned in the cities of Capitola, Santa Cruz, Scotts Valley, and Watsonville, and the County of Santa Cruz (Section E.4). These projects are concentrated in the existing developed and cultivated agricultural areas within the RCIS Area, including the unincorporated towns of Live Oak, Soquel, and Aptos (Section E.4).

2.2.5 Existing Protected Lands

The RCIS Area contains 91,343 acres that are protected from conversion to residential or commercial development and managed for open space or agriculture by fee title or conservation easement (Table 2-3, Figure 2-4; GIN 2021; USGS 2018).

These existing protected lands comprise 32% of the 285,261-acre RCIS Area (Table 2-3) and combine with intact, unprotected habitat including working lands to support rare species, sustain important natural communities, and provide essential ecosystem services (Schmidt et al. 2015). Understanding the distribution of the existing protected lands will inform the development of the conservation strategy for this RCIS.

Of the total protected land area, 84,014 acres (30% of the area or 92% of the protected lands) are protected by fee title alone, 7,329 acres (2.6% of the area or 8% of the protected lands) are protected by a conservation easement alone, while 10,232 acres (4% of the area or 11% of protected lands) are protected by both fee title and conservation easement.

The existing protected lands are owned by two federal, eight state, and 18 local government (i.e., cities, the county, and special districts) agencies, as well as six non-profit organizations with land protection missions (i.e., land trusts). Additional lands are protected by conservation easements held by these and other private, local, state, and federal agencies and organizations. California Department of Parks and Recreation (State Parks) is the largest protected landowner (45,719 acres); the Peninsula Open Space Trust (8,807 acres), City of Santa Cruz (5,919 acres) and United States Bureau of Land Management (5,776 acres) also hold considerable areas.

Gap Status Codes categorize the degree of protection for biodiversity conservation on a scale of 1-4, in which Status 1 is most protective for biodiversity, and Status 4 is least protective (Table 2-3; Figure 2-4; USGS 2018). Lands owned by non-profit entities, including local land trusts, collectively have the most land managed for biodiversity (Status 2: 11,618 acres); State Parks with special designation units, such as West Waddell Creek State Wilderness in Big Basin State

Table 2-2: Protected Lands in the RCIS Area

Ownership	Gap Status[1] (Acres)				% of RCIS Area	% of Protected Lands
	Status 2	Status 3	Status 4	All		
Fee				**84,014**	**29.7**	**92.0**
Federal	268	5,776	1	6,045	2.1	6.6
State	9,718	2,741	41,318	53,777	18.9	58.9
County	142		1,114	1,256	0.4	1.4
City	1,141		5,942	7,083	2.5	7.8
Special District	1,512	177	2,055	3,744	1.3	4.1
Non-Profit	11,618		492	12,109	4.5	13.4
Easement						
Easement	128	617	6,584	7,329	2.6	8.0
Easement and Fee[2]				*10,232*		
Total	**24,527**	**9,311**	**57,504**	**91,343**[2]	**32.0**	**100.0**

[1] 'GAP Status Codes' defined by the Gap Analysis Project (USGS 2018) provide a general assessment of management intent to protect biodiversity, but do not measure effectiveness of management to protect biodiversity. GAP 3 and 4 lands may contain important habitat for native species, and promote habitat connectivity. Gap status codes were developed by the USGS and may not accurately reflect the management of all properties in the RCIS Area.

Status 1 – Managed for biodiversity with natural disturbance events allowed (none of the properties in the RCIS Area are classified as Status 1);

Status 2 – Managed for biodiversity with management that may interfere with natural processes;

Status 3 – Permanent protection, but the land is subject to multiple uses;

Status 4 – No known institutional mandates to prevent conversion of natural habitat types (Status 4 was assumed when Gap attribute was blank).

Acreages and percentages may not sum correctly due to rounding error.

[2] Some properties are protected both in fee title and by conservation easement. To avoid duplicating their acreages, these properties are listed according to their fee owner and the additional easement acreages are not included in the protected lands total

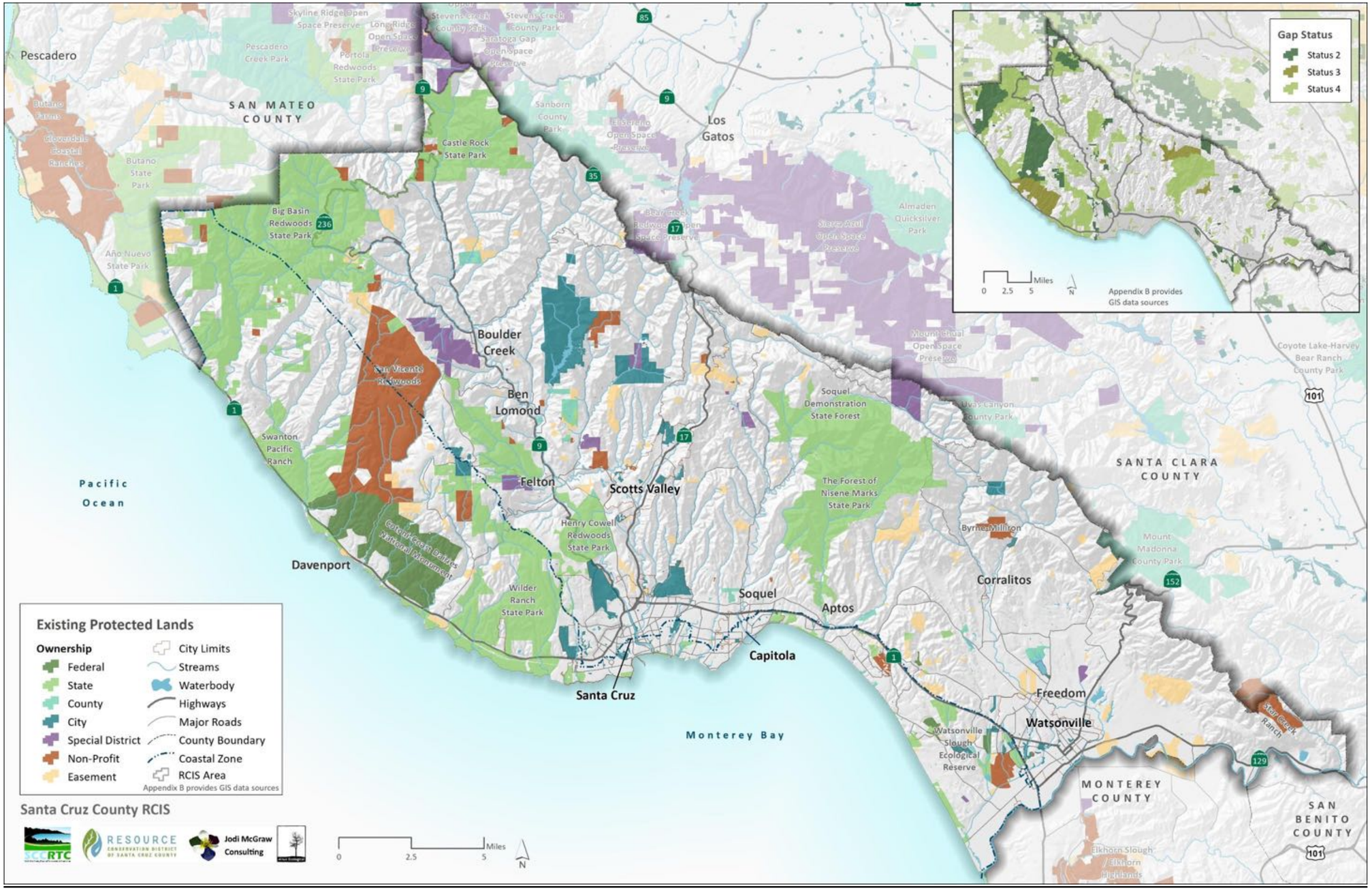

Figure 2-4: Existing Protected Lands

Park and San Lorenzo Headwaters Natural Preserve in Castle Rock State Park, also comprise a large area of Status 2 lands (9,718 acres). Gap status codes were developed by the USGS and may not accurately reflect the management of all properties in the RCIS Area.

Protected lands in Santa Cruz County adjoin those in neighboring counties, creating a network of protected parks and open space in the Santa Cruz Mountains and broader California Central Coast. Significant protected lands adjacent to the RCIS Area include state and county parks in San Mateo County to the north, Midpeninsula Regional Open Space District Preserves and Santa Clara County Parks lands to the north and east, and Elkhorn Slough/Elkhorn Highlands Natural Reserve in Monterey County to the south (Figure 2-4).

The RCIS Area also adjoins the following marine protected areas, which protect biodiversity in a total of 3,902,712 -acres of the Monterey Bay and Pacific Ocean:

- Monterey Bay National Marine Sanctuary (3,902,712 acres);
- Año Nuevo State Marine Conservation Area (7,134 acres);
- Año Nuevo ASBS State Water Quality Protection Area (13,560 acres);
- Greyhound Rock State Marine Conservation Area (7,681 acres);
- Soquel Canyon State Marine Conservation Area (14,700 acres);
- Natural Bridges State Marine Reserve (162 acres); and
- California Coastal National Monument (Includes offshore rocks, islands, exposed reefs, and pinnacles along the coastline; DOI 2020).

The RCIS Area features a relatively large percentage of existing protected land (32%); indeed, the area is outpacing the state-wide goal to conserve 30% of California's coastal water and land by 2030 to protect biodiversity and provide nature-based solutions to address climate change, which was established by executive order (Newsom 2020). However, additional land and water protection will be essential to achieving the goals of this RCIS as the existing protected lands do not protect adequate areas of the various community and habitat types to sustain the rare species, sensitive communities, and ecosystem processes (Section 5.2).

2.2.6 Conservation and Mitigation Banks

The RCIS Area features portions of the service areas for four conservation banks and one mitigation bank (Table 2-4, Figure 2-5; CDFW 2020b, RIBITS 2020). These protected lands are all located outside of Santa Cruz County except the Zayante Sandhills Conservation Bank, which is located in Ben Lomond. The conservation and mitigation banks sell credits for California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), four endangered Sandhills species and Sandhills communities, coho salmon, steelhead (*Oncorhynchus mykiss*) and jurisdictional waters (Table 2-4). These conservation and mitigation credits can be purchased by project proponents to offset impacts to these resources caused by development, infrastructure, and other activities.

Additionally, the RCD is developing an in-lieu fee program with the US Fish and Wildlife Service to provide compensatory mitigation for impacts to California red-legged frog, Santa Cruz long-toed salamander, and tidewater goby (*Eucyclogobius newberryi*) and their habitat in Santa Cruz and Monterey Counties (RCD 2019a).

Table 2-3: Conservation and Mitigation Banks with a Service Area that includes the RCIS Area[1]

Bank	Resource Covered	Location	Service Area (Acres)	% of RCIS Area
Conservation Bank				
Sparling Ranch Conservation Bank	California Tiger Salamander	San Benito and Santa Clara	4,879	1.7
	California Red-legged Frog	San Benito and Santa Clara	27,729	9.7
Ohlone West Conservation Bank	California Tiger Salamander	Alameda	909	0.3
Zayante Sand Hills Conservation Bank	Endemic Sandhill Species[2] and Communities	Santa Cruz	186,962	65.5
East Austin Creek Conservation Bank[3]	Coho Salmon and Steelhead	Sonoma	224,620	78.7
Mitigation Bank				
Pajaro River Mitigation Bank	Jurisdictional Waters	San Benito	56,466	19.8

[1] Other landowners in the RCIS Area, including water districts, have permanently protected and manage habitat that they use to mitigate their own projects over time. Unlike with state and/or federally authorized conservation and mitigation banks, credits for mitigation on those properties cannot be transferred to other entities.

[2] Mount Hermon June beetle (*Polyphylla barbata*), Zayante band-winged grasshopper (*Trimerotropis infantilis*), Ben Lomond wallflower (*Erysimum teretifolium*), Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*), silverleaf manzanita (*Arctostaphylos silvicola*), and Ben Lomond buckwheat (*Eriogonum nudum* var. *decurrens*).

[3]The portion of the East Austin Creek Conservation Bank Service Area that is within the RCIS Area is characterized as 'Secondary', which means that a higher ratio of credits may need to be purchased than if the service area were designated as 'Primary'.

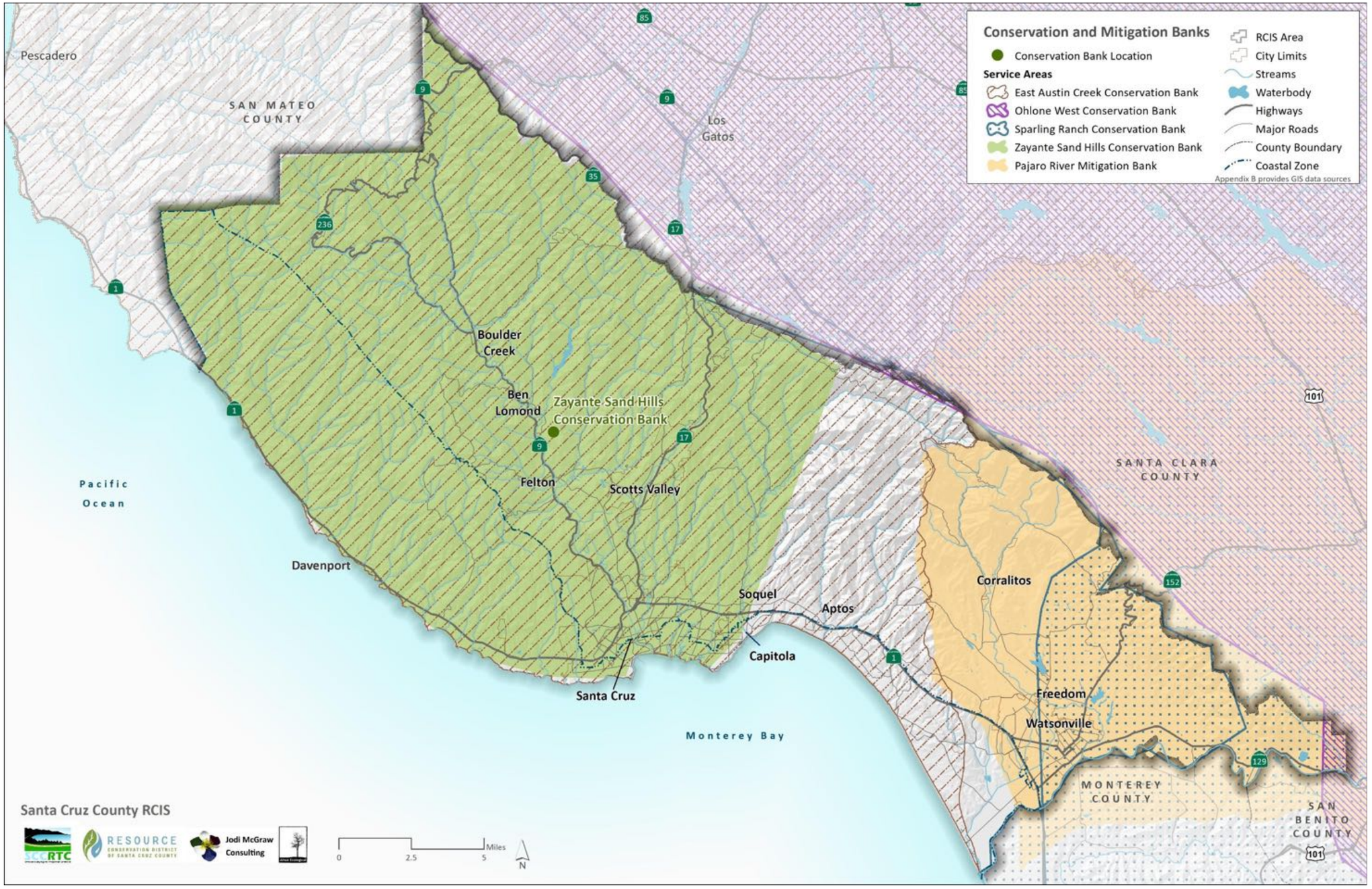

Figure 2-5: Conservation and Mitigation Banks

2.3 Existing Conservation Plans

2.3.1 Recovery Plans

Habitat within the RCIS Area is addressed in a total of twenty recovery plans, which identify goals, objectives, and recovery actions for federal and/or state listed threatened and endangered species. These include six multi-species recovery plans that collectively address four animals and ten plants whose historical or current range is within Santa Cruz County, and 14 single-species recovery plans that address twelve animals and two plants (Table 2-5).

Table 2-4: Recovery Plans in the RCIS Area

Plan Name	Citation	Relevant Species Addressed
Multi-species Recovery Plans		
Final Coastal Multispecies Recovery Plan	NMFS 2016b	Central California Coast steelhead
Recovery Plan for Marsh Sandwort *(Arenaria paludicola)* and Gambel's Watercress *(Rorippa gambelii)*	USFWS 1998b, 2019a	marsh sandwort[1]
Seven Coastal Plants and the Myrtle's Silverspot Butterfly Recovery Plan	USFWS 1998c, 2019b	Monterey spineflower
Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula	USFWS 2003b	marsh sandwort[2]
Recovery Plan for Insect and Plant Taxa from the Santa Cruz Mountains in California	USFWS 1998d	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond spineflower, Ben Lomond wallflower, Scotts Valley spineflower, Scotts Valley polygonum, Ohlone tiger beetle
Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area	USFWS 1998f	white-rayed pentachaeta[3]
Single-Species Recovery Plans		
Recovery Strategy for California Coho Salmon	CDFW 2004	Coho salmon
Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit	NMFS 2012	Central California Coast coho salmon

Plan Name	Citation	Relevant Species Addressed
South-Central California Coast Steelhead Recovery Plan	NMFS 2013	South-Central California Coast steelhead
Recovery Plan for the Central California Distinct Population Segment of the California Tiger Salamander *(Ambystoma californiense)*	USFWS 2017a	California tiger salamander
Recovery Plan for the Pacific Coast Population of the Western Snowy Plover *(Charadrius alexandrinus nivosus)*	USFWS 2007a	Western snowy plover
Recovery Plan for the Tidewater Goby *(Eucyclogobius newberryi)*	USFWS 2005b	tidewater goby
Recovery Plan for *Chorizanthe robusta var. robusta* (Robust Spineflower)	USFWS 2004a	robust spineflower
Draft Revised Recovery Plan for the Santa Cruz Long-toed Salamander *(Ambystoma macrodactylum croceum)*	USFWS 2004b	Santa Cruz long-toed salamander
Final Revised Recovery Plan for the Southern Sea Otter *(Enhydra lutris nereis)*	USFWS 2003a	southern sea otter
Recovery Plan for the California Red-legged Frog *(Rana aurora draytonii)*	USFWS 2002a	California red-legged frog
Draft Recovery Plan for the Least Bell's Vireo *(Vireo bellii pusillus)*	USFWS 1998a	least bell's vireo[4]
Recovery Plan for the Santa Cruz Cypress *(Cupressus [Hesperocyparis] abramsiana)*	USFWS 1998e	Santa Cruz cypress
Recovery Plan for the Threatened Marbled Murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California	USFWS 1997	marbled murrelet
California Least Tern Recovery Plan	USFWS 1985a	California least tern[5]
Recovery Plan for the San Francisco Garter Snake *(Thamnophis sirtalis tetrataenia)*	USFWS 1985b	San Francisco garter snake

[1] Marsh sandwort is not currently found in Santa Cruz County, though the region is mentioned as hopeful for relocation in recovery plan; Gambel's watercress is not present currently or historically in Santa Cruz County.

[2] This recovery plan focuses on San Francisco lessingia and Raven's manzanita, but also discusses species located in Santa Cruz County that share habitats with the listed species and have suffered substantial declines on the northern San Francisco Peninsula and adjacent coast.

[3] White-rayed pentachaeta is not currently found in Santa Cruz County, though the region is mentioned as a potential relocation area in the species' recovery plan.

[4] Least Bell's Vireo does not typically occur in Santa Cruz County, though the region is within the species' historic breeding range.

[5] California least tern does not typically occur in Santa Cruz County, though the region is within the species' historic breeding range.

2.3.2 Habitat Conservation Plans

Portions of the RCIS Area are addressed in six programmatic Habitat Conservation Plans (HCPs; Table 2-6). These plans developed to comply with Section 10 of the federal Endangered Species Act cover multiple activities occurring in different areas over a longer-period of time. An additional 30 HCPs in the RCIS Area address single projects in relatively small areas (Table 2-6) and often address just one or two covered species. Section 5.4 summarizes how the RCIS conservation strategy is consistent with the recovery plans and approved HCPs.

The existing programmatic HCP permit areas range between 1,693 and 564,781 acres, with the latter including area outside of the RCIS Area (Table 2-6). In addition, 22 project-specific HCPs have been developed to address activities in a single location in the RCIS Area. Collectively, the HCPs within the RCIS Area cover seven plant species and 12 animal species (Table 2-6).

The RCIS Area is not addressed in any Natural Community Conservation Plans (NCCPs) developed pursuant to the Natural Community Conservation Planning Act (Fish and Game Code sections 2800-2835), which identify and provide for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. However, the RCIS Area is contiguous with the Santa Clara Valley Habitat Plan, a regional HCP and NCCP that covers the southeastern portion of adjacent Santa Clara County (ICF 2012).

Table 2-5: Habitat Conservation Plans in the RCIS Area

Habitat Conservation Plan	Reference	Plan Area (Acres)	Species Addressed that occur within the RCIS Area
Programmatic Habitat Conservation Plans			
Draft City of Santa Cruz Anadromous Salmonid Habitat Conservation Plan	City of Santa Cruz *in prep.*	TBD	steelhead and coho salmon

Habitat Conservation Plan	Reference	Plan Area (Acres)	Species Addressed that occur within the RCIS Area
City of Santa Cruz Operations and Maintenance Habitat Conservation Plan	City of Santa Cruz 2021		Ben Lomond spineflower, robust spineflower, Santa Cruz tarplant, San Francisco popcornflower, Ohlone tiger beetle, Mount Hermon June beetle, tidewater goby, Pacific lamprey, California red-legged frog, Southwestern pond turtle
Pacific Gas and Electric Company Multiple Region Operation and Maintenance Habitat Conservation Plan	PG&E 2020	564,781	California tiger salamander, California red-legged Frog, marbled murrelet, Mount Hermon June beetle, Ohlone tiger beetle, Santa Cruz long-toed salamander, Zayante band-winged grasshopper, Monterey spineflower, robust spineflower
Interim Programmatic Habitat Conservation Plan for Mount Hermon June Beetle, Ben Lomond Spineflower	USFWS et al. 2011	1,693	Mount Hermon June beetle, Ben Lomond spineflower
PGE Vegetation Management Habitat Conservation Plan	PG&E 2018	10.2	Santa Cruz long-toed salamander, California red-legged frog, Monterey spineflower
Project-Specific Habitat Conservation Plans (Listed in order of acreage)			
Quail Hollow Quarry	Graniterock 1998	219	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond wallflower, Ben Lomond spineflower
Seascape Uplands	Reid 1994	192	Santa Cruz long-toed salamander
Wilder Quarry (Granite Rock)	1998[1]	125	California red-legged Frog

Habitat Conservation Plan	Reference	Plan Area (Acres)	Species Addressed that occur within the RCIS Area
Santa Cruz Gardens Unit 12	Arnold and Lyons 2008	58.5	Santa Cruz tarplant, Ohlone tiger beetle
Tucker Pond	Reid and Biosearch 2006	55	Santa Cruz long-toed salamander, California red-legged frog
UCSC Ranch View Terrace	Jones and Stokes 2005	38.8	California red-legged frog, Ohlone tiger beetle
Hanson Aggregates Felton Plant	HRG 1999	35	Mount Hermon June beetle, Zayante band-winged grasshopper
Bean Creek Estates	Arnold et. Al 2008	18.1	Mount Hermon June beetle, Ben Lomond spineflower, Santa Cruz wallflower
City of Santa Cruz Graham Hill Water Treatment Plant	EMS and Arnold 2013	12.71	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond spineflower
Bonny Doon Quarries	1999[1]	4.9	California red-legged Frog
Salvation Army	McGraw 2009a	4.5	Mount Hermon June beetle, Ben Lomond spineflower
PG&E Gas Pipeline	PG&E 2017	2.9	Mount Hermon June beetle
Lone Pine Lane (Sisk)	2008[1]	1.24	Mount Hermon June beetle
Collado Drive	2008[1]	1.093	Mount Hermon June beetle
Busch Residence	2008[1]	0.999	Mount Hermon June beetle
Carter-224 Hidden Glen Drive	Arnold 2008	0.52	Mount Hermon June beetle
Tinkess Parcel	McGraw 2008a	0.44	Mount Hermon June beetle
San Lorenzo Valley Water District Probation Tank Replacement Project	McGraw 2017a	0.43	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond spineflower, Ben Lomond wallflower
Blake Lane	McGraw 2017b	0.42	Mount Hermon June beetle

Habitat Conservation Plan	Reference	Plan Area (Acres)	Species Addressed that occur within the RCIS Area
Mayer Property	Arnold 2002	0.35	Mount Hermon June beetle, Ben Lomond spineflower
Mansfield Property	Arnold 2009b	0.3	Mount Hermon June beetle
County of Santa Cruz Juvenile Hall	McGraw 2019	0.27	Mount Hermon June beetle
Scotts Valley Multi-Agency Regional Intertie Project	Arnold and Bandel 2014	0.23	Mount Hermon June beetle, Zayante band-winged grasshopper, California red-legged frog
Clements Property	McGraw 2017c	0.2	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond spineflower
Sunde Residence	McGraw 2007b	0.19	Mount Hermon June beetle
County of Santa Cruz Juvenile Hall	McGraw 2016	0.19	Mount Hermon June beetle
Sohl Residence	Arnold 2014	0.063	Mount Hermon June beetle
Menchine Residence	Arnold 2009a	0.046	Mount Hermon June beetle
Mañana Woods Booster Pump Station Project	McGraw 2008b	0.045	Mount Hermon June beetle
Walters Property	McGraw 2012	0.02	Mount Hermon June beetle
West Residence	McGraw 2009b	0.015	Mount Hermon June beetle

[1] These HCPs are listed on the Ventura Fish and Wildlife Office website; however, the HCPs could not be located.

2.3.3 Other Conservation Plans

The RCIS Area is also addressed in several other conservation strategies and assessments encompassing a wide range of biodiversity conservation values and their management; some of these plans also address areas outside of the RCIS Area. These plans address the following aspects of the RCIS Area, as detailed in Table 2-7:

- **Conservation Plans**: land protection, restoration, and management goals and priorities for the state (California State Wildlife Action Plan), 10-County Bay Area (Conservation Lands Network), and the County (Conservation Blueprint for Santa Cruz County);

- **Habitat management plans**: habitat management in areas important for rare species and biodiversity;
- **Water quality and management plans and watershed assessment and enhancement plans**: water quality and groundwater management, as well as biodiversity and rare species conservation for aquatic systems and their watersheds;
- **Fisheries**: conservation of rare salmonids and other fish species; and
- **Other Plans and Programs**: other plans that address conservation including ecosystem services, and the nexus with wildfire protection and transportation infrastructure.

Table 2-6: Other Conservation Plans in the RCIS Area[1]

Conservation Plan	Citation	Conservation Values Addressed
Conservation Plans		
Conservation Lands Network (incl. Bay Area Critical Linkages Project 2013)	BAOSC 2019	Rare species, sensitive communities, connectivity, old growth forests, watersheds, aquatic systems, climate change resiliency, etc.
California State Wildlife Action Plan	CDFW 2015	Species of Greatest Conservation need, multi-species Ecosystem approach, climate change vulnerability, prioritizing strategic conservation targets, planning at level of geographic provinces, anadromous fishes, alleviate pressures and stresses
Conservation Blueprint for Santa Cruz County	Mackenzie et al. 2011	Rare species, sensitive communities, connectivity, old growth forests, watersheds, aquatic systems
Habitat Management Plans		
The Sandhills Conservation and Management Plan	McGraw 2004	Sandhills communities and endemic species
Monterey Bay National Marine Sanctuary Final Management Plan	NOAA 2008	Marine and coastal areas
Water Quality and Management Plans		

Conservation Plan	Citation	Conservation Values Addressed
Water Quality Control Plan for the Central Coastal Basin (Basin Plan)	CCRWQCB 2019	Steelhead and coho salmon; designates beneficial uses and water quality objectives for waters of the State, including surface waters and groundwater; amendments for water quality programs to address Total Maximum Daily Loads (TMDL) including sediment, nutrients, toxins, and pathogens
Integrated Regional Water Management Plan	County of Santa Cruz 2019a	Coho salmon and steelhead; aquatic habitat, coastal dunes, water supply, water quality, climate change, Total Maximum Daily Loads (TMDL), sea level rise, flooding
Santa Cruz Mid-County Groundwater Basin Groundwater Sustainability Plan	SCMCGA 2019	Sustainable groundwater management including groundwater overdraft, sea water intrusion, and protection of sensitive species that are dependent on groundwater
Pajaro Valley Basin Management Plan[2]	PVWMA 2014, PVWMA 2021	Sustainable groundwater management including groundwater overdraft, sea water intrusion, and protection of sensitive species that are dependent on groundwater
Santa Margarita Groundwater Sustainability Plan	SMGA 2021	Sustainable groundwater management including groundwater overdraft, sea water intrusion, and protection of sensitive species that are dependent on groundwater
Watershed Restoration Program and Enhancement Plans		
Integrated Watershed Restoration Program Priority Project List	IWRP 2019	Steelhead, coho salmon, tidewater goby, California red-legged frog, Santa Cruz long-toed salamander, southwestern pond turtle; coordinated watershed restoration; water quality enhancement

Conservation Plan	Citation	Conservation Values Addressed
Aptos Creek Watershed Assessment and Enhancement plan	Conrad and Dvorsky 2003	Steelhead and coho salmon; fisheries habitat enhancement, riparian restoration, water quality improvement
Arana Gulch Watershed Enhancement Plan	Strelow Consulting 2002	Steelhead and coho salmon; erosion, and fish barriers
Lower Pajaro River Enhancement Plan	Fall Creek Engineering et. Al 2002	Steelhead; riparian restoration, erosion, nutrients, and toxins (DDT)
San Lorenzo River Salmonid Enhancement Plan	Alley et al. 2004	Steelhead and coho salmon; fisheries decline, habitat improvement
San Vicente Creek Watershed Plan for Salmonid Recovery	RCD 2014	Steelhead and coho salmon; fish passage barriers, riparian habitat.
The Soquel Creek Watershed Assessment and Enhancement Project Plan	RCD 2003	Steelhead and coho salmon; fish passage; water quality improvement; instream flow, riparian habitat enhancement;
Scotts Creek[3] Watershed Assessment	Scotts Creek Watershed Council 2003	Steelhead and coho salmon; fish passage; water quality improvement; instream flow, riparian habitat enhancement;
Watsonville Sloughs Watershed Conservation and Enhancement Plan	Swanson Hydrology 2003	tidewater goby, California red-legged frog; riparian habitat and freshwater marsh habitat enhancement; water quality improvement.
Pinto Lake Implementation Strategies	RCD 2013	Riparian and wetland restoration, restoring water quality in Pinto Lake to prevent cyanobacteria blooms
Rapid Assessment Methods within the San Lorenzo Watershed	Central Coast Wetlands Group and County of Santa Cruz 2021	Document riparian conditions to develop riparian protection and enhancement projects
Fisheries/Aquatic Conservation Programs and Reports		
Strategic Plan for Recovery of the Santa Cruz long-toed salamander and California red-legged frog in the Larkin Valley area	RCD 2019b	Santa Cruz long-toed salamander and California red-legged frog

Conservation Plan	Citation	Conservation Values Addressed
Comparative Lagoon Ecological Assessment Project (CLEAP) Report	2ndNature 2006	Steelhead, coho salmon, tidewater goby
Priority Action Coho Team: Strategic Partnering to Accelerate Central California Coast Coho Salmon Recovery	PACT 2019	Coho salmon
Species in the Spotlight: Coho, Central California Coast Coho - Year Action Plan	NMFS 2016a	Coho salmon
Juvenile Steelhead & Stream Habitat (JSSH) Monitoring Program	Beck et al. 2019	Steelhead
San Lorenzo River Riparian Conservation Program	City of Santa Cruz et al. 2018	Riparian and riverine communities, steelhead, and coho salmon
Other		
Healthy Lands and Healthy Economies: Nature's Value in Santa Cruz County	Schmidt et al. 2015	Valuation of ecosystem services and natural capital
Early Mitigation for Transportation Improvements in Santa Cruz County	County of Santa Cruz Early Mitigation Partnership 2018	Collaboration goals for effective mitigation of sensitive species affected by transportation projects in Santa Cruz County
Santa Cruz, San Mateo Community Wildfire Protection Plan	CalFire et al. 2018	Wildfire management plan that addresses Santa Cruz long-toed salamander, California red-legged frog, marbled murrelet, San Francisco garter snake; endemic sandhills species and communities, maritime chaparral, riparian, oak woodlands

[1] This table does not include conservation and management plans for individual properties, which are too numerous to list but play an important role in conservation in the RCIS Area.

[2] Department of Water Resources approved the PVWMA Basin Management Plan as functional equivalent to a Groundwater Sustainability Plan (GSP) on July 17, 2019. The PVWMA released a Groundwater Sustainability Updated in December 2021 (PVWMA 2021)

[3] The RCIS uses "Scott Creek" rather than "Scotts Creek" except where referring to the title of a document, such as here.

2.4 Natural Environment

This section describes the natural environment within the RCIS Area in terms of its ecoregions, climate, disturbance regimes, natural communities, and habitat connectivity.

2.4.1 Ecoregions

The RCIS Area occurs within the California Coastal Chaparral Forest and Shrub Province (Code: 261), as designated by the United States Department of Agriculture (USDA) in their mapping of Ecological Regions (McNab et al. 2007; Figure 2-6). The province covers much of the California coast from San Francisco to Baja California, and features coastal plains and high hills with a Mediterranean-like climate. Precipitation occurs as rainfall primarily between October and April, with an annual dry season extending from the late spring into the fall. Within the province, mean daily temperatures average 50 to 63 °F; coastal areas experiencing cooler summer daytime temperatures modified by morning fog and sea breezes, while inland and higher elevations experience higher temperatures (McNab et al. 2007). Much of the vegetation in this province is tolerant of drought and adapted to fire.

The Central California Coast Section (Code: 261A) of the province, in which the RCIS Area is located, features low to moderate elevation parallel ranges and valleys and underlain by sedimentary, granitic, and ultramafic geologic formations. The vegetation is a mixture of western hardwoods, coastal prairie-scrub, coastal sagebrush, redwood forest, chaparral-mountain shrub, and annual grasslands cover types (McNab et al. 2007).

Within the Central California Coast Section, the RCIS Area includes three subsections (Figure 2-6):

- The Santa Cruz Mountains Subsection (Code: 261Af) is the predominant subsection, covering 74% of the RCIS Area, and includes the mountainous terrain;
- The Watsonville Plain-Salinas Valley Subsection (Code: 261Ah) includes the lower elevation areas from the City of Santa Cruz south to the Pajaro Valley, and covers 22% of the RCIS Area; and
- The Leeward Hills Subsection (Code: 261Ag) occurs in the southeastern tip of the RCIS Area, where it covers only 0.3% of the land therein.

2.4.2 Climate

The RCIS Area generally features a Mediterranean-like climate with mild, wet winters and hot, dry summers. The variable topography in the region creates variable microclimates. The Santa Cruz Mountains rise dramatically from the coast, reaching more than 3,000 feet in elevation in the span of just a few miles. These high peaks have cooler winter temperatures and receive substantially more rainfall. Average annual rainfall ranges from about 22 inches on the coast near Watsonville to more than 60 inches along the ridge of Ben Lomond Mountain (Mackenzie

Figure 2-6: Ecological Regions

et al. 2011) The microclimates in the RCIS Area combine with variation in geology, soils, hydrology, and land use history, among other factors, to support a diverse mosaic of natural communities (Section 2.4.5).

Precipitation drives stream flows, which vary seasonally, with about 85 percent of the annual rainfall occurring between December and May. The highest flows typically occur between December and March when winter storms are at their peak and when soils are saturated. Peak flows drop off considerably after the winter rains cease, although many streams maintain smaller but steady flows in the dry months due to the slow release of stored subsurface water (Mackenzie et al. 2011). Area exhibits high interannual variability, which can have important implications for its ecological systems. Between 1868, when records began to be collected, and 2005, average rainfall in the City of Santa Cruz was 28.5 inches but ranged between 10.2 inches in 1924 to 61.3 inches in 1941 (Griggs and Haddad 2011). Dry periods extend for three or more years (i.e., droughts) occur periodically and can have important implications for terrestrial as well as aquatic systems and species.

2.4.3 Disturbance Regimes

The ecosystems and communities within the RCIS Area are shaped by a variety of ecological disturbances: relatively discrete, natural events that disrupt the structure of an ecosystem, community, or population, and cause changes in resource availability or the physical environment (Pickett and White 1985). Fires, floods, and soil disturbances (e.g., landslides, animal diggings, and earthquakes) remove established plants and animals, and free up resources such as light, nutrients, and space; in doing so, they create opportunities for early successional species, and promote diversity within the landscape by increasing spatial heterogeneity (Sousa 1984).

Disturbances occur at various temporal and spatial scales, ranging from a tree fall that happens in minutes and creates a small canopy gap, to large wildfires, such as the 2020 CZU Lightning Complex Fire that burned 86,533 acres including 56,529 acres in Santa Cruz County over a five-week period. Varying types of disturbance overlap in the landscape, and occur with differing frequency, intensity, and severity, among other aspects of the disturbance regime.

Prior to human arrival, the landscape was likely burned infrequently by large fires ignited by lightning strikes (Sugihara et al. 2018). With the arrival of humans about 12,000 years ago, indigenous burning altered the frequency, size, extent, and seasonality of fire, which likely differed among community types (Kimmerer and Lake 2001, Anderson 2018). Fire management by indigenous communities combined with lightning may have led to higher levels of biodiversity (Anderson 2018). Incorporating indigenous knowledge and practices into fire management may increase the effectiveness of fire as tools for restoring and plant communities in the RCIS Area.

Native species in the RCIS Area have evolved in response to these disturbance regimes, and many disturbance-adapted species require some aspect of disturbance to complete their life

history. For Santa Cruz cypress (*Hesperocyparis abramsiana* var. *abramsiana*), fire opens the serotinous cones and releases its seeds, and also creates bare mineral soil and open canopy conditions that promote seedling establishment (USFWS 1998e, McGraw 2011). In the absence of fire, mature trees die and their populations of viable seed may diminish, creating a 'senescence risk' that could threaten to extirpate populations as can occur due to fire exclusion (Ne'eman et al. 1999, McGraw 2011).

Disturbance regimes can be altered by land use modifications and climate change, among other anthropogenic factors, which can interact in complex ways to alter the effects of disturbance for natural systems within the landscape (Newman 2019). Drivers of global change will produce new spatial patterns, altered disturbance regimes, and novel trajectories of change (Turner 2010). Atmospheric rivers promoted by global warming create intense rainfall events and more intense and severe floods; meanwhile, climate-change-induced droughts can render vegetation susceptible to mortality by pests or pathogens, promoting the intensity, severity, and/or frequency of fire. Since the turn of the century, 14 wildfires totaling 77,730 acres have burned 69,529 acres, or 24% of the RCIS Area (Figure 2-7). For comparison, wildfires totaling 5,172 acres were recorded between 1954 and 2000 (Calfire 2021). Increased frequency of fire has the potential to alter plant community structure and species composition, and could cause type conversion, even in natural communities dominated by plants and animals adapted to fire (Section 4.10.1.5).

While these anthropogenically modified disturbances can be particularly harmful for species that do not require disturbance to persist and instead can be harmed by disturbance, even disturbance-adapted species can be negatively impacted by disturbances that are outside of the natural disturbance regime, such as fires that occur in the wrong season, burn at significantly higher temperatures due to high fuel loads or occur too infrequently. These types of anthropogenically modified disturbances can promote the invasion and spread of exotic plants, which can outcompete disturbance-adapted species, many of which are poor competitors, and alter ecosystems including disturbance regimes (Hobbs and Huenneke 1992, D'Antonio et al. 1999).

Because of the important and complex roles of disturbance, biodiversity conservation within the RCIS Area will require managing disturbance and addressing its complex interactions with anthropogenic factors, to safeguard functioning ecosystems, maintain natural community structure and species composition, and promote persistence of species (Newman 2019).

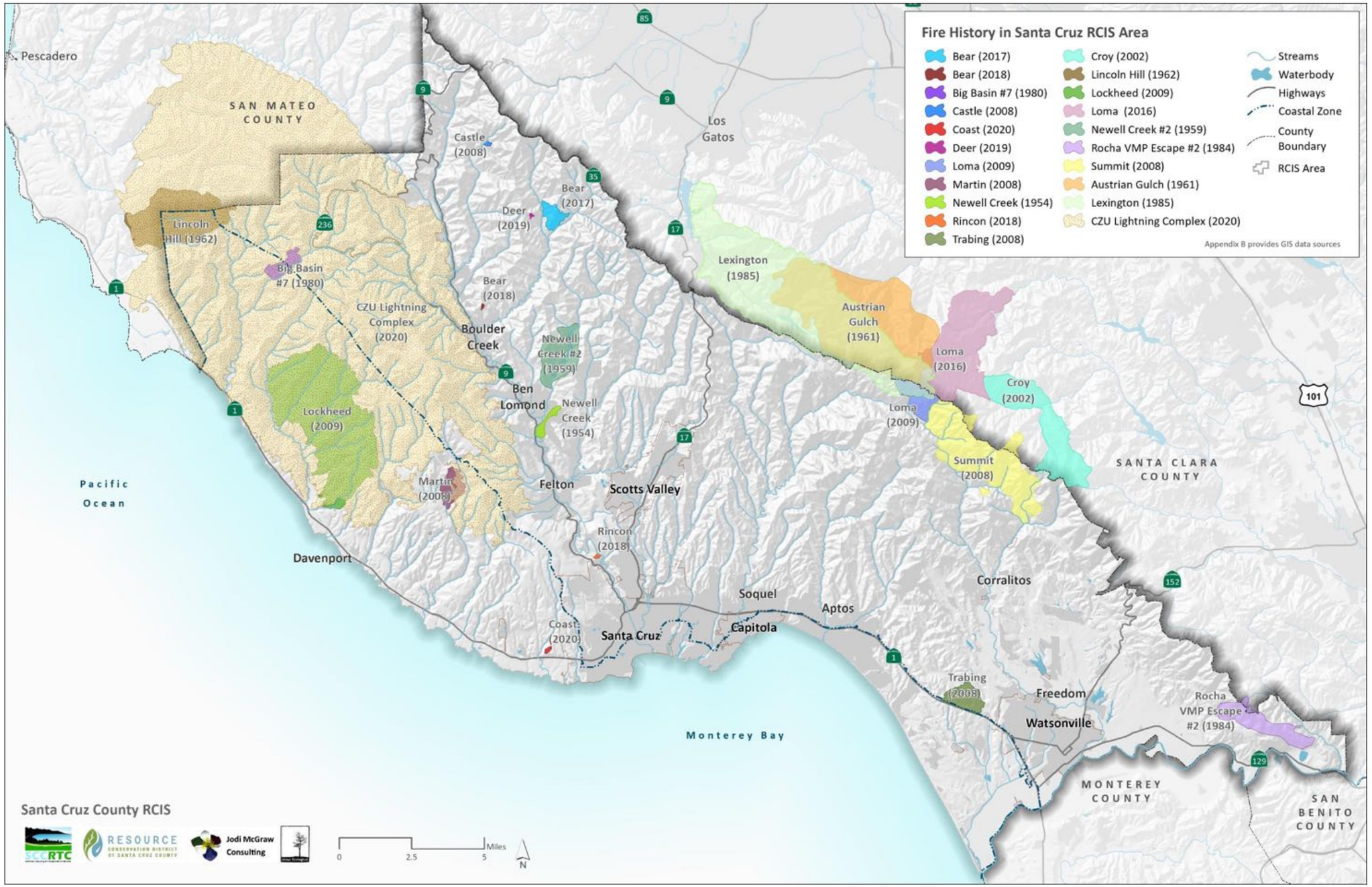

Figure 2-7: Fire History

2.4.4 Watersheds

The RCIS encompasses 65 smaller drainage basins or subwatersheds (Figure 2-8), each having unique characteristics based on variations in size, aspect, elevational gradient, precipitation, geology, and soils. For planning purposes, the RCIS Area was divided into four watershed regions that are similar to the HUC 10 Watersheds (USDA and NRCS 2013), but were created by grouping the 65 sub-watersheds mapped within the RCIS Area (Figures 2-8; Mackenzie et al. 2011). The following briefly characterizes each of these larger watershed areas:

- **North Coast:** Along the northern coast between Big Basin and Wilder Ranch state parks are coastal watersheds that drain directly into the Pacific Ocean As elevations drop from Ben Lomond Ridge, deeply incised canyons dominated by redwood vegetation give way to maritime chaparral and then coastal scrub and grassland along the coast. This North Coast, which totals 78,235 acres (27.4% of the RCIS Area) features 239 miles of perennial and intermittent streams that have been identified as priorities for conservation of coho salmon and steelhead, the Swanton Botanic Province, which is an area of diverse plant life (West 2010), and karst formations that provide caves important for endemic invertebrates as well as the water supply system.
- **San Lorenzo**: The San Lorenzo River Watershed is the largest watershed lying completely within the RCIS Area and encompasses 86,789 acres (30.4% of the RCIS Area) and features 302 miles of perennial and intermittent streams. It includes critical sub-watersheds for the protection of fish and other aquatic wildlife such as Zayante Creek and the San Lorenzo River Lagoon, which is important for the tidewater goby, and steelhead. Upper Newell Creek watershed drains into Loch Lomond Reservoir, a principal water supply source for the City of Santa Cruz (Mackenzie et al. 2011).
- **Mid-County:** South of the San Lorenzo River Watershed and North of Pajaro River Watershed are several watersheds that drain into Monterey Bay including Arana Gulch, Rodeo Gulch, and several small creeks that drain the coastal terraces near San Andreas Fault. This Mid-County area totals 58,496 acres (20.5% of the RCIS Area) and features 159 miles of perennial and intermittent streams including two major streams, Soquel and Aptos creeks, which are important for steelhead and represent the southernmost range of coho salmon. The upper watersheds in this region is dominated by redwood forest, while the lower foothills support expansive oak woodlands.
- **Pajaro:** The lower Pajaro River Watershed includes 61,742 acres (21.6%) within the RCIS Area, which is about 15% of the Pajaro River Watershed that also includes portions of San Benito, Monterey, and Santa Clara counties. The valleys within this watershed are largely cultivated or developed, but are innervated by important streams for steelhead and other aquatic species, which include 184 miles of perennial and intermittent streams; this watershed also features sloughs, lakes, and wetlands that dot the landscape. The watershed is ringed by the Southern Santa Cruz Mountains which support extensive grasslands important for raptors, and intact habitat that has been identified as essential for maintaining habitat connectivity between the Santa Cruz Mountains and the Gabilan Range to the south.

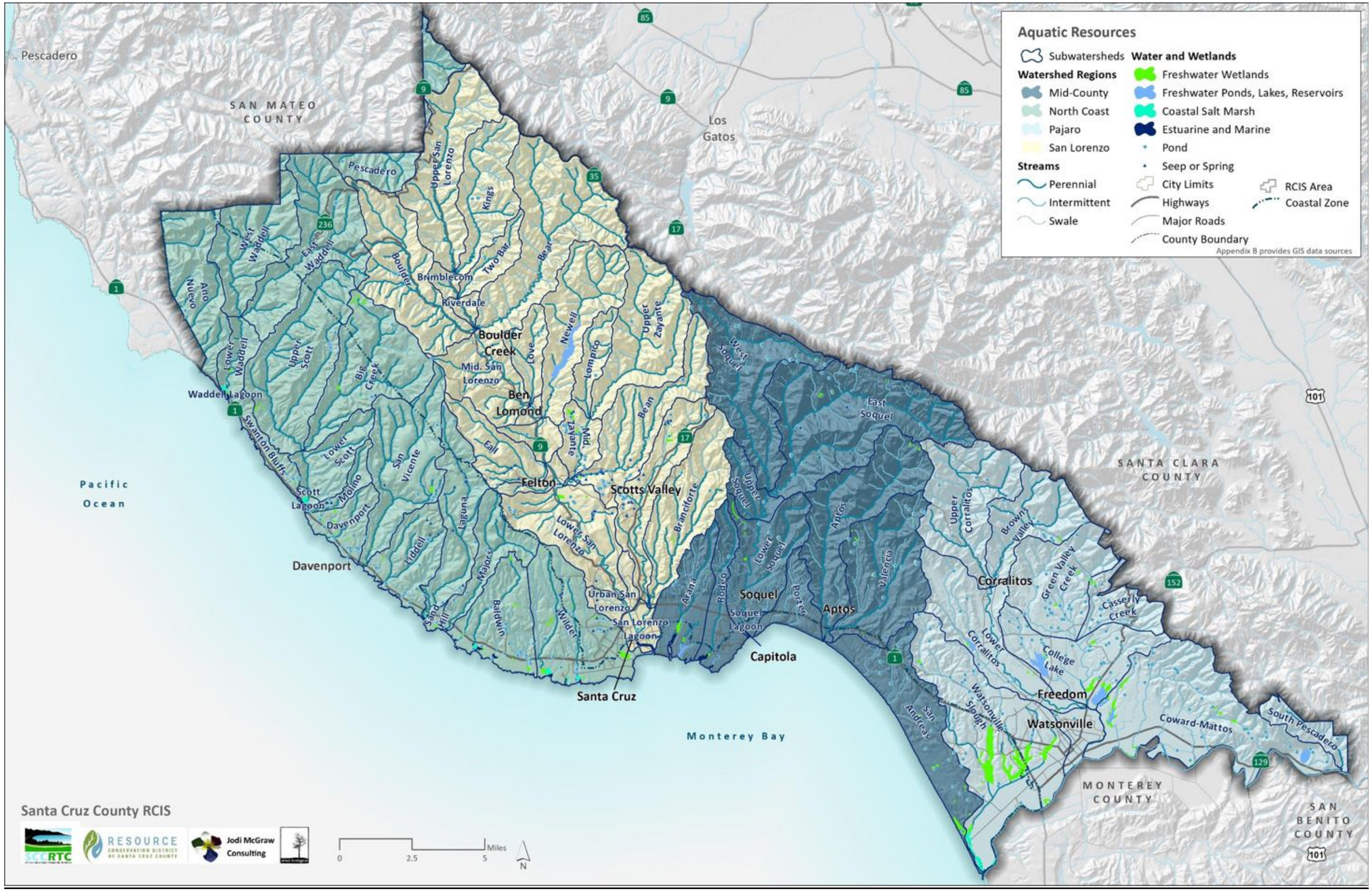

Figure 2-8: Aquatic Resources

2.4.5 Natural Communities and Other Land Cover

The RCIS Area supports a mosaic of natural communities, which reflect the RCIS Area's variable soils, hydrology, topography, and disturbance history, among other factors. They include aquatic systems such as streams, lakes, ponds, sloughs, and estuaries (Figure 2-8), and terrestrial systems including grasslands, shrublands, woodlands, and forests, as well as wetlands (Figure 2-9). These natural systems occur amidst other land cover types, including urban and cultivated lands (Table 2-8, Figure 2-9).

This RCIS used the best available information to map the natural communities. Available GIS data were incorporated in a stepwise fashion and decision rules were developed to control which layers were given priority in areas of overlap so that more accurate and/or more biologically relevant information was reflected in the final map and table (Table B-2). Crosswalks were used to compile the various sources into the common classification for the RCIS, and relate those types to the California natural communities list (CDFW 2020c), the California Wildlife Habitat Relationships (CWHR) classification system (CDFW 2018), and the CDFW list of sensitive natural communities (CDFW 2009, 2020c).

The Santa Cruz Mountains Stewardship Network is developing a fine-scale vegetation map for the Santa Cruz Mountains bioregion, including all of Santa Cruz County. The Vegetation Map and Landscape Database Project will combine high-quality lidar data, high-resolution optical imagery, fieldwork, and local expert input to create detailed maps and datasets of fine-scaled vegetation consistent with the Manual of California Vegetation (Sawyer et al. 2009, CNPS 2021). Other project products include vegetation lifeform mapping, multiclass impervious/permeable surface mapping, detailed lidar-derived topographic/terrain models, and a countywide 5m fire fuels model. The fine-scale vegetation map, which is slated to be completed in Fall 2022/Winter 2023, is anticipated to be an invaluable tool in implementation of this RCIS, by helping users locate areas for conservation actions. Any updates to this RCIS are anticipated to integrate the data or future high-resolution data.

The following sections briefly describe the aquatic and terrestrial natural communities in the RCIS Area.

Table 2-7: Natural Communities and Other Land Cover

Natural Community or Other Land Cover	CDFW Natural Communities[1]	California Wildlife Habitat Relationship (CWHR) Type [2]	Sensitive Communities[3]	Area (acres)	% of RCIS Area	% Protected[4]
Grasslands				**14,715**	**5.2%**	**32**
Grasslands	California Annual and Perennial Grassland	Annual Grass, Perennial Grass, Wet Meadow	Yes (partial)	14,715	5.2%	32
Shrubland				**22,725**	**8.0%**	**37**
Coastal Scrub	California Coastal Scrub Macrogroup	Coastal Scrub	Yes (partial)	12,689	4.5%	42
Chamise Chaparral	California Chaparral Macrogroup	Mixed Chaparral	No	2,002	0.7%	37
Maritime Chaparral	California Chaparral Macrogroup	Mixed Chaparral	Yes	8,033	2.8%	31
Hardwood Woodland/Forest				**28,793**	**10.1%**	**28**
Coast Live Oak	Coast Live Oak Woodland Alliance and Shreve Oak Forest Provisional Alliance	Coastal Oak Woodland	Yes (partial)	19,056	6.7%	29
Coastal Mixed Hardwood	California Forest and Woodland Macrogroup	Coastal Oak Woodland	Yes (partial)	6,326	2.2%	27
Riparian Woodland	Southwestern North American riparian flooded and swamp forest macrogroup	Valley Foothill Riparian, Montane Riparian	Yes	3,412	1.2%	30
Conifer Woodland/Forest				**154,917**	**54.3%**	**41**
Knobcone Pine	Knobcone pine forest alliance	Closed-Cone Pine-Cypress	Yes	6,463	2.3%	57
Sandhills	Silverleaf Manzanita Chaparral Alliance, Ponderosa pine forest Alliance	Mixed Chaparral	Yes	5,630	2.0%	35
Sand Parkland	Ponderosa Pine Forest Alliance	Ponderosa Pine	Yes	255	0.09%	70

Natural Community or Other Land Cover	CDFW Natural Communities[1]	California Wildlife Habitat Relationship (CWHR) Type [2]	Sensitive Communities[3]	Area (acres)	% of RCIS Area	% Protected[4]
Monterey Pine	Bishop pine – Monterey pine forest alliance	Closed-Cone Pine-Cypress	Yes	694	0.24%	38
Santa Cruz Cypress	Santa Cruz cypress groves alliance		Yes	209	0.07%	50
Pacific Douglas-Fir	Douglas fir forest alliance	Douglas Fir	No	6,883	2.4%	38
Redwood – Douglas-Fir	Redwood forest alliance	Redwood	Yes (partial)	11,993	4.2%	49
Redwood	Redwood forest alliance	Redwood	Yes (partial)	122,791	43.1%	39
Aquatic Systems and Wetlands				**1,902**	**0.67%**	**54**
Perennial Streams		Riverine	Yes	567 miles[5]		36
Intermittent Streams		Riverine	Yes	317 miles[5]		32
Swales (Ephemeral Streams)		Riverine	Yes	684 miles[5]		37
Freshwater Wetlands	Arid West freshwater emergent marsh	Freshwater Emergent Wetland	Yes	793	0.28%	64
Coastal Salt Marsh	Temperate Pacific tidal salt and brackish meadow	Estuarine, Saline Emergent Wetland	Yes	125	0.04%	57
Freshwater Ponds, Lakes, Reservoirs [6]	NA	Lacustrine	Yes	829	0.29%	49
Estuarine and Marine	NA	Estuarine and Marine	Yes	155	0.05%	30
Other				**62,209**	**21.8%**	**10**
Barren/Rock	NA	NA	No	512	0.18%	43
Non-Native/Ornamental	Eucalyptus, tree-of-heaven, black locust groves, semi-natural alliance	Urban	No[7]	2,590	0.9%	19
Beach, Dunes, and Rocky Shore	Vancouverian Coastal Dune and Bluff Macrogroup	Barren (for Dunes)	Yes	588	0.2%	56
Cultivated	NA	Numerous types[8]	No	26,415	9.3%	13

Natural Community or Other Land Cover	CDFW Natural Communities[1]	California Wildlife Habitat Relationship (CWHR) Type [2]	Sensitive Communities[3]	Area (acres)	% of RCIS Area	% Protected[4]
Urban[9]	NA	Urban	No	32,105	11.3%	5
Total				**285,261**	**100.0%**	**32**

[1] CDFW Natural Communities List complies with the National Vegetation Classification Standard (NVCS). NVCS is a hierarchical classification consisting of eight levels including three CDFW natural community levels: macrogroup, group, and alliance (CDFW 2020c).

[2] Defined using California Wildlife Habitat Relationships (CWHR) classification system (CDFW 2018).

[3] "Yes" indicates 0natural communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects (CDFW 2009, 2020c). "Yes (partial)" identifies natural community and other landcover categories for which a subset of the mapped area is sensitive. For example, native perennial grasslands are sensitive communities while California annual grasslands are not. "No" indicates land cover types that do not qualify as 'sensitive communities'. Additional areas, such as eucalyptus groves that are a type of non-native/ornamental land cover, can be sensitive habitat under various location and state designations if they support rare species such as monarch butterfly.

[4] The percentage of the vegetation or land cover type that is within an existing protected land, which was calculated using the gap analysis described in Section 5.2. Note that all acreages and percentages may not sum correctly due to rounding error

[5] Stream miles are not included in calculations of the percentage of RCIS Area or the percentage of the RCIS Area that is protected.

[6] The area (acreage) of water is underestimated, as most streams are mapped as linear features so their wetted area is largely not reflected as 'water'. Lakes, ponds, and reservoirs mapped within the vegetation and other land cover dataset total 829 acres; however, this does not include smaller ponds including those mapped as points (Figure 2-8), which are not reflected in this area. In general, the mapping of aquatic systems (as well as other plant communities and land cover) in the RCIS is regional scale and not intended to delineate jurisdictional waters, wetlands, or other habitat features.

[7] Eucalyptus and other non-native trees do not constitute sensitive natural communities as defied by CDFW (2009, 2020c); however, these trees can constitute a 'sensitive habitat' under the Coastal Act when they support overwintering Monarch butterflies, provide bird rookeries, and/or support nesting raptor species.

[8] Cultivated lands include: pasture, dryland grain crops, irrigated hayfield, irrigated row and field crop, cropland, deciduous orchard, evergreen orchard, vineyard.

[9] Urban denotes areas that are developed or otherwise built up as mapped in the Farmland Mapping and Monitoring Program (DOC 2016). In compiling the vegetation map, areas mapped as featuring sandhills, riparian woodland, or other sensitive habitat were retained and 'overrode' areas mapped as urban/built up, to reflect their conservation value (Table B-2).

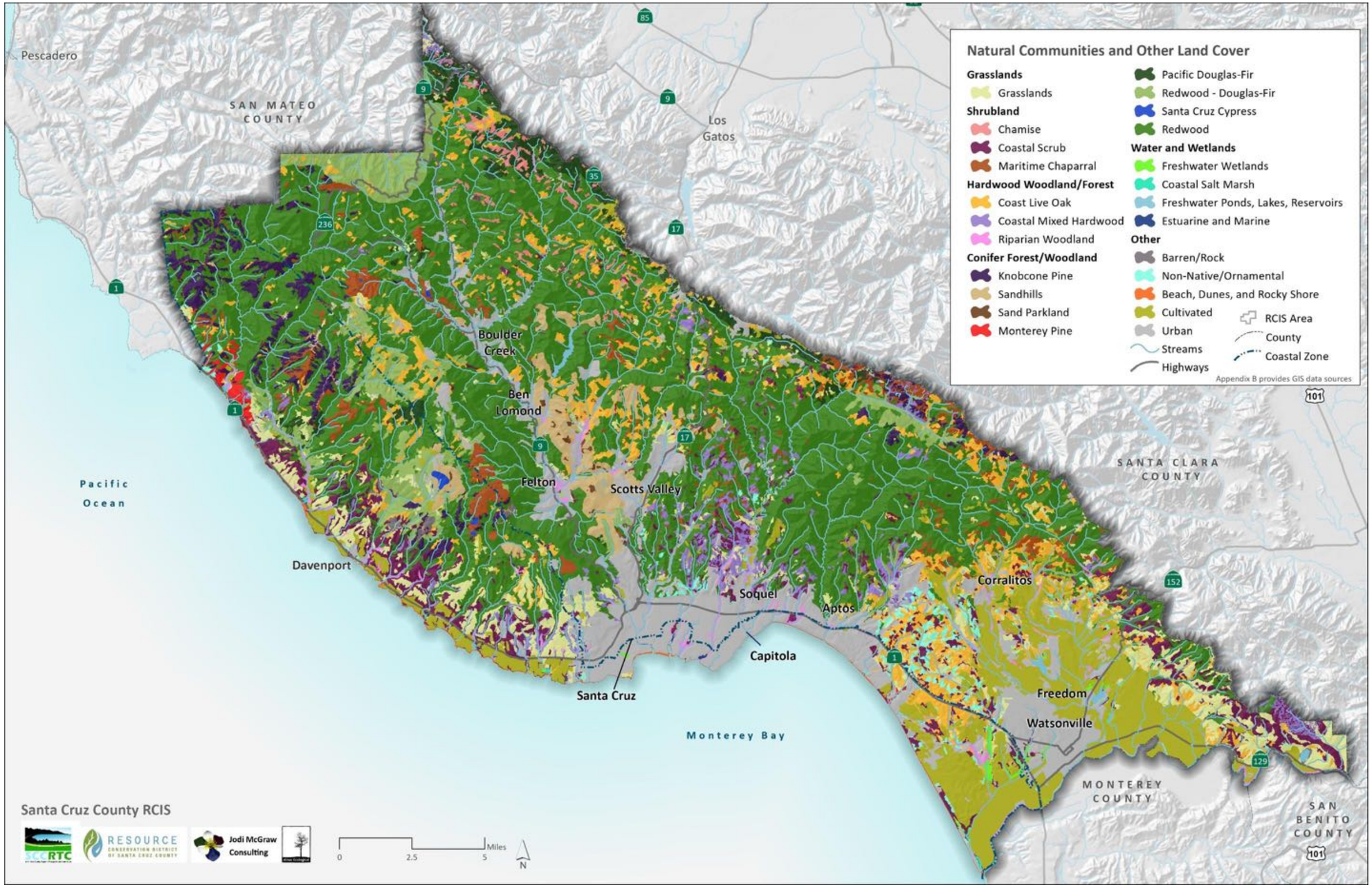

Figure 2-9: Natural Communities and other Land Cover Types

2.4.5.1 Aquatic Systems

The RCIS Area features a high concentration of the Central Coast's important aquatic ecosystems including streams, sloughs, wetlands, ponds, and lakes. The RCIS Area features 587 miles of perennial, 323 miles of intermittent streams, and an additional 686 miles of swales that collectively support diverse assemblages of aquatic invertebrates, fish, and amphibians, including steelhead and coho salmon. The region's streams originate in, and flow to the ocean within, the RCIS Area, except for the Pajaro River, which originates in Santa Clara and San Benito counties but flows into the Monterey Bay within the RCIS Area, and a small reach in the Pescadero Creek headwaters that originates in the RCIS Area but drains into San Mateo County. The remaining streams all drain into the Monterey Bay National Marine Sanctuary, where they can have important implications for water quality and habitat conditions in the near-shore environment (Figure 2-8). Where they meet the ocean, several of the streams feature estuaries (i.e., lagoons) that are important for steelhead, tidewater goby, and a host of other riverine and marine species. Streams and lakes in the RCIS Area support over 3,500 acres of riparian woodlands, which are important for maintaining aquatic habitat, support diverse assemblages of native animals, including neotropical migratory birds, and provide essential corridors for wildlife movement, particularly in urban or cultivated areas.

Santa Cruz County's streams and riparian areas have been impacted by factors that degrade habitat, including residential development, stream channelization, loss of riparian vegetation, excessive sedimentation, and pollution (Mackenzie et al. 2011). In addition to these stressors, substantial declines in fish populations in Santa Cruz County have resulted from the reduction of habitat quantity and quality related to streamflow reductions from direct diversion and groundwater withdrawal. Instream flow requirements for fish and other aquatic species varies by season, stream, and reach within stream. Impacts to streamflow from consumptive use are more pronounced during the dry season in summer and early fall. During this time, surface diversions and groundwater pumping can reduce water quality, dry streambeds, adversely affect spawning and migration, and disconnect aquatic habitat (County of Santa Cruz 2020b).

Located at the interface between the riverine and marine communities, the bar-built estuaries in the RCIS Area create over 100 acres of habitat that evolve over the course of year as the estuary transforms from a tidal dominant system during open bar conditions to a more freshwater dominated system when the bar is closed. Depending on the season and salinity, estuaries can provide habitat for migratory and wetland birds, rearing steelhead, spawning tidewater goby, California red-legged frog, and Southwestern pond turtle. Estuaries are highly sensitive to changes in sea-level rise, ocean energy and precipitation patterns as well as pollutants from their upstream watersheds.

The RCIS Area features numerous lakes, ponds, and reservoirs totaling more than 800 acres[3] which provide habitat for aquatic species including pond-breeding reptiles and amphibians, support riparian vegetation important for many species including neotropical migratory birds, provide a source of free water for terrestrial species, including bats, and provide floodwater detention.

The RCIS Area also features abundant wetlands, including freshwater emergent wetlands associated with the streams, ponds, and reservoirs, as well as brackish and saltwater wetlands near the coast. The RCIS wetlands include the Watsonville Sloughs, which are one of the largest remaining coastal wetland ecosystems in California, and critically important for migratory and wetland birds, and special- status species such as the California red-legged frog and Southwestern pond turtle (Mackenzie et al. 2011). These wetlands attenuate floodwaters and improve water quality, providing important ecosystem services (Schmidt et al. 2015).

Santa Cruz County waters provide drinking water for residents and visitors, critical habitat to numerous threatened and endangered species and opportunities for recreational and commercial activities. Nearly all of Santa Cruz County's water supply (all but 0.1%) is locally derived, which is unique given much of the State's reliance on federal and state water projects: in Santa Cruz County, 21% of the water supply is from surface water, 76% is from groundwater, and the remaining 3% is recycled water (County of Santa Cruz 2019b). However, like many other areas of California, the County faces water resource challenges including impaired water quality, inadequate water supply, over-drafted groundwater basins, depleted streams, and degraded riparian habitat (County of Santa Cruz 2019b). Depletion of groundwater can have implications for groundwater dependent ecosystems in the RCIS Area, including springs, ponds, lakes, streams, wetlands, karst caves, and deep-rooted plant communities, including riparian woodlands. Efforts are underway as part of the Sustainable Groundwater Management Act (and building on previous efforts) to manage groundwater in the Santa Margarita, Santa Cruz Mid-County, and Pajaro Valley basins (SCMCGA 2019, County of Santa Cruz 2019a, SMGA 2021, PVWMA 2021).

2.4.5.2 Terrestrial Systems

The RCIS Area features a mosaic of terrestrial plant communities, which reflect variation in geology, soils, microclimate, hydrology, and land use history; in some cases, the history of disturbance including fire can influence the current community type (Section 2.4.3). Table 2-9 provides a brief description of the mapped communities focused on characterizing their dominant species, factors influencing their distribution, and successional relationships to other communities. It also characterizes the communities according to their relationship with fire, based on the response of the dominant plant species to fire, which can have important implications for the maintenance of biodiversity within the communities.

[3] Lakes, ponds, and reservoirs mapped within the vegetation and other land cover dataset total 829 acres; however, this does not include smaller ponds including those mapped as points in Figure 2-7, which add to this area.

Table 2-8: Brief description of the Natural Plant Communities in the RCIS Area

Community and Extent in RCIS Area	Fire Relationship[1]	Brief Description
Grasslands 14,715 ac. (5.2%)	Fire adapted	• Upland, herbaceous communities dominated by grasses • Includes coastal prairie grasslands, which feature diverse assemblages of native grasses and forbs in areas within reach of coastal fog, including marine terraces featuring claypan soils • Also includes California annual grasslands dominated by exotic annual grasses but with scattered native herbs and grasses. • Some grasslands are anthropogenic clearings in shrublands and forests, rather than edaphic (soils based)
Shrubland **22,725 ac. (8.0%)**		**Shrub-dominated communities that generally occur on inimical (thinner, nutrient poor) soils compared to forests**
Coastal Scrub 12,689 ac. (4.5%)	Fire adapted	• Shrubland dominated by soft-wooded, evergreen, relatively short (1-2 m tall) shrubs • Dominant species include coyote brush (*Baccharis pilularis* ssp. *consanguinea*) and California sagebrush (*Artemisia californica*) • Primarily occurs on slopes near the ocean, but can occur on dry slopes inland • Successional (i.e., later successional sere) with some grasslands, which can be converted to coastal scrub in the absence of grazing, fire, or other disturbance
Chamise Chaparral 2,002 ac. (0.70%)	Fire adapted	• Shrubland dominated by schlerophyllous (thick leaved), hard-wooded shrubs that are generally taller (2-4 m) than in coastal scrub • Occurs in inland portions of the RCIS Area, away from reach of the coastal fog, which supports maritime chaparral • Dominated by chamise (*Adenostoma fasiculatum*), and other fairly widespread chaparral shrubs such as black sage brittleleaf manzanita (*Arctostaphylos crustacea* ssp. *crustacea*) and yerba santa (*Eriodictyon californicum*)

Community and Extent in RCIS Area	Fire Relationship[1]	Brief Description
Maritime Chaparral 8,033 ac. (2.8%)	Fire dependent	• Shrubland dominated by tall, schlerophyllous, hard-wooded shrubs within reach of the coastal fog • Often occurs on nutrient poor (oligotrophic) soils (e.g., decomposed granite or sand) • Supports a diverse assemblage of native shrubs including several rare manzanita species such Ohlone manzanita (*Arctostaphylos ohloneana*) and Shreiber's manzanita (*A. glutinosa*), and Santa Cruz manzanita (*A. andersonii*), as well as more widespread species such as crinite (*A. crustacea* ssp. *crinita*) and sensitive manzanita (*A. nummularia*) • Communities dominated by silverleaf manzanita are included within the 'Sandhills' mapping unit, though they are a form of maritime chaparral • Communities featuring scattered closed-cone pines (knobcone pine and Santa Cruz cypress) are classified based on the trees; however, these communities are ecologically similar and intergrade with maritime chaparral (and Sandhills)
Hardwood Woodland/Forest 28,793 ac.(10.1%)		**Tree-dominated communities supporting hardwoods (dicotyledonous trees), as opposed to conifers, in the canopy which is either dense (forest) or moderate (woodland), and features shade-tolerant herbs, vines, and shrubs in the understory**
Coast Live Oak 19,056 ac.(6.7%)	Fire adapted	• Mesic woodlands/forests on generally deep soils on coastal slopes dominated by coast live oak (*Quercus agrifolia*) • Can occur as an oak savanna where it intergrades with coastal grasslands • Inland and mid-to-high elevation stands within the RCIS Area are dominated by Shreve oak (*Quercus parvula* var. *shrevei*), which has been historically mapped as coastal live oak (or interior live oak, *Q. wislizenii*)
Coastal Mixed Hardwood 6,326 ac.(2.2%)	Fire adapted	• Community with a mix of hardwoods including coast live oak, Shreve oak, California bay (*Umbellularia californica*), Pacific madrone (*Arbutus menziesii*) tanoak (*Notholithocarpus densiflorus*), bigleaf maple (*Acer macrophyllum*), and black oak (*Q. kelloggii*) at higher elevations further inland

Community and Extent in RCIS Area	Fire Relationship[1]	Brief Description
		• Features scattered coast redwood (Sequoia sempervirens) and Pacific Douglas-fir (*Pseudotsuga menziesii*), which may become more common in the absence of fire
Riparian Woodland 3,412 ac. (1.2%)	Fire adapted	• Woodlands dominated by deciduous trees that occur in moist areas adjacent to streams or ponds and lakes • Dominant species include willows (*Salix* spp.), cottonwoods (*Populus* spp.) alders (*Alnus* spp.), box elder (*Acer negundo*), big leaf maple, and California sycamore (*Platanus racemosa*).
Conifer Woodland/Forest 154,917 (54.3%)		**Tree-dominated communities supporting conifers (gymnosperms)**
Knobcone Pine 6,463 ac. (2.3%)	Fire dependent	• Areas featuring knobcone pine (*Pinus attenuata*) but that lack Santa Cruz cypress or ponderosa pine • Often occurs in close association with maritime chaparral on xeric and oligotrophic (i.e., sandy and/or thin) soils; accordingly, the understory is comprised of maritime chaparral shrubs
Sandhills 5,630 ac.(2.0%)	Fire dependent	• Areas on Zayante sand soil in central Santa Cruz County that primarily support maritime chaparral dominated by silverleaf manzanita (*Arctostaphylos silvicola*) and associated shrubs including buckbrush (*Ceanothus cuneatus* var. *cuneatus*) • More well-developed soils, moister microhabitat areas, and/or later successional areas support woodlands/forests dominated by ponderosa pine (*Pinus ponderosa*) and coast live oak, often with scattered shrubs in the understory. • Sandhills communities include sand parkland; however, this diverse and rare community type was mapped and treated separately
Sand Parkland 255 ac. (0.09%)	Fire dependent	• Sandhills community characterized by scattered ponderosa pines and coast live oak, very limited or no shrubs, and a diverse assemblage of native forbs that includes

Community and Extent in RCIS Area	Fire Relationship[1]	Brief Description
		several endemic species and a suite of coastal disjunct species (i.e., species primarily found in coastal beaches, dunes, and bluffs) • Occurs primarily (though not exclusively) on ridges in sandhills
Monterey Pine 693 ac. (0.24%)	Fire dependent	• Forests dominated by Monterey pine (*Pinus radiata*), which generally feature coastal scrub shrubs and herbs in the understory • Includes 639 acres of stands in the Año Nuevo region, where the species is native, as well as 5 acres near La Selva Beach where it was planted (and may be invasive)
Santa Cruz Cypress 209 ac. (0.07%)	Fire dependent	• Areas featuring Santa Cruz cypress (*Hesperocyparis abramsiana*), which occurs in just five small stands on the western Santa Cruz Mountains on sandy soils. • Canopy also features knobcone pine; understory is comprised of shrubs found in maritime chaparral
Pacific Douglas-Fir[2] 6,883 ac.(2.4%)	Fire adapted	• Conifer forests dominated by Pacific Douglas-fir and featuring coast redwood as an associate • Other associates include hardwoods such as Pacific madrone, tanoak, California bay, and Shreve oak
Redwood – Douglas-Fir[2] 11,993 ac. (4.2%)	Fire adapted	• Conifer forests featuring a mix of Pacific Douglas-fir and coast redwood, with Pacific Douglas-fir usually dominant • Hardwood associates include primarily tanoak and Pacific madrone
Redwood[2] 122,791 ac.(43.0%)	Fire adapted	• Conifer forests dominated by coast redwood but also featuring Pacific Douglas-fir • Hardwoods include primarily tanoak but also Pacific madrone, Shreve oak, and California bay
Wetland 825 ac. (0.29%)		**Plant communities transitional between aquatic and terrestrial systems, where the water table is usually at or near the soil surface**

Community and Extent in RCIS Area	Fire Relationship[1]	Brief Description
Freshwater Wetlands 793 ac. (0.28%)	Fire adapted	• Wetlands associated with freshwater • Dominated by cattails (*Typha* spp.), bulrushes (*Bolboschoenus* spp., *Scirpus* spp., and *Schoenoplectus* ssp.), rushes (*Juncus* spp.) and sedges (*Carex* spp.), among others
Coastal Salt Marsh 125 ac. (0.04%)	Fire sensitive	• Wetlands supported by brackish or saltwater • Dominated by pickleweed (*Salicornia* spp.) and saltgrass (*Distichlis spicata*)
Other		
Non-Native/Ornamental 2,590 ac. (0.9%)	Varies	• Areas dominated by non-native species including primarily trees such as Monterey cypress (*Hesperocyparis* macrocarpa) and gum (*Eucalyptus* spp.)
Beach, Dunes, and Rocky Shore 588 ac. (0.2%)	Fire sensitive	• Areas along the coastal strand including beaches, dunes, rocky shore, and coastal cliffs and bluffs.

[1] Fire Relationship characterized based on the general response of the dominant species to fire

- **Fire dependent:** Dominated by plant species that cannot persist without recurring fire.
- **Fire sensitive:** Dominated by plant species that are killed by, and do not regenerate well following, fire, which is not an important component of the natural disturbance regime.
- **Fire adapted:** Dominated by species adapted to fire within the natural range of variation of the disturbance regime (i.e., type, seasonality, intensity, and frequency). Includes all communities not characterized as fire dependent or fire sensitive.

[2] The redwood and Douglas-fir forests collectively feature 10,306 acres of old-growth and older-second-growth forests

The terrestrial systems vary in areal extent from just 209 acres of Santa Cruz Cypress, which is found almost exclusively in Santa Cruz County, to nearly 123,000 acres of redwood forests (Table 2-9), of which 10,306 acres are characterized as old-growth or older-second-growth forests (SRL 2008, Singer 2012a). These terrestrial natural communities are a key component of the rich biodiversity in the area, as they support more than 1,000 native plant species known to occur in Santa Cruz County (Neubauer 2013) and create diverse habitat conditions for a wealth of native animals. The diversity reflects not only the diversity of land facets in the RCIS Area, but also its location its central location along the California Coast, where it features a mix of species found in the cooler, moister northern portions of the state, as well as those found in the hotter and drier southern region. Many of the natural communities provide essential ecosystem services including water filtration (especially forests and wetlands), carbon sequestration, and prevention of environmental hazards such as erosion including devastating floods and mudslides (Mackenzie et al. 2011).

2.4.6 Habitat Connectivity

Habitat connectivity is essential to the persistence of biodiversity and the maintenance of ecosystem processes. Specifically, it is critical to:

- Supporting species with large home ranges such as mountain lions, for which habitat within each range or portions thereof is insufficient to support persisting populations;
- Allowing individuals to migrate seasonally, in response to changes in habitat suitability, or to disperse to establish a new territory;
- Facilitating recolonization of habitat patches after a disturbance (e.g., fire);
- Promoting exchange of genetic material to facilitate population viability; and
- Enabling migration in response to climate change.

Maintaining connectivity between the Santa Cruz Mountains and adjacent mountain ranges has been identified as especially critical for several species, including mountain lion. This highly territorial species with a large home range (100-150 square miles for males) occurs at low density (Beier 1993, Morrison and Boyce 2009). Juveniles, which must disperse from their natal territories, can benefit from access to habitat in adjacent mountain ranges. Without immigration, the Santa Cruz Mountains population could decline below levels needed to maintain genetic diversity or a persisting population (Thorne et al. 2002, Gustafson et al. 2018). It will also be essential to maintain the permeability of habitat *within* the RCIS Area, including between patches of remaining intact habitat. Notably, traffic and attendant development through the Highway 17 corridor create a partial barrier to east-west movement through the RCIS Area and may impede gene flow (Wilmers et al. 2013).

Within the region's streams, habitat connectivity is essential for migration of aquatic species, including anadromous fish such as coho salmon, steelhead, and Pacific lamprey which rely on aquatic habitat connectivity for seasonal movement, to locate optimal spawning and rearing

habitat and both winter and summer refugia. Likewise, pond-breeding amphibians and reptiles, such as Santa Cruz long-toed salamander, California red-legged frog, and southwestern pond turtle, among others, rely on connectivity to move from ponds to upland habitat used for foraging, aestivation, and dispersal. Indeed, most animals require connected, permeable habitat featuring adequate plant cover and other natural features to complete their life history. Urban development, agriculture, and transportation infrastructure have impeded animal movement though the landscape.

Riparian corridors can facilitate animal movement through the landscape, and can be critical to animal movement through cultivated and urbanized areas (Hilty and Merenlender 2004). Anthropogenic factors including stream channelization, road crossings, loss of riparian vegetation; surface water diversions and groundwater extraction; encroachment from various land-uses and development; and dams and reservoirs have created barriers to in-stream migration. Meanwhile, riparian vegetation clearing as part of development and for compliance with food safety auditor requirements has reduced the width and fragmented riparian corridors in some areas, potentially constraining their ability to facilitate animal movement.

Landscape permeability and connectivity will be imperative for species to adapt to climate change (Heller and Zavaleta 2009). As the climate warms, species will require a permeable landscape to migrate within the RCIS Area as well as between the RCIS Area and adjacent areas, to stay within their climate envelope (i.e., adapted climatic tolerance), including by moving along latitudinal and elevational gradients, or to access climate refugia such as wet areas and cooler microclimates (Morelli et al. 2016).

Conservation actions should maintain or enhance habitat connectivity, as interconnected protected areas will be effective at maintaining biodiversity, especially in the face of climate change (Hilty et al. 2020).

Two major studies illuminate the priority areas to maintain or enhance connectivity in the RCIS Area.

1. **Santa Cruz Mountains Bioregion Habitat Connectivity Study (Merenlender and Feirer 2011):** To identify a patch network within Santa Cruz County, the Conservation Blueprint team collaborated with Conservation Biologist Dr. Adina Merenlender on an analysis which was designed to identify remaining patches of intact habitat and evaluate areas where corridors might be most effectively located in order to connect them (Merenlender and Feirer 2011). The patch network reflects the general naturalness of the landscape, rather than the suitability of habitat for any one species. However, the resulting patch network was compared with mountain lion movement data. A wide-ranging, territorial species that utilizes a wide variety of habitats, mountain lions represent an appropriate species for evaluating habitat connectivity in the Santa Cruz Mountains (Mackenzie et al. 2011).
2. **Bay Area Critical Linkages Study (Penrod et al. 2013):** This study identified landscape linkages to connect protected habitat located within natural landscape blocks in the Bay

Area and adjacent areas. It also identified important aquatic linkages for species such as steelhead. The linkages were developed based on analyses conducted for species include: mountain lion, California red-legged frog, foothill yellow-legged frog, and steelhead (Penrod et al. 2013).

These two complementary studies, which were conducted at different spatial scales using different methods, collectively identify key areas for maintaining habitat permeability and connectivity within the RCIS Area, and connecting the RCIS Area to important habitat beyond its borders (Table 2-10, Figure 2-10).

The Santa Cruz Mountains Bioregion Habitat Connectivity Study identified six large patches (and one patch complex) of intact habitat within the RCIS Area, as well as six Critical Areas to Maintain Landscape Permeability, which connect these large habitat patches within the RCIS Area (Table 2-10, Figure 2-10). The Critical Landscape Linkages identified through the study also highlight connections to adjacent habitat outside the RCIS Area; specifically, linkages to the Diablo Range through Coyote Valley and the Upper Pajaro River, and a linkage to the Gabilan Range through the Aromas Hills Area (Figure 2-10).

Broadly, the Bay Area Critical Linkages project identified two linkage designs to connect intact blocks of habitat in the Santa Cruz Mountains to large landscape blocks in the two adjacent mountain ranges:

- **Santa Cruz Mountains–Diablo Range**: This linkage extends from the Stevens Creek watershed southeast along the eastern slope of the Santa Cruz Mountains. The linkage connects the Santa Cruz Mountains to the Diablo Range across U.S. 101 through the Coyote Valley and across the Pajaro River corridor.
- **Santa Cruz Mountains–Gabilan Range**: This linkage extends from the Pajaro Hills through the Chittenden Gap in the western Santa Cruz Mountains south to Pinnacles National Park in the Gabilan Range.

The Bay Area Critical Linkages Project also identified Key Riparian Corridors based on streams that are important for anadromous fish Recognizing streams provide important corridors for numerous species as well as essential breeding habitat for many birds, amphibians, and reptiles, Riparian Buffer Zones were created within 1 km of these streams to facilitate movement of species along stream corridors (Penrod et al. 2013; Figure 2-10). Identifying and removing fish passage barriers with an emphasis on those in the key riparian corridors to allow anadromous fish, including steelhead and coho salmon, to access suitable upstream habitat that is important to complete their life history. The County of Santa Cruz has assembled a local fish passage database that classifies instream barriers and can help inform and prioritize efforts to enhance connectivity within streams (Section 5.3.2).

Table 2-9: Significant Habitat Patches and Patch Complexes within the RCIS Area (Mackenzie et al. 2011)

Significant Habitat Patch or Complex	Patch Size within RCIS Area (acres)	Total Patch Size (acres)	Connected Patch or Complex
North Coast – forested area split evenly between San Mateo and Santa Cruz counties, includes Big Basin State Park and private forests in Scott Creek Watershed	33,797	70,400	Upper San Lorenzo
Upper San Lorenzo – forested area including Castle Rock State Park and adjoining private forests	11,873	11,904	North Coast
Ben Lomond Mountain – a complex of ten patches that are closely located	22,319	22,464	Loch Lomond, Aptos
Loch Lomond – forested area surrounding the Santa Cruz City Water Department's Loch Lomond reservoir	9,647	9,664	Ben Lomond Mtn., Aptos
Aptos – forested area including Nisene Marks State Park and Soquel Demonstration Forest	14,478	14,528	Loch Lomond, Ben Lomond Mtn, Upper Corralitos
Upper Corralitos – mostly privately owned forested land north of Corralitos	5,594	5,824	Aptos, Pajaro Hills
Pajaro Hills – grasslands, shrublands, and forests that straddles the Santa Clara County line in the hills above the Pajaro Valley	7,967	24,192	Upper Corralitos
Total	**105,676**	**158,976**	

Restoration of riparian and other vegetation in the Riparian Buffer Zones can facilitate aquatic species dispersal to upland habitats, for species such as California red-legged frog that utilize both aquatic and upland habitats. Riparian areas also provide cover (i.e., shrubs and trees) used by many species to move through open habitat, and are critical to animal movement through cultivated and urbanized areas as noted above (Hilty and Merenlender 2004).

Figure 2-10: Habitat Connectivity

3 Conservation Framework and Elements

This section identifies the RCIS conservation elements: the biological communities and species, as well as other aspects of the landscape, for which the RCIS provides an analysis of pressures and stressors (Section 4) and then presents the conservation strategies (Section 5). This section describes the conservation planning framework (Section 3.1), contains background information on the conservation elements, including how they were selected (Section 3.2), identifies the conservation elements (Section 3.2) and then presents the conservation elements (Sections 3.3 through 3.7).

3.1 Conservation Framework

The RCIS conservation strategy was developed through the following conservation planning framework:

1. **Select Conservation Elements (Section 3):** Identify the natural communities, species, and other aspects of the landscape, that the conservation strategy is designed to benefit. Though the RCIS analysis and strategies focused on these 23 conservation elements, they were selected to collectively create a comprehensive and cohesive strategy that would benefit species, communities, and ecosystems throughout the RCIS Area.
2. **Analyze Pressures and Stressors (Section 4):** Evaluate the pressures that create degraded ecological conditions known as stressors for the conservation elements and the natural systems in the RCIS Area overall. The tables in Section 4 identify the threats addressing each of the 23 conservation elements.
3. **Develop Conservation Strategies (Section 5):** Develop goals, objectives, actions, and priorities for each of the conservation elements, to address the pressures and stressors affecting them and otherwise meet their key ecological requirements. These conservation strategies are the heart of the RCIS.
4. **Identify Ecological Connections and Benefits**: To illustrate the benefits of the conservation strategies for additional species, Chapter 5 features a table that identifies focal and non-focal species that are anticipated to benefit from the conservation strategies for each of the conservation elements (Table 5-2). This analysis is designed to help those implementing the strategy to identify the species that will benefit, and design mitigation credit agreements to develop mitigation credits for target species.

   Additionally, the conservation strategy tables in Section 5 identify the species that can benefit for each action. To illustrate connections between the strategies for the 23 conservation elements, each strategy features a section, “Other Actions that Benefit this Conservation Element”, that lists the actions in other conservation strategies that will also benefit the conservation element.

3.2 Conservation Element Types and Selection Approach

The RCIS guidelines identify two main types of "conservation elements", which are the elements of the RCIS that are analyzed and that will benefit from conservation actions and habitat enhancement actions set forth in the RCIS (CDFW 2018):

1. **Focal Species:** Sensitive species; and
2. **Other Conservation Elements**: natural communities, biodiversity, habitat connectivity, ecosystem functions, water resources, and other natural resources.

The RCIS guidelines also allow identification of non-focal species: species associated with a focal species or other conservation elements and that will benefit from conservation actions and habitat enhancement actions set forth in the RCIS. Focal species, other conservation elements, and non-focal species, can all benefit through both conservation investments and mitigation credit agreements.

This RCIS addresses five conservation elements: natural communities, other conservation elements, focal species, non-focal species, and co-benefited species. This section describes the elements, the rationale for their inclusion, and the selection criteria, and relates them to the categories identified in the RCIS Guidelines (CDFW 2018). The sections that follow identify the actual elements.

This RCIS emphasizes **natural communities**: 13 vegetation and other landcover types that were selected to develop a cohesive, landscape-scale conservation strategy to support both rare and common species, biodiversity, and other conservation values. The natural community-based conservation elements, which constitute 'other conservation elements' under the RCIS Guidelines (Section 3.2; Table 3-1), are emphasized in this RCIS for the following reasons:

- **Comprehensive and Cohesive**: A strategy developed to conserve natural communities and sustain ecosystem process can conserve a broader suite of native species than strategies based on single-species planning (Groves 2003).
- **Foundational:** Natural communities provide the ecological foundation for conservation of species, which rely on interconnected habitats and sustained ecosystem processes.
- **Resilient:** Addressing ecosystem functions and factors that influence them, including natural disturbances (e.g., flood, fire, etc.) and anthropogenic factors, including climate change, can promote resiliency of populations, communities, and ecosystems.
- **Action Oriented:** Conservation actions for species or suites of species most often target protection, restoration, and enhancement of ecosystems and natural communities; therefore, planning around communities promotes effectiveness of such strategies designed to protect species.
- **Consistent**: This systems-based approach is consistent with a variety of conservation planning approaches including:

  - The Conservation Blueprint for Santa Cruz County (Mackenzie et al. 2011), which set goals for habitat protection based on communities;
- The Nature's Value in Santa Cruz County (Schmidt et al., 2015), which assessed ecosystem services provided by natural lands;
  - CDFW's Natural Communities Conservation Planning framework, which endeavors to protect habitat within broad landscapes to maintain intact ecosystems (Clark 1994);
  - biological resource mitigation approaches, which emphasize habitat connectivity, processes, and redundancy; and
  - other state agency mandates including the State and Regional Water Resources Control Boards' protection of waters of the State and wetlands, and the State Coastal Commission's protection of Environmentally Sensitive Habitat Areas.

Three **other conservation elements**, habitat connectivity, working lands, and bat habitat complement the natural communities-based approach to address other important facets within the landscape. Habitat connectivity is essential to goals for communities and species, while working lands (i.e., timber, grazing, and cultivated lands) play an important role in landscape-scale conservation in the region. Bat habitat occurs throughout the RCIS Area, including in all of the natural communities as well as the built-environmental (e.g., barns, bridges, etc.). The pressures and stressors as well as the use of the built environment as habitat result in conservation strategies for bats that are somewhat unique, and as such, are addressed as a separate conservation element.

Recognizing the value of natural community-based, landscape-scale planning for native species conservation, the RCIS also identifies seven **focal species** based on the RCIS guidelines, which require RCISs to identify focal species that include: 1) listed species, 2) wide-ranging species, c) climate-vulnerable species, and d) taxonomic representation (CDFW 2018). To meet these requirements, this RCIS addresses the unique conservation needs of seven focal species which were selected to meet the criteria above. The conservation strategies for focal species were developed to complement and support the strategies developed for community-based and other conservation elements. This approach contrasts with many other RCISs, which generally focus on a longer lists of focal species that have been selected to cover the range of natural communities within the RCIS in order to create a comprehensive and cohesive strategy.

Non-focal species are other species that are listed under the federal Endangered Species Act (ESA), California Endangered Species Act (CESA), and/or are identified as Fully Protected under the California Fish and Game Code Sections 3511, 4700, 5050 and 5515. These 30 species conservation needs are addressed through conservation of natural communities, other conservation elements, and focal species. These species, like focal species, generally require compensatory mitigation when they are impacted during projects including maintenance or infrastructure construction activities.

Table 3-1: Conservation Elements of the Santa Cruz County RCIS Conservation Strategy

Element in this RCIS	RCIS Guidelines Category	Description	Rationale for Inclusion	Selection Criteria
Natural Communities	Other Conservation Elements	13 natural communities or other land cover types	A communities-based approach can provide the basis for a comprehensive and cohesive strategy to conserve the region's multiple rare species while maintaining common species and supporting essential ecosystems services	• Supports disproportionate number of rare species • Identified as a sensitive community • Widespread community (in the RCIS Area) that supports additional rare species, as well as more wide-ranging and common species, and can support ecosystem services
Other Conservation Elements	Other Conservation Elements	Habitat connectivity, working lands, and bat habitat	Other important aspects of the RCIS Area for the maintenance of native biodiversity and rare species	Other non-community and non-species elements of the landscape that are essential to address in developing a comprehensive conservation strategy for the region, and that are unique in their pressures and stressors and thus strategies.

Focal Species	Focal Species	7 special-status species[1]	• Provide focused analysis for species to meet the RCIS guidelines
			• Identify species that can be the subject of conservation investments or MCAs
				• State-listed species under CESA (primarily)[2]
				• Collectively utilize a range of non-marine aquatic and terrestrial natural community types[3]
				• Collectively represent a range of taxonomic groups (plants, invertebrates, fish, etc.)
				• Include:
				  ○ Climate-vulnerable species
				  ○ Wide-ranging species

Element in this RCIS	RCIS Guidelines Category	Description	Rationale for Inclusion	Selection Criteria
Non-Focal Species	Non-Focal Species	30 state and/or federally listed species[4]	Identify additional listed species that can be the subject of conservation investments or MCAs during implementation	Listed and/or Fully Protected species that are not focal species, but will benefit from the conservation actions identified for one more communities, other conservation elements, or focal species.
Co-benefited Species	Not addressed in the RCIS guidelines	157 other rare species in the RCIS Area	Identify additional, non-listed species that could be benefit from conservation investments or MCAs during implementation; however, MCA credits for these species cannot be generated	Rare species that are not focal or non-focal species, and that can benefit from the actions listed for one or more communities, focal species, or other conservation elements

[1] This RCIS uses a systems-level approach to conservation that emphasizes natural communities and other conservation elements (Section 3.2)

[2] Focal species include two species not listed under CESA, in order to provide taxonomic representation.

[3] Though the RCIS Area adjoins the coast, marine species and communities were excluded from the RCIS as it is a primarily land-based conservation strategy. Marine species, including southern sea otter, are anticipated to benefit from the RCIS strategies that improve water quality in the near-shore environment.

[4] Listed as an endangered or threatened under CESA and ESA, or as a candidate under CESA, or Fully Protected under California Fish and Game Code Sections 3511, 4700, 5050 and 5515. Includes de-listed species: species previously listed under ESA but removed from the list.

Other rare species that are not state or federally listed, but may be recognized as sensitive under the California Environmental Quality Act, California Coastal Act, or other state or local regulations, were categorized in this RCIS as **co-benefited species.** These plants and animals will benefit from the conservation strategies, but are not focal species or non-focal species. Compensatory mitigation is generally not required for impacts to these species, except in the coastal zone where such mitigation may be required to comply with Local Coastal Program and the California Coastal Act.

3.3 Natural Communities

This RCIS will address as conservation elements 13 natural communities and other land cover types, which are the foundation of a cohesive and comprehensive conservation strategy. The communities were selected because they feature:

1. sensitive habitat recognized by local, state, and federal regulations (e.g., riparian areas and wetlands);
2. support the RCIS Area's rare species, by including high concentrations of rare species and/or at least one narrowly endemic species, for which the RCIS Area is essential to long-term species' persistence; and/or
3. provide important habitat for common or widespread species, and sustain the region's ecosystem services.

Table 3-2 lists the natural communities included as elements of the RCIS. In some cases, ecologically related communities were combined, such as sandhills and sand parkland, and maritime chaparral and knobcone pine forest, so they will be addressed together as part of a common strategy. Figure 3-1 illustrates the locations of mapped occurrences of these community conservation elements within the landscape.

3.4 Other Conservation Elements

Habitat connectivity, working lands, and bat habitat are facets that were identified as 'other conservation elements' (the official term of these types of conservation elements in the RCIS Program) based on their importance for biological resources conservation in the RCIS Area. Working lands (i.e., timber, grazing, and cultivated lands) play an important role in landscape-scale conservation in the region (Section 2.2.3). Habitat connectivity is essential to goals for communities and species including adaptation to climate change (Section 2.4.6).

Bats play essential roles in natural communities and the maintenance of biodiversity; they control pests, conduct pollination, and facilitate seed dispersal and natural and working lands. Bats occur throughout the RCIS Area, including all of the natural community conservation elements. Because of their unique ecological requirements, including roosting habitat, and different pressures and stressors, habitat for bats was addressed in a single conservation element designed to be applied throughout the natural communities, working lands, and even urban areas in the RCIS Area.

Table 3-2: Natural Communities included in the RCIS and the Criteria Met

	RCIS Area		Criteria for Inclusion as Community Elements		
Natural Community Elements	**Acres**	**% of Total**	**Sensitive Habitat[1]**	**Rare Species**	**Widespread/ Ecosystem Services**
Terrestrial	**189,993**	**66%**			
Grasslands	14,715	5.2%	Coastal Terrace Prairie	Numerous plants and animals incl. Santa Cruz tarplant, San Francisco popcorn flower, Ohlone tiger beetle, golden eagle, Northern harrier, and American badger	Water supply and quality
Maritime Chaparral/Knobcone Pine	14,496[5]	5.2%	Northern Maritime Chaparral	Vaginulate grimmia, Monterey spineflower, Schreiber's manzanita, Ohlone manzanita, Santa Cruz manzanita, Santa Cruz kangaroo rat	
Sandhills/Sand Parkland	5,885	2.1%	Northern Maritime Chaparral, Maritime Coast Range Ponderosa Pine Forest, Sand Parkland	Numerous incl. Ben Lomond wallflower, Ben Lomond spineflower, silverleaf manzanita, Ben Lomond buckwheat, Mount Hermon June beetle, Zayante band-winged grasshopper, Blainville's horned lizard, Santa Cruz kangaroo rat	Water supply and quality
Santa Cruz Cypress Forest	209	0.07%	Santa Cruz Cypress Forest	Santa Cruz cypress	
Monterey Pine Forest[2]	639	0.22%	Monterey Pine Forest	Monterey pine	
Oak Woodland and Forest	25,381	8.9%	Shreve oak, coast live oak, canyon live oak, black oak, and mixed oak woodlands and forests	slender silver moss, robust spineflower, black salamander, sharp-shinned hawk, Cooper's hawk, San Francisco dusky-footed woodrat	Water supply and quality

Natural Community Elements	RCIS Area		Criteria for Inclusion as Community Elements		
	Acres	% of Total	Sensitive Habitat[1]	Rare Species	Widespread/ Ecosystem Services
Redwood and Douglas-fir Forest	141,667	49.7%	redwood forest and woodland (incl. old-growth and older-second-growth forests)	tear drop moss, minute pocket moss, Methuselah's beard lichen, Marbled murrelet, Vaux's swift, and Townsend's big-eared bat	Water supply and quality
Beach, Dunes, and Rocky Cliffs	588	0.21%	Beaches, Dunes, Rocky Cliffs, Coastal Bluff, Coastal Strand	Numerous plants and animals incl. coast wallflower, Monterey coast paintbrush, globose dune beetle, Northern California legless lizard, western snowy plover, American peregrine falcon, and California brown pelican	Sea-level rise/coastal flood protection
Karst Formations	1,363[3]	0.48%[3]		Numerous endemic species incl. Empire cave pseudoscorpion, Dolloff Cave spider, Empire Cave neochthonius, Mackenzie's cave amphipod, and Santa Cruz teleman spider	Water supply and water quality
Aquatic	5,293	1.9%			
Riparian and Riverine	3,412[4]	1.2%	Streams and Riparian Corridors	Numerous riverine species including: steelhead, coho salmon, Pacific lamprey, Monterey roach, resident stickleback, speckled dace, California giant salamander, California red-legged frog, foothill yellow-legged frog, and southwestern pond turtle Numerous riparian species including: yellow warbler, San Francisco dusky-footed woodrat, ring-tailed cat, and western red bat	Water supply, water quality, and flood protection

Natural Community Elements	RCIS Area		Criteria for Inclusion as Community Elements		
	Acres	% of Total	Sensitive Habitat[1]	Rare Species	Widespread/ Ecosystem Services
Bar-Built Estuaries[5]	307	0.11%	Estuaries and wetlands	Tidewater goby, coho salmon, steelhead, California red-legged frog, southwestern pond turtle, and San Francisco garter snake.	Flood protection
Freshwater Wetlands[5]	767	0.1%	Freshwater wetlands	American bittern, snowy egret, tricolored blackbird, Monterey ornate shrew,	Water filtration, flood protection
Ponds, Lakes, and Reservoirs	807	0.3%	Waters of the State/U.S.	Numerous species including: California floater clam, California red-legged frog, California tiger salamander, Santa Cruz long-toed salamander, San Francisco garter snake, southwestern pond turtle, osprey, bald eagle,	Water supply and water quality

[1] Lists resources regulated by local, state, and federal regulations protecting the communities including: County of Santa Cruz Sensitive Habitat and Riparian Corridor and Wetlands Protection ordinances; the California Environmental Quality Act; Porter-Cologne Water Quality Control Act; and Clean Water Act (Sections 401 and 404).

[2] There are a total of 693 acres of mapped Monterey Pine Forest in the RCIS Area; however, only the 639 acres in the Año Nuevo, Waddell, Swanton Bluffs, and Scott Creek watersheds are naturally occurring and thus included in the conservation element.

[3] This is the mapped extent of marble outcrops visible on surface and may not represent the entire area of karst formation (Section 5.3.9). The marble outcrop acreage overlaps the other natural communities and was not included in the sum for terrestrial systems.

[4] This represents the acreage of mapped riparian woodlands as defined in Table 2-8 and does not include the additional riparian habitat associated with streams, including redwood forests.

[5] Bar-built estuaries includes the open water and adjacent (contiguous) mapped wetlands. Freshwater wetlands includes all other mapped wetlands not near estuaries. Wetlands with an overstory of shrubs and trees cannot be detected through remote sensing used to map vegetation, and thus may be under mapped.

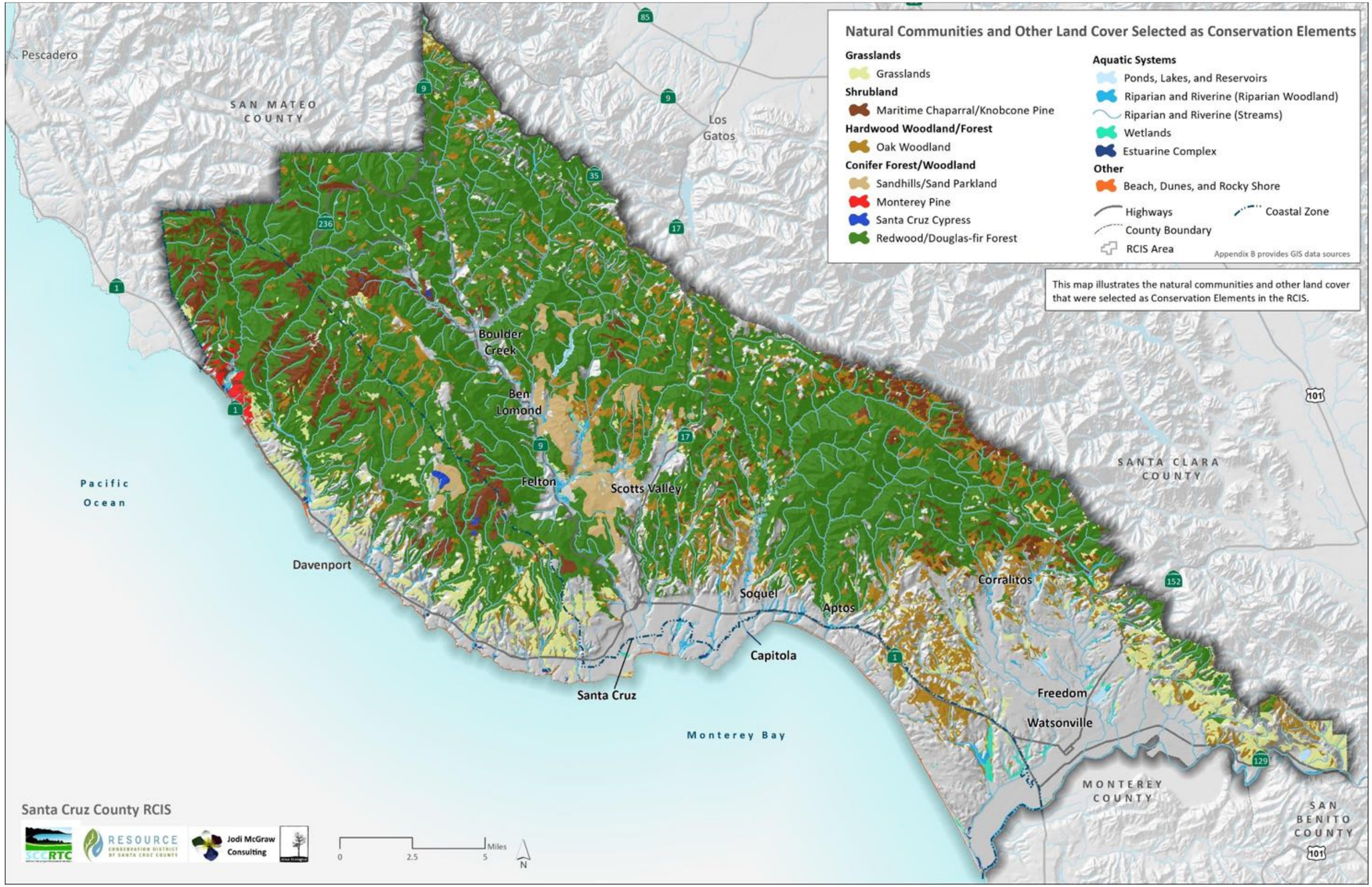

Figure 3-1: Natural Community-Based Conservation Elements

Rock outcroppings, which are important habitat features for a variety of species including bryophytes, lichens, rare plants, and animals such as bats, were addressed as part of the strategies for the various terrestrial communities that they occur within (e.g., maritime chaparral and knobcone pine forest and Santa Cruz cypress forest). This approach recognizes that their protection, management, and other conservation efforts will most oftentimes be applied to the more widespread community (rather than the rock outcroppings themselves).

3.5 Focal Species

This RCIS addresses seven focal species (Table 3-3), which were the subject of focused analysis per the RCIS guidelines (CDFW 2018). As outlined in Section 3.2 and illustrated in Table 3-1, the focal species were selected from the database of 193 rare, non-marine species that was compiled for the RCIS Area (Appendix F), based on the following criteria:

1. **State-listed species:** all but two of the focal species are listed under CESA;
2. **Community Representation:** the focal species collectively utilize from a range of aquatic and terrestrial natural community types;
3. **Taxonomic Representation:** the focal species collectively represent the following groups: plants, invertebrates, fish, amphibians, reptiles, birds, and mammals.
4. **Other RCIS Requirements**: the focal species include climate-vulnerable species and wide-ranging species.

As described in Section 3.2, the focal species in this RCIS were chosen to complement the natural community conservation elements and other conservation elements (Habitat Connectivity, Working Lands, and Bat Habitat) to create a comprehensive and cohesive conservation strategy for the region. In this approach, the 13 natural communities and three other conservation elements provide for conservation of many rare as well as common species and the habitats on which they rely.

Table 3-3: Focal species of this RCIS

Species	Special Status[1]	Primary Community Conservation Element(s)[2]	Other Selection Criteria
Santa Cruz tarplant (*Holocarpha macradenia*)	FT, SE, CRPR 1B.1	Grassland	Plant
Zayante band-winged grasshopper (*Trimerotropis infantilis*)	FE	Sandhills and Sand Parkland	Invertebrate; climate vulnerable species
coho salmon (*Oncorhynchus kisutch*)	FE, SE	Bar-Built Estuary; Riparian and Riverine	Fish; climate vulnerable species

Species	Special Status[1]	Primary Community Conservation Element(s)[2]	Other Selection Criteria
Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*)	FE, SE, FP	Ponds, Lakes, and Reservoirs; Oak Woodland and Forest	Amphibian; climate vulnerable species
Southwestern pond turtle (*Actinemys pallida*)	SSC	Riparian and Riverine; Ponds, Lakes and Reservoirs; Grassland	Reptile; climate vulnerable species
marbled murrelet (*Brachyramphus marmoratus*)	FT, SE	Redwood and Douglas-Fir Forest	Bird
mountain lion (*Puma concolor*)	SC	Most Communities	Mammal; wide-ranging species

[1] Status Designations

FE: Federally Endangered. In danger of becoming extinct in all or a significant portion of their range

FT: Federally Threatened. Likely to become endangered in the foreseeable future in the absence of special protection

SE: State Endangered. Native California taxa, which are in serious danger of becoming extinct throughout all or a significant portion of their range.

ST: State Threatened. Native California taxa, which although not presently threatened with extinction, likely to become Endangered in the foreseeable future, in the absence of special protection and management efforts.

FP: Fully Protected under the California Fish and Game Code

SC: State Candidate. State Candidate for listing as Endangered, Threatened, or Rare

SSC: Species of Special Concern in California [used for animals only]

CRPR 1B.1: Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California

[2] Identifies the community conservation element(s) with which the species is most commonly associated. Table 5-2 identifies all of the conservation elements with which each focal and non-focal species is associated.

3.6 Non-Focal Species

The conservation strategies in this RCIS for natural communities, other conservation elements, and focal species are also anticipated to benefit directly and/or indirectly 30 state and/or federally listed species (including de-listed species) in the RCIS Area (Table 3-4), as well as monarch butterfly, which is a candidate for federal listing. Due to the number of rare species within the RCIS Area, non-focal species were identified based upon the following criteria: 1) listed under the ESA, CESA or state Fully Protected statues;2) conservation needs will generally be met through actions for natural communities, focal species, or other conservation elements;

and 3) the species typically requires compensatory mitigation for impacts to critical habitat, degradation or loss of occupied habitat, and/or incidental take.

Table 5-2 identifies the RCIS conservation elements (natural communities, focal species, and other conservation elements) with which the non-focal species are associated and their key ecological attributes. Additionally, the conservations strategies for conservation elements list the non-focal (as well as focal) species that will benefit from the overall strategy as well as individual actions. This allows mitigation credits to be generated for non-focal species through implementation of conservation actions with which they are associated.

Table 3-4: Non-focal species of this RCIS

Species	Special Status[1]	Primary Associated Community Conservation Elements[2]
Plants		
Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*)	FE, CRPR 1B.1	Sandhills and Sand Parkland
Monterey spineflower (*Chorizanthe pungens* var. *pungens*)	FT, CRPR 1B.2	Maritime Chaparral and Knobcone Pine
Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*)	FE, CRPR 1B.1	Grassland
robust spineflower (*Chorizanthe robusta* var. *robusta*)	FE, CRPR 1B.1	Oak Woodland and Forest; Grassland; Maritime Chaparral and Knobcone Pine
Santa Cruz wallflower (*Erysimum teretifolium*)	FE, SE, CRPR 1B.1	Sandhills and Sand Parkland
Santa Cruz cypress (*Hesperocyparis abramsiana* var. *abramsiana*)	FT, SE, CRPR 1B.2	Santa Cruz Cypress Forest
white-rayed pentachaeta (*Pentachaeta bellidiflora*)	FE, SE, CRPR 1B.1	Grassland
San Francisco popcornflower (*Plagiobothrys diffusus*)	SE, CRPR 1B.1	Grassland
Scotts Valley polygonum (*Polygonum hickmanii*)	FE, SE, CRPR 1B.1	Grassland
Pacific Grove clover (*Trifolium polyodon*)	SR, CRPR 1B.1	Grassland
Invertebrates		
Monarch butterfly (*Danaus plexippus*)	FC	Redwood and Douglas-Fir Forest; Monterey Pine Forest

Species	Special Status[1]	Primary Associated Community Conservation Elements[2]
western bumble bee (*Bombus occidentalis*)	SC	Grassland
Ohlone tiger beetle (*Cicindela ohlone*)	FE	Grassland
Mount Hermon June beetle (*Polyphylla barbata*)	FE	Sandhills and Sand Parkland
Fish		
Tidewater goby (*Eucyclogobius newberryi*)	FE, SSC	Bar-Built Estuary; Riparian and Riverine
steelhead – central California coast DPS (*Oncorhynchus mykiss irideus*)	FT	Bar-Built Estuary; Riparian and Riverine
steelhead – south-central California coast DPS (*Oncorhynchus mykiss irideus*)	FT	Bar-Built Estuary; Riparian and Riverine
Amphibians		
California tiger salamander (*Ambystoma californiense*)	FT, ST	Ponds, Lakes, and Reservoirs; Grassland
Foothill yellow-legged frog (*Rana boylii*)	ST, SSC	Riparian and Riverine
California red-legged frog (*Rana draytonii*)	FT, SSC	Riparian and Riverine; Ponds, Lakes, and Reservoirs
Reptile		
San Francisco garter snake (*Thamnophis sirtalis tetrataenia*)	FE, SE, FP	Ponds, Lakes, and Reservoirs; Grassland; Bar-built Estuaries; Riparian and Riverine
Birds		
Tricolored blackbird (*Agelaius tricolor*)	ST, SSC	Ponds, Lakes, and Reservoirs; Freshwater Wetlands
Golden eagle (*Aquila chrysaetos*)	FP	Grassland
Swainson's hawk (*Buteo swainsoni*)	ST	Working Lands (Cultivated)
Western snowy plover (*Charadrius nivosus nivosus*)	FT, SSC	Beaches, Dunes, and Rocky Cliffs
White-tailed kite (*Elanus leucurus*)	FP	Grassland

Species	Special Status[1]	Primary Associated Community Conservation Elements[2]
American peregrine falcon (*Falco peregrinus anatum*)	FD, SD, FP	Beaches, Dunes, and Rocky Cliffs
Bald eagle (*Haliaeetus leucocephalus*)	FD, SE, FP	Ponds, Lakes, and Reservoirs
California brown pelican (*Pelecanus occidentalis californicus*)	FD, SD, FP	Beaches, Dunes, and Rocky Cliffs
Mammal		
ringed-tailed cat (*Bassariscus astutus*)	FP	Riparian and Riverine

[1] Status Designations

FE: Federally Endangered. In danger of becoming extinct in all or a significant portion of their range

FT: Federally Threatened. Likely to become endangered in the foreseeable future in the absence of special protection

FD: Federally Delisted. Previously on the federal Endangered Species Act but removed

FP: Fully Protected under the California Fish and Game Code Sections 3511, 4700, 5050 and 5515

FC: Federal candidate for listing under ESA

SE: State Endangered. Native California taxa, which are in serious danger of becoming extinct throughout all or a significant portion of their range.

ST: State Threatened. Native California taxa, which although not presently threatened with extinction, likely to become Endangered in the foreseeable future, in the absence of special protection and management efforts.

SC: State Candidate. State Candidate for listing as Endangered, Threatened, or Rare

SD: State Delisted. Previously on the California Endangered Species Act but removed

SSC: Species of Special Concern in California [used for animals only]

CRPR 1B.1: Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California

CRPR 1B.2: Plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California

[2] Identifies the community conservation element(s) with which the species is most commonly associated. Table 5-2 identifies all of the conservation elements with which each focal and non-focal species is associated.

3.7 Co-Benefited Species

An additional 156 rare species in the RCIS Area, which are not listed under ESA or CESA, are anticipated to also benefit from the conservation strategies developed for natural communities, other conservation elements, and focal species in this RCIS (Table 3-5).

Table 3-5: Co-benefited species anticipated to benefit from the conservation strategies

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Plants		
Blasdale's Bent Grass (*Agrostis blasdalei*)	CRPR 1B.2	Grassland
Bent-flowered fiddleneck (*Amsinckia lunaris*)	CRPR 1B.2	Grassland
slender silver moss (*Anomobryum julaceum*)	CRPR 4.2	Oak Woodland and Forest; Redwood and Douglas-Fir Forest
coast rockcress (*Arabis blepharophylla*)	CRPR 4.3	Grassland
Santa Cruz manzanita (*Arctostaphylos andersonii*)	CRPR 1B.2	Maritime Chaparral and Knobcone Pine Forest
Schreiber's manzanita (*Arctostaphylos glutinosa*)	CRPR 1B.2	Maritime Chaparral and Knobcone Pine Forest
Hooker's manzanita (*Arctostaphylos hookeri* ssp. *hookeri*)	CRPR 1B.2	Maritime Chaparral and Knobcone Pine Forest
Ohlone manzanita (*Arctostaphylos ohloneana*)	CRPR 1B.1	Maritime Chaparral and Knobcone Pine Forest
sandhills beachwort (*Artemisia pycnocephala* (sandhills ecotype)		Sandhills and Sand Parkland
Brewer's calandrinia (*Calandrinia breweri*)	CRPR 4.2	Maritime Chaparral and Knobcone Pine Forest
pink star-tulip (*Calochortus uniflorus*)	CRPR 4.2	Grassland
Santa Cruz Mountain pussypaws (*Calyptridium parryi* var. *hesseae*)	CRPR 1B.1	Maritime Chaparral and Knobcone Pine Forest
swamp harebell (*Campanula californica*)	CRPR 1B.2	Freshwater Wetland
Bristly Sedge (*Carex comosa*)	CRPR 2B.1	Freshwater Wetland
deceiving sedge (*Carex saliniformis*)	CRPR 1B.2	Freshwater Wetland
johnny-nip (*Castilleja ambigua* var. *ambigua*)	CRPR 4.2	Grassland
banded owl's clover (*Castilleja exserta* ssp. *latifolia*)		Grassland; Beaches, Dunes, and Rocky Cliffs

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Monterey Coast paintbrush (*Castilleja latifolia*)	CRPR 4.3	Beaches, Dunes, and Rocky Cliffs
Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*)	CRPR 1B.1	Grassland
Bolander's water hemlock (*Cicuta maculata* var. *bolanderi*)	CRPR 2B.1	Freshwater Wetland
purple godetia (*Clarkia purpurea* ssp. *purpurea*)		Grassland
San Francisco collinsia (*Collinsia multicolor*)	CRPR 1B.2	Oak Woodland and Forest
tear drop moss (*Dacryophyllum falcifolium*)	CRPR 1B.3	Redwood and Douglas-Fir Forest
Palmer's live forever (*Dudleya palmeri* (local form)		Sandhills and Sand Parkland
California bottle-brush grass (*Elymus californicus*)	CRPR 4.3	Oak Woodland and Forest; Riparian and Riverine; Redwood and Douglas-Fir Forest
Watsonville buckwheat (*Eriogonum nudum* var. *alterans*)		Grassland
Ben Lomond buckwheat (*Eriogonum nudum* var. *decurrens*)	CRPR 1B.1	Sandhills and Sand Parkland
Coast wallflower (*Erysimum ammophilum*)	CRPR 1B.2	Beaches, Dunes, and Rocky Cliffs
coarse-leaved wallflower (*Erysimum franciscanum* var. *crassifolium*)		Beaches, Dunes, and Rocky Cliffs
sandhills poppy (*Eschscholzia californica* ssp. *nov*.)		Sandhills and Sand Parkland
minute pocket moss (*Fissidens pauperculus*)	CRPR 1B.2	Redwood and Douglas-Fir Forest
Gilia longituba (SLV form) (*Gilia longituba*)		Grassland
Toren's grimmia (*Grimmia torenii*)	CRPR 1B.3	Karst Formations

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
vaginulate grimmia (*Grimmia vaginulata*)	CRPR 1B.1	Maritime Chaparral and Knobcone Pine Forest
short-leaved evax (*Hesperevax sparsiflora* var. *brevifolia*)	CRPR 1B.2	Beaches, Dunes, and Rocky Cliffs
Point Reyes horkelia (*Horkelia marinensis*)	CRPR 1B.2	Grassland
harlequin lotus (*Hosackia gracilis*)	CRPR 4.2	Grassland
coast iris (*Iris longipetala*)	CRPR 4.2	Grassland; Wetland; Riparian and Riverine
perennial goldfields (*Lasthenia californica* ssp. *macrantha*)	CRPR 1B.2	Grasslands
Dylan's linanthus (*Leptosiphon grandiflorus* ssp.)		Beaches, Dunes, and Rocky Cliffs; Grasslands
Small-leaved lomatium (*Lomatium parvifolium*)	CRPR 4.2	Maritime Chaparral and Knobcone Pine Forest
Arcuate bush mallow (*Malacothamnus arcuatus*)	CRPR 1B.2	Maritime Chaparral and Knobcone Pine Forest
Mt. Diablo cottonweed (*Micropus amphibolus*)	CRPR 3.2	Grassland; Oak Woodland and Forest
marsh microseris (*Microseris paludosa*)	CRPR 1B.2	Grassland
elongate copper moss (*Mielichhoferia elongata*)	CRPR 4.3	
Santa Cruz County monkeyflower (*Mimulus rattanii* ssp. *decurtatus*)	CRPR 4.2	Sandhills and Sand Parkland
Scotts Valley sandwort (*Minuartia californica* ssp. *nov*.)		Grassland
northern curly-leaved monardella (*Monardella sinuata* ssp. *nigrescens*)	CRPR 1B.2	Sandhills and Sand Parkland
woodland woollythreads (*Monolopia gracilens*)	CRPR 1B.2	Maritime Chaparral and Knobcone Pine Forest
Kellman's Bristle Moss (*Orthotrichum kellmanii*)		Maritime Chaparral and Knobcone Pine Forest
Santa Cruz Mountains beardtongue (*Penstemon rattanii* var. *kleei*)	CRPR 1B.2	Oak Woodland and Forest; Redwood and Douglas-Fir Forest

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Gairdner's yampah (*Perideridia gairdneri* ssp. *gairdneri*)	CRPR 4.2	Grassland
Bentham's ponderosa pine (*Pinus ponderosa* ssp. *benthamiana*)		Sandhills and Sand Parkland
Monterey pine (*Pinus radiata*)	CRPR 1B.1	Monterey Pine Forest
white-flowered rein orchid (*Piperia candida*)	CRPR 1B.2	Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Michael's rein orchid (*Piperia michaelii*)	CRPR 4.2	Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Choris' popcornflower (*Plagiobothrys chorisianus* var. *chorisianus*)	CRPR 1B.2	Maritime Chaparral and Knobcone Pine Forest
Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*)	CRPR 4.2	Freshwater Wetland
sandhills everlasting (*Pseudognaphalium* sp. *nov*.)		Sandhills and Sand Parkland
annual alkali grass (*Puccinellia simplex*)	CRPR 1B.2	Freshwater Wetland
Lobb's aquatic buttercup (*Ranunculus lobbii*)	CRPR 4.2	Ponds, Lakes, and Reservoirs; Wetland
California beaked-rush (*Rhynchospora californica*)	CRPR 1B.1	Freshwater Wetland
Hoffmann's sanicle (*Sanicula hoffmannii*)	CRPR 4.3	Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Chaparral ragwort (*Senecio aphanactis*)	CRPR 2B.2	Maritime Chaparral and Knobcone Pine Forest
Maple-leaved checkerbloom (*Sidalcea malachroides*)	CRPR 4.2	Oak Woodland and Forest
San Francisco campion (*Silene verecunda* ssp. *verecunda*)	CRPR 1B.2	Grassland; Maritime Chaparral and Knobcone Pine Forest
Santa Cruz microseris (*Stebbinsoseris decipiens*)	CRPR 1B.2	Grassland
marsh zigadenus	CRPR 4.2	Grassland

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
(*Toxicoscordion fontanum*)		
dwarf star lily (*Toxicoscordion fremontii* var. *minor*)		Grassland
Santa Cruz clover (*Trifolium buckwestiorum*)	CRPR 1B.1	Grassland
coast bouquet clover (*Trifolium grayi* ssp. 3)		Grassland
Scotts Valley bouquet clover (*Trifolium grayi* ssp. *nov*. 1)		Grassland
San Lorenzo Valley bouquet clover (*Trifolium grayi* ssp. *nov.* 2)		Grassland
Saline clover (*Trifolium hydrophilum*)	CRPR 1B.2	Freshwater Wetland
Methuselah's beard lichen (*Usnea longissima*)	CRPR 4.2	Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Invertebrates		
Opler's longhorn moth (*Adela oplerella*)		Grassland
California floater clam (*Anodonta californiensis*)		Riparian and Riverine; Ponds, Lakes, and Reservoirs
Obscure Bumble Bee (*Bombus caliginosus*)		Grasslands
Undescribed aquatic cave isopod (*Calasellu* ssp. *nov*.)		Karst Caves
sandy beach tiger beetle (*Cicindela hirticollis gravida*)		Beaches, Dunes, and Rocky Cliffs
undescribed fulgoroid roothopper (*Cixius* sp. *nov*.)		Karst Caves
globose dune beetle (*Coelus globosus*)		Beaches, Dunes, and Rocky Cliffs
Empire Cave pseudoscorpion (*Fissilicreagris imperialis*)		Karst Caves
sandhills melittid bee (*Hesperapis* sp. *nov*.)		Sandhills and Sand Parkland
California fairy shrimp (*Linderiella occidentalis*)		Ponds, Lakes, and Reservoirs

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Moestan blister beetle (*Lytta moesta*)		Grasslands
Dolloff Cave spider (*Meta dolloff*)		Karst Caves
sandhills metopia (*Metopia* sp. *nov*.)		Sandhills and Sand Parkland
Empire Cave neochthonius (*Neochthonius imperialis*)		Karst Caves
sandhills scorpion (*Peroctinous* sp. *nov*.)		Sandhills and Sand Parkland
Antioch sphecid wasp (*Philanthus nasalis*)		Sandhills and Sand Parkland
Santa Cruz rainbeetle (*Pleocoma conjugens*)		Sandhills and Sand Parkland
sandhills flesh-fly (*Senotaenia* sp. *nov*.)		Sandhills and Sand Parkland
Unsilvered fritillary butterfly (*Speyeria adiaste adiaste*)		Oak Woodland and Forest; Redwood and Douglas-Fir Forest
sandhills Jerusalem cricket (*Stenopelmatus* sp. *nov*.)		Sandhills and Sand Parkland
sandhills robberfly (*Stenopogon* sp. *nov*.)		Sandhills and Sand Parkland
Mackenzie's cave amphipod (*Stygobromus mackenziei*)		Karst Caves
California brackishwater snail (*Tryonia imitator*)		Karst Caves
Santa Cruz teleman spider (*Telema* sp. *nov*.)		Karst Caves
Fish		
Sacramento sucker (*Catostomus occidentalis*)		Riparian and Riverine
Pacific lamprey (*Entosphenus tridentatus*)	SSC	Riparian and Riverine
resident (threespine) stickleback (*Gasterosteus aculeatus*)		Riparian and Riverine

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Monterey hitch (*Lavinia exilicauda harengeus*)	SSC	Riparian and Riverine; Ponds, Lakes, and Reservoirs
Monterey roach (*Lavinia symmetricus subditus*)	SSC	Riparian and Riverine
speckled dace (*Rhinichthys osculus*)		Riparian and Riverine
Amphibians		
Santa Cruz black salamander (*Aneides niger*)	SSC	Grassland; Oak woodland and Forest; Redwood and Douglas-Fir Forest
California giant salamander (*Dicamptodon ensatus*)	SSC	Riparian and Riverine; Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Rough-skinned newt (*Taricha granulosa*)		Ponds, Lakes, and Reservoirs; Riparian and Riverine; Grassland; Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Reptiles		
northern California legless lizard (*Anniella pulchra*)	SSC	Beaches, Dunes, and Rocky Cliffs
California whiptail (*Aspidoscelis tigris munda*)		Sandhills and Sand Parkland
California nightsnake (*Hypsiglena ochrorhynchus nuchalata*)		Sandhills and Sand Parkland
California mountain kingsnake (*Lampropeltis zonata*)		Sandhills and Sand Parkland
Blainville's horned lizard (*Phrynosoma blainvillii*)	SSC	Sandhills and Sand Parkland
Birds		
Cooper's hawk (*Accipiter cooperii*)		Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Sharp-shinned hawk (*Accipiter striatus*)		Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Grasshopper sparrow (*Ammodramus savannarum*)	SSC	Grassland

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Great Egret (*Ardea alba*)		Freshwater Wetland
Great blue heron (*Ardea herodias*)		Freshwater Wetland; Ponds, Lakes, and Reservoirs
long-eared owl (*Asio otus*)	SSC	Oak Woodland and Forest; Oak Woodland and Forest; Redwood and Douglas-Fir Forest; Riparian and Riverine
Burrowing owl (*Athene cunicularia*)	SSC	Grassland
American bittern (*Botaurus lentiginosus*)		Freshwater Wetland
Ferruginous hawk (*Buteo regalis*)		Grassland
Vaux's Swift (*Chaetura vauxi*)	SSC	Redwood and Douglas-Fir Forest
Northern harrier (*Circus cyaneus*)	SSC	Grassland; Freshwater Wetland
Olive-sided Flycatcher (*Contopus cooperi*)	SSC	Sandhills and Sand Parkland, Redwood and Douglas-Fir Forest
yellow rail (*Coturnicops noveboracensis*)	SSC	Freshwater Wetland
black swift (*Cypseloides niger*)	SSC	Beaches, Dunes, and Rocky Cliffs
Snowy egret (*Egretta thula*)		Freshwater Wetland
California horned lark (*Eremophila alpestris actia*)		Grassland
Merlin (*Falco columbarius*)		Grassland
Prairie falcon (*Falco mexicanus*)		Grassland
Common Loon (*Gavia immer*)	SSC	Freshwater Wetland; Ponds, Lakes, and Reservoirs
Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)	SSC	Bar-Built Estuary; Ponds, Lakes, and Reservoirs; Wetland

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Loggerhead shrike (*Lanius ludovicianus*)	SSC	Maritime Chaparral and Knobcone Pine Forest
Black-crowned night heron (*Nycticorax nycticorax*)		Freshwater Wetland; Ponds, Lakes, and Reservoirs
Osprey (*Pandion haliaetus*)		Ponds, Lakes, and Reservoirs
American White Pelican (*Pelecanus erythrorhynchos*)	SSC	Freshwater Wetland; Ponds, Lakes, and Reservoirs
Double-crested cormorant (*Phalacrocorax auritus*)		Freshwater Wetland; Ponds, Lakes, and Reservoirs
White-faced Ibis (*Plegadis chihi*)		Freshwater Wetland; Ponds, Lakes, and Reservoirs
Purple martin (*Progne subis*)	SSC	Grasslands; Ponds, Lakes, and Reservoirs
Yellow Warbler (*Setophaga petechia*)	SSC	Riparian and Riverine
Elegant Tern (*Thalasseus elegans*)		Bar-Built Estuary; Beaches, Dunes, and Rocky Cliffs
Mammal		
Pallid bat (*Antrozous pallidus*)	SSC	Bat Habitat[3]; Oak Woodland and Forest; Redwood and Douglas-Fir Forest; Grassland
Townsend's big-eared bat (*Corynorhinus townsendii townsendii*)	SSC	Bat Habitat[3,] Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Santa Cruz kangaroo rat (*Dipodomys venustus venustus*)		Sandhills and Sand Parkland; Maritime Chaparral and Knobcone Pine Forest
Western mastiff bat (*Eumops perotis californicus*)	SSC	Bat Habitat; Grassland; Maritime Chaparral and Knobcone Pine Forest
Silver-haired bat (*Lasionycteris noctivagans*)		Bat Habitat; Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Western red bat (*Lasiurus blossevillii*)	SSC	Bat Habitat; Riparian and Riverine; Grasslands

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]
Hoary bat (*Lasiurus cinereus*)		Bat Habitat; Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Western small-footed myotis (*Myotis ciliolabrum*)		Bat Habitat[3]
Long-eared myotis (*Myotis evotis*)		Bat Habitat[3]
Fringed myotis (*Myotis thysanodes*)	SSC	Bat Habitat[3]
Long-legged myotis (*Myotis volans*)		Bat Habitat[3]
Yuma myotis (*Myotis yumanensis*)		Bat Habitat[3]
San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*)	SSC	Riparian and Riverine; Redwood and Douglas-Fir Forest; Maritime Chaparral and Knobcone Pine Forest; Grassland; Oak Woodland and Forest; Redwood and Douglas-Fir Forest
Monterey ornate shrew (*Sorex ornatus salarius*)	SSC	Wetland; Riparian and Riverine; Grassland
American badger (*Taxidea taxus*)	SSC	Grassland

[1] Status Designations

CRPR 1B.1: Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California

CRPR 1B.2: Plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California

CRPR 1B.3: Plants rare, threatened, or endangered in California and elsewhere; not very threatened in California

CRPR 2.1: Plants rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California

CRPR 2.2: Plants rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California

CRPR 2.3: Plants rare, threatened, or endangered in California, but more common elsewhere; not very threatened in California

CRPR 3.1: Plants about which we need more information; seriously threatened in California

CRPR 3.2: Plants about which we need more information; fairly threatened in California

Species	Special Status[1]	Primary Associated Community and Other Conservation Elements[2]

CRPR 3.3: Plants about which we need more information; not very threatened in California

CRPR 4.1: Plants of limited distribution; seriously threatened in California

CRPR 4.2: Plants of limited distribution; fairly threatened in California

CRPR 4.3: Plants of limited distribution; not very threatened in California

SSC: Species of Special Concern in California (applies only to animals only)

[2] Identifies the community conservation element(s) with which the species is most commonly associated. The species may benefit from conservation strategies for these or other conservation elements.

[3] Bats utilize a wide range of both aquatic and terrestrial communities, as well as specialized microhabitats including anthropogenic features (e.g., buildings and mines) during their life history, For this reason, Bat Habitat was designated as a separate conservation element in the RCIS. Bat Habitat is listed as the only *Primary Associated Community and Other Conservation Element* for bat species that are habitat generalists.

4 Pressures and Stressors

The conservation elements in the RCIS Area are influenced by a variety of pressures, both anthropogenic and natural, that create degraded ecological conditions known as stressors. This section describes the historic, current, and projected pressures and stressors to provide general background information about these factors influencing biodiversity and natural systems in the region.

The pressures and stressors were identified through review of the *State Wildlife Action Plan* (CDFW 2015) for the Bay Delta and Central Coast Province; the list presented therein was expanded and refined through review of additional literature, professional experience, and input from the RCIS technical advisors

The order of the pressures and stressors presented in the tables and discussion does not reflect their relative impact or importance in the RCIS Area. Rather, they are listed in order of the mechanisms by which they predominantly influence the natural systems (Section 4.1). Specifically, pressures and stressors from land uses (e.g., development, working lands, and mines/quarries) are listed first, followed by water use and other factors that degrade natural systems and threaten species populations. Although climate change is listed near the bottom, it is recognized as one of the largest threats to biodiversity in the RCIS Area and globally.

The pressures and stressors are summarized for aquatic systems (Table 4-1) and upland/terrestrial systems, bat habitat, habitat connectivity, and working lands (Table 4-2). In each table, check marks indicate the pressures and stressors that impact specific conservation elements. The 23 conservation strategies in Section 5.3 describe the unique pressures and stressors impacting each conservation element and identify actions to address them.

4.1 Overview of Mechanisms

The pressures and stressors discussed in this chapter threaten the conservation elements and other biological resources in the RCIS Area through three primary mechanisms:

1. **Habitat Loss**: Reduction of the areal extent of the natural community or species habitat in the RCIS Area, due to type conversion or other modification caused by a variety of factors including development, mining, and working lands.
2. **Habitat Fragmentation:** Reduction in the patch size and continuity of natural community and species habitat in the landscape due to habitat loss, which can cause remaining habitat to become isolated. Fragmentation results from habitat loss and habitat degradation.
3. **Habitat Degradation:** Reduction in the quality of the habitat for a species, loss of community structure and species composition or loss of critical ecological functions, due to a variety of anthropogenic factors (e.g., land and water use, exotic species, pollution, artificial light pollution, alteration of disturbance regimes, and unauthorized activities).

Table 4-1: Pressures and stressors affecting the aquatic conservation elements

Pressure	Stressors	Bar Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle
Development: Maintenance of Existing and Creation of New Residential and Commercial Development, as well as Transportation, Water, and other Infrastructure	Reduction in areal extent, complexity, and function of riparian and wetland habitats, which can reduce species distributions, populations, migration, and persistence.	✓	✓	✓	✓	✓	✓	✓
	Fragmentation of habitat due to habitat loss and human-created barriers (e.g., dams, culverts, transportation corridors, and other in-stream barriers; fences, structures, and other built environment elements), which can limit access to important habitat, dispersal, and migration, and obstruct metapopulation dynamics.	✓	✓	✓	✓	✓	✓	✓
	Degradation of habitat through: removal of large woody debris, sediment bars, and riparian vegetation to increase channel capacity and reduce roughness for flood risk reduction.	✓	✓	✓	✓	✓		✓
	Degradation of habitat due to pollution: input of fine sediment (see stresses below), sewage, nutrients, pesticides, and other contaminants; light pollution; and increased water temperature due to loss of vegetation canopy	✓	✓	✓	✓	✓	✓	✓
	Reduction in water quantity due to: water withdrawals (see specific stresses below); hydromodifications resulting from run-off patterns on impervious surfaces; direct fill of seeps, wetlands, and water bodies.	✓	✓	✓	✓	✓	✓	✓
	Disconnection of streams from their floodplains, causing: reduced groundwater recharge; and increased seawater intrusion, desiccation of floodplain wetlands; loss of winter refugia and rearing habitat for fish and other aquatic species; reduction of natural sediment and nutrient inputs; disruption of natural flood regimes that create and maintain stream and riparian complexity.	✓	✓	✓	✓	✓	✓	✓
	Channel straightening and channel bed/banks armoring for flood control that reduce instream habitat complexity and heterogeneity	✓	✓	✓	✓	✓	✓	✓
	Hydrologic impacts and degradation due to impervious surfaces which increase erosion potential during high flow, reduced summer base flows, and degrade water quality through pollutants in run off.	✓	✓	✓	✓	✓	✓	✓
	Degradation of habitat through introduction of exotic species (see specific stresses below)	✓	✓	✓	✓	✓	✓	✓
Working Lands	Removal of aquatic and riparian communities, which reduces, fragments, and degrades habitat, thus reducing species populations	✓	✓	✓	✓	✓	✓	✓
	Habitat fragmentation and reduced landscape permeability through habitat conversion, culverting of streams, installation of fences, and associated human activities	✓	✓	✓	✓	✓	✓	✓
	Introduction of effluents, including runoff, fine sediment from chronic erosion (as outlined in stresses below), pesticides, pathogens, pollutants, noise, and light	✓	✓	✓	✓	✓	✓	✓
	Stream channel modifications (straightening, realignment) that reduce stream length, increase channel slopes, increase stream energy, and result in loss of habitat complexity and connectivity to adjacent habitats.	✓	✓	✓	✓	✓	✓	✓
	Elimination or reduction of riparian vegetation and loss of large woody debris which is essential for aquatic habitat conditions (nutrient inputs, temperature regulation, hydrologic regimes, stream bank protection, habitat structure and complexity, etc.).	✓	✓	✓	✓	✓	✓	✓
	Introduction of exotic plants and animals	✓	✓	✓	✓	✓	✓	✓
Mining and Quarrying	Removal of natural communities, which can reduce, fragment, or degrade habitat		✓	✓	✓	✓	✓	✓
	Creation of pollution from noise, light, dust, and stormwater, including fine sediments and turbidity, that can affect species and communities		✓	✓	✓	✓	✓	✓
	Introduction of exotic species (specific stresses are described below)		✓	✓	✓	✓	✓	✓
Water use (diversions, pumping, storage, and return flows)	Habitat loss, due to reduced areal extent of wetted area, critically shallow riffles and pools, and loss of wetland and riparian vegetation due to groundwater depletion		✓		✓	✓	✓	✓
	Habitat fragmentation due to habitat loss, which isolates pools during the low flows, and fragments riparian and wetland habitat	✓	✓	✓	✓	✓	✓	✓

Pressure	Stressors	Bar Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle
	Degradation of aquatic habitat including: increased salinity and stratification, increased water temperatures, elevated risk of algal blooms, creation of oxygen-deficient conditions, and reduction of aquatic macroinvertebrates.	✓	✓	✓	✓	✓	✓	✓
	Invasion and spread of exotic animals (e.g., carp, mosquito fish, bass, and American bullfrog) that out-compete native animals and thrive in non-natural, perennial aquatic features including ponds, lakes, streams, wetlands, and reservoirs created as part of water use projects.	✓	✓	✓	✓	✓	✓	✓
Increase Supply of Fine Sediment	Habitat loss due to reduced hydrologic capacity of water bodies (streams, ponds, lakes, and reservoirs) as well as freshwater wetlands	✓	✓	✓	✓	✓	✓	✓
	Degradation of stream habitat for foraging, through increased turbidity and reduction in benthic macroinvertebrates, loss of coarse substrate (e.g., cobbles) for spawning, and filling of pools that provide refugia	✓	✓	✓	✓	✓	✓	✓
Exotic Plants	Degradation of habitat by outcompeting native plants, including rare plants; reducing habitat diversity and complexity; altering community structure and species composition; killing trees, which increases water temperature, reduces nutrient inputs, and increases predation risk; reducing hydrology through increased water demand; altering water chemistry including dissolved oxygen and nutrients.	✓	✓	✓	✓	✓	✓	✓
	Promote fire outside of the natural regime (i.e., increased intensity, frequency, severity, or altered type) by increasing fuels		✓		✓	✓	✓	✓
Exotic/Domestic Animals	Prey upon native plants and animals; outcompete native animals; and modify food webs	✓	✓	✓	✓	✓	✓	✓
Incompatible Recreation	Tramples species or alters their key habitat features (e.g., stream banks, burrows, redds, breach sandbars)	✓	✓	✓	✓	✓	✓	✓
	Deters use of habitat by species wary of humans (due to noise, scent, etc.)	✓	✓	✓	✓	✓	✓	✓
	Promotes invasion and spread of exotic plants and animals	✓	✓	✓	✓	✓	✓	✓
	Disturbs soil and causes erosion, which can lead to sediment deposition that reduces water quality and degrades habitat	✓	✓	✓	✓	✓	✓	✓
	Spreads disease	✓	✓	✓	✓	✓	✓	✓
	Pollutes water (e.g., with trash, petroleum products, etc.)	✓	✓	✓	✓	✓	✓	✓
	Harasses native animals directly (e.g., through fishing)	✓	✓	✓	✓	✓	✓	✓
Unauthorized Activities (e.g., camping, cannabis cultivation, dumping and breaching)	Removes established native plants and alters plant community structure and species composition	✓	✓	✓	✓	✓	✓	✓
	Pollutes land and water (e.g., with trash, pesticides, etc.)	✓	✓	✓	✓	✓	✓	✓
	Reduces water levels (i.e., as a result of unauthorized diversions and consumption)	✓	✓	✓	✓	✓	✓	✓
	Ignites wildfires that can degrade habitat	✓	✓	✓	✓	✓	✓	✓
	Reduces animal populations through poaching and illegal fishing	✓	✓	✓	✓	✓	✓	✓
	Impacts water quality, creates unnatural timing and magnitude of breaching events, temporarily fragments habitat through rapid draining of inundated marsh plains	✓	✓		✓	✓		✓
	Promotes populations of human commensal species (e.g., rats and corvids) that prey upon other native species)	✓	✓	✓	✓		✓	✓
Climate Change	Altered hydrology through more frequent and extended droughts and higher intensity rainfall and runoff events	✓	✓	✓	✓	✓	✓	✓
	Altered riparian and wetland vegetation, through anticipated increases in temperature and drought, and reduction in summer fog, which can degrade aquatic habitat for animals	✓	✓	✓	✓	✓	✓	✓
	Degrade water quality by increasing temperature, which increases metabolic demand of aquatic species and reduces dissolved oxygen content	✓	✓	✓	✓	✓	✓	✓
	Altered disturbance regimes, by increasing the frequency, intensity, and severity of fire or altering the fire behavior – in turn impacting structure and composition of vegetation.	✓	✓	✓	✓	✓	✓	✓
Loss of Genetic Diversity	Loss of genetic diversity due to population bottlenecks and fragmentation, which limits interbreeding among distantly related individuals.					✓	✓	✓

Table 4-2: Pressures and stressors affecting the terrestrial conservation elements

Pressure	Stressors	Grasslands	Maritime Chaparral Knobcone Pine Forest	Sandhills and Sand Parkland	Santa Cruz Cypress Forest	Monterey Pine Forest	Oak Woodland and Forest	Redwood and Douglas-Fir Forest	Beach, Dunes, and Rocky Cliffs	Karst Caves	Santa Cruz Tarplant	Mount Hermon June Beetle	Marbled Murrelet	Mountain Lion	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Bat Habitat	Habitat Connectivity	Working Lands
Development-Maintenance of Existing and Construction of New Residential, Commercial, Transportation, and other Infrastructure	Reduction in the areal extent of habitat, which can reduce species distributions, populations, and persistence	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Fragmentation of habitat, by removing habitat, creating barriers (e.g., buildings, transportation, and fences), which reduces connectivity and permeability of the landscape to movement by species and ecological processes (e.g., fire)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Degradation of habitat due to: exotic (incl. domestic) species; noise, light, and air pollution; pesticides; runoff; altered disturbance regime (e.g., fire exclusion and flood control); other human activities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Working Lands	Removal (i.e., type conversion) of natural communities, which reduces, fragments, and degrades habitat, thus reducing species populations	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	
	Alteration of community structure and species composition due to grazing and selective harvest, which changes abiotic and biotic habitat	✓					✓	✓			✓		✓	✓	✓	✓	✓	✓	
	Fragmentation and reduced landscape permeability through including through fences and human activities	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	
	Introduction of effluents, including runoff, pesticides, pollutants, noise, and light	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Introduction of exotic plants and animals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Mining and Quarrying	Removal of natural communities, which can reduce, fragment, or degrade habitat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Creation of pollution to noise, light, and air that can affect species and communities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Introduction of exotic species (see specific stresses below)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Altered Disturbance Regimes	Exclusion of fire, which can inhibit fire-adapted species (e.g., fire followers) and cause unnatural succession that eliminates, fragments, and degrades habitat earlier successional species	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓	✓	✓	✓	✓
	Increase the size, intensity, and severity of fires, and alter the fire type (e.g., canopy rather than ground fire), impacting species and altering post-fire community structure and species composition	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Reduction/elimination of native ungulate grazing mammals, resulting in shrub encroachment and thatch buildup	✓									✓				✓	✓		✓	
Unauthorized Uses (e.g., illegal camping, illegal cannabis	Removes established native plants and alters plant community structure and species composition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Pollutes land and water (e.g., with trash, pesticides, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 4-2: Pressures and stressors affecting the terrestrial conservation elements

Pressure	Stressors	Grasslands	Maritime Chaparral Knobcone Pine Forest	Sandhills and Sand Parkland	Santa Cruz Cypress Forest	Monterey Pine Forest	Oak Woodland and Forest	Redwood and Douglas-Fir Forest	Beach, Dunes, and Rocky Cliffs	Karst Caves	Santa Cruz Tarplant	Mount Hermon June Beetle	Marbled Murrelet	Mountain Lion	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Bat Habitat	Habitat Connectivity	Working Lands
cultivation, and illegal dumping)	Reduces water levels (i.e., as a result of unauthorized diversions and consumption)									✓					✓	✓	✓		✓
	Ignites wildfires that can degrade habitat	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
	Reduces animal populations through poaching and illegal fishing								✓					✓		✓	✓		
	Promotes populations of human commensal species (e.g., rats and corvids) that prey upon other native species)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Incompatible Recreation	Tramples species and their key habitat features (e.g., burrows)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	Deters use of habitat by species wary of humans (due to noise, scent, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
	Promotes invasion and spread of exotic plants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	Disturbs soil and causes erosion	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	Spreads disease	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Exotic Plants	Outcompete native plants, reducing rare plant populations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	Degrade habitat for native animals by reducing populations of palatable plants and altering community structure and species composition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Increase soil nutrients (e.g., nitrogen), promoting further invasions and altering community structure and species composition	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Promote fire outside of the natural regime (i.e., increased intensity, frequency, severity, or altered type) by increasing fuels	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Exotic Animals (incl. domestic animals)	Prey upon native plants and animals; outcompete native animals	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
	Spread disease	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Deter animal use through presence (incl. scent)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Climate Change	Directly reduce suitability of habitat by affecting temperature and precipitation regimes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Change abiotic habitat conditions including surface and ground water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Modify the structure and species composition of communities which can reduce, fragment, or degrade habitat	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Alter disturbance regimes, by increasing the frequency, intensity, and severity of fire or altering the fire type, and changing flood regimes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Loss of Genetic Diversity	Loss of genetic diversity due to population bottlenecks and habitat fragmentation, which limits interbreeding among more distantly related individuals.											✓		✓	✓				

In addition, **climate change**, or alteration of the climate (i.e., temperature, precipitation, wind, fog, etc.) due to anthropogenic greenhouse gas emissions, can result in the widespread loss, fragmentation, and degradation of habitat. Habitat loss, fragmentation, degradation, climate change, can interact to threaten habitat connectivity which, in turn, impacts the other conservation elements.

Reductions in population size and fragmentation of populations can cause species to go through genetic bottlenecks that **reduce genetic diversity**. These declines in genetic diversity also constitute pressures, as they can increase susceptibility of populations to disease and reduce their ability to adapt to changing conditions in ways that can reduce their long-term persistence.

4.2 Development

The RCIS Area is subject to various development activities including the construction, maintenance, and use of: residential and commercial development and infrastructure for water, energy, transportation, and related public services. Such development converts habitat directly, fragments remaining habitat, and often degrades adjacent habitat as a result of intensified human activities that lead to pollution, introduction of invasive species, and changes in sound, light, and other environmental variables. These impacts can be associated with new development and ongoing use and maintenance of existing development and infrastructure.

Most new development and operations and maintenance of public infrastructure are subject to local, state, and federal regulations to protect sensitive biological resources that reduce the pressures and stressors. However, some ongoing improvements to existing developed lands are not subject to environmental protection measures and mitigations. Section 2.2 describes the current land uses including development and planned future development and infrastructure improvements in the RCIS Area. Tables 4-1 and 4-2 identify some of the primary stressors to the conservation elements and other natural systems caused by development-related activities.

4.3 Working Lands

Although working lands are a conservation element addressed in this RCIS (Section 3.4), cultivated agriculture, timber harvest, and livestock grazing can also constitute a pressure for some of the natural communities and focal species addressed in this RCIS. If and how working lands present stresses depends on the location and type of land use and management actions (Tables 4-1 and 4-2). Cattle grazing can help maintain coastal terrace prairie and other grassland habitat and; in the absence of recurring fire, livestock grazing can also help prevent shrub encroachment and thus type conversion of much of the grassland habitat in the RCIS Area, which is essential for foraging raptors and a high percentage of the county's rare plants. Grazing is also essential to maintaining populations of some special-status species, including Santa Cruz tarplant and Ohlone tiger beetle. Nonetheless, overgrazing can also degrade habitat for some species, by promoting the invasion and spread of exotic plants, affecting hydrologic and erosional processes, and affecting water quality in streams and ponds.

Economically viable timber harvests help maintain redwood forest habitat in the RCIS Area, which might otherwise be subject to rural residential development. Selective timber harvest, as practiced in the Santa Cruz Mountains region, reduces tree density and, in doing so, can help re-create natural community structure and species composition in redwood forests that were historically clear cut around the turn of the 20th century (O'Hara et al. 2010, Plummer et al. 2012). Nonetheless, timber harvest, like any disturbance, can degrade habitat for some species, by altering plant community structure and species composition, including by promoting the invasion and spread of exotic species through road construction and equipment that has not be adequately decontaminated; timber harvest and associated road construction can also influence both hydrologic and sediment delivery processes, thereby reducing habitat quality and water quality in aquatic systems with specific water quality BMPs are not installed and monitored for effectiveness. Historic timber harvest activities have resulted in reduced recruitment of large woody debris into streams, which degrades riverine and associated riparian habitat by simplifying the channel structure, disconnecting streams from floodplains, reducing sediment and nutrient retention capacity, disrupting hydrologic processes, and reducing cover for aquatic organisms. It is important to note that California Forest Practice Rules (section 14 CCR 916.9) have specific, legally required, local practices for Santa Cruz County and these are arguably the most restrictive and protective in North America. Moreover, the Forest Practice Rules specifically require retention of the largest trees along watercourses, explicitly to maximize future the recruitment of large woody debris by retaining trees that are most likely to fall into stream channels.

Cultivated agriculture can benefit certain species that utilize aspects of cultivated land (e.g., tricolored blackbirds, pollinators), and through implementing management practices that steward the soil and water, cultivated agriculture can provide critically important ecosystem services like carbon sequestration, improved soil microbe diversity, and water treatment and infiltration. Economically viable agriculture helps maintain open space in the RCIS Area, preventing conversion to other developed land uses. However, it generally negatively impacts biological systems by converting and fragmenting habitat and in some cases blocking migrations/movement corridors. Activities associated with food production can also degrade adjacent habitat through a variety of mechanisms as outlined in Tables 4-1 and 4-2. The cultivation of cannabis can have similar impacts to other cultivated crops. Illegal operations conducted without local land use permits and associated protections and mitigations (Section 4.9) can remove, degrade, and fragment habitat, introduce pesticides that can cause impacts to native animals and plants, and reduce the quality and quantity of water in streams and ponds (County of Santa Cruz 2017).

4.4 Mines and Quarries

The RCIS Area features mines and quarries that are used to obtain raw materials for building and product development, mines for limestone, shale, granite, and sand. While the scale of mining activities in the RCIS Area is small compared to other land uses, such as development and working lands, mining activities result in the direct removal of established natural communities, fragmentation of habitat, and if not well managed, degradation of adjacent

habitat by introducing exotic plants and pollution (e.g., effluents, sediment, and noise). The impacts depend on the natural system being evaluated, but are most acute for those subject to mining including the sandhills, which have been extensively mined for sand. Karst caves, which were subject to limestone quarrying. In addition, streams and associated aquatic systems including wetlands in and adjacent to mines, have also been impacted by mining, which can alter flow patterns and increase input of fine sediments and other pollutants.

Current regulations including the Surface Mine and Reclamation Act (SMARA) and the County Mining Ordinance require reclamation following mining activities; however, habitat restoration is not required and instead, the modified areas must be reclaimed for an end use which could include development. Moreover, many quarries in the RCIS Area, including three quarries in the Santa Cruz Sandhills, were created before the passage of SMARA in 1975, leaving some mined areas and entire quarries un-reclaimed.

4.5 Water Use

Water use associated with commercial and residential development and agriculture in the RCIS Area can negatively impact the region's aquatic and groundwater dependent ecosystems. The region derives most of its water from surface and groundwater sources located within the RCIS Area, which are the same sources that are critical for maintaining natural hydrologic regimes and, in turn, the native vegetation and fish/wildlife species adapted to aquatic habitats (Mackenzie et al. 2011). Stream diversions can reduce stream flows during periods that are critical for fish and other aquatic species, while groundwater pumping can lower water tables, result in seawater intrusion, and reduce hyporheic water that supports stream flows and wetland and riparian plants; these changes can, in turn, lead to increased sun exposure, higher water temperatures, algal blooms and/or oxygen deficient conditions that impact aquatic invertebrate populations. Meanwhile, water storage (e.g., ponds and reservoirs), irrigation and return flows (e.g., agricultural, residential, or industrial) can create unnatural perennial aquatic features that provide habitat for invasive species that outcompete native aquatic species adapted to seasonal precipitation and run-off patterns in the RCIS Area.

4.6 Altered Disturbance Regimes

Various anthropogenic factors have altered the regime of natural disturbances, including floods and fire, that structured the RCIS Area's natural communities and to which many species, including rare species, are adapted (Section 2.4.3). Fire exclusion/suppression to protect lives and property have reduced fire frequency, leading to senescence risk for species that require fire to regenerate. When fires do eventually occur, the unnaturally high fuel levels can increase fire severity and intensity (Steel et al. 2015) and even alter the fire type from surface to canopy fire in some systems; these changes in the fire regime can alter the effects of fire for even fire-adapted systems. Meanwhile, increasing temperatures and drought due to climate change can expand the seasonality of fire, which historically occurred primarily during the dry season but can occur throughout much of the year as a result of reduced precipitation and warmer temperatures; these climate changes also have the potential to increase fire frequency.

Increased incidence of fire in the landscape can degrade habitat through a variety of mechanisms, including altering plant community structure and species composition, promoting the invasion and spread of exotic plants (which can also promote fire), and leading to fire suppression activities including use of fire retardant and installation of fire (i.e., dozer) lines that can degrade habitat through a variety of mechanisms including denuding habitat, promoting exotic plants, and altering soil nutrient cycles and surface water flow paths. Natural flood regimes and storm hydrographs play an important role in structuring riverine and riparian habitat, as well as other natural communities that are surface and groundwater dependent, such as ponds and wetlands. The aerial extent, frequency, and intensity of flooding has been altered by development (e.g., increased storm peaks resulting from impervious surfaces and increased stream energy due to straightened channels), and historic tide gates intended to limit the flow of saline water upstream, but often fail or leak, which can negatively impact plants and animals adapted to freshwater regimes, and water management infrastructure (e.g., dams and flood control levees that reduce peak flows, disconnect natural floodplains, and interrupt natural sediment transport processes). These changes, including flood control projects on the San Lorenzo and Pajaro rivers, can affect the structure and composition of vegetation in these communities and can result in loss or extirpation of native fish and animals that are adapted to the natural disturbance regimes. The changes to flood related disturbance regimes are being further influenced by climate change.

4.7 Exotic Species

Exotic plants are stressors resulting from various land uses including development, mining, and working lands, and are a pressure themselves, causing a host of stresses for natural communities and species (Tables 4-1 and 4-2). Due to its history of land use and diversity of natural systems, Santa Cruz County supports (at last tally) 556 exotic plant taxa (i.e., those not native to California), which constitute slightly more than one third of the region's flora (Neubauer 2013). Some of these exotic species are regarded as invasive, as they exert strong negative impacts on native species and communities through competition, altering natural community structure and species composition, or altering ecosystem properties including nutrient cycling and disturbance regimes. Many of these invasive plant species provide limited or no habitat or food for native animals and, without their native predators to control their populations, can rapidly increase their populations and degrade natural communities.

Non-native animals can similarly stress natural systems through various mechanisms, including competition, predation, disease transmission, and altering community structure, food webs, and ecosystem functions. Aquatic systems have been acutely impacted by non-native invertebrates (e.g., New Zealand mudsnail), fish (e.g., mosquito fish, carp, and bass), and American bullfrogs. Upland systems are affected by wild turkeys, which have become abundant in the Santa Cruz Mountains in the past decade, as well as wild boar (feral pigs).

4.8 Incompatible Recreation

Though well-managed outdoor recreation can be compatible with many of the focal species and natural communities, some recreational activities can impact aquatic and terrestrial systems through a variety of mechanisms (Tables 4-1 and 4-2). Terrestrial recreation activities, including hiking, dog walking, horseback riding, mountain biking, and off-highway vehicle use, can degrade habitat by trampling established plants and animals or their habitat (e.g., burrows); cause erosion; result in direct harassment of native animals; polluting habitat through unmanaged waste and debris; and promoting the invasion and spread of exotic plants. The extent of these impacts depends on a variety of factors including the type, intensity, frequency, areal extent, and seasonality of uses.

Trampling and erosion from terrestrial recreational activities can also negatively impact aquatic systems, including by removing established vegetation and degrading water quality (e.g., through sedimentation and animal waste). Additionally, aquatic systems can be impacted by water-based activities including boating, fishing, and surfing (incl. kite surfing), which can harass native animals, introduction of exotic animals (e.g., New Zealand mudsnail) and plants, and introducing effluents and light pollution, which can alter aquatic species behaviors (movements and habitat use) and lead to increased predation.

4.9 Unauthorized Activities

Natural communities and species have been negatively impacted by a host of additional human activities. These include unauthorized activities that occur on protected as well as unprotected lands and are generally not designed or implemented to avoid, minimize, and mitigate their impacts on sensitive habitat and species. These unauthorized activities include:

- Unauthorized camping;
- Illegal dumping;
- Illegal cannabis growing;
- Unauthorized grading;
- Unauthorized breaching of lagoons; and
- Unauthorized vegetation removal.

These and other similar unauthorized activities, can degrade habitat and impact populations of native species through a variety of mechanisms including: temporary loss of habitat, removal of established vegetation; degradation of water quality; reduction in water availability; ignition of wildfires; introduction of chemicals that impact native species; poaching; and introduction of trash that promotes populations of human commensal species including exotic rats, and native corvids including common raven. These animals associated within human activity can outcompete native species, including marbled murrelet, through predation. The potential

impacts of lagoon breaching (authorized and unauthorized) is discussed in more detail in Bar-Built Estuary conservation element.

4.10 Climate Change

4.10.1 Projected Climate Changes

4.10.1.1 Temperature

Within the RCIS Area, overall temperature is anticipated to increase substantially as a result of climate change (Table 4-3). Under the projection based on Representative Concentration Pathway 4.5 (RCP 4.5), which represents a mitigation scenario where global carbon dioxide emissions peak by 2040, average annual minimum temperatures will increase by 3.7 °F by mid-century and 4.8 °F by the end of the century, while changes in the average annual maximum temperature will be 3.4 °F and 4.4 °F, respectively (Table 4-3). Under the 'Business as Usual' scenario, where global CO2 emissions continue to rise through the 21st century (RCP 8.5), average annual minimum temperatures will increase by 4.7 °F by mid-century and 7.7 °F by the end of the century, while average annual maximum temperatures will increase by 4.3 °F and 7.0 °F, respectively (Table 4-3; Langridge 2018).

Table 4-3: Projected climate change in Santa Cruz County (Langridge 2018)

		RCP 4.5		RCP8.5	
Climate Variable (Average Annual)	**Historical (1961-1990)**	**Mid-Century (2040-2069)**	**End of the Century (2070-2099)**	**Mid-Century (2040-2069)**	**End of the Century (2070-2099)**
Minimum Temperature (°F)	42.8	46.5	47.6	47.5	50.5
Maximum Temperature (°F)	67.5	70.9	71.9	71.8	74.5
Precipitation (inches)	37.2	40.6	41.3	41.5	47.0

4.10.1.2 Precipitation

Precipitation in the RCIS Area is expected to increase slightly, while precipitation variability will increase substantially (Table 4-3, Langridge 2018). Under the RCP 4.5, average annual precipitation will increase 3.4 inches by mid-century and 4.1 inches by the end of the century, while these increases will be 4.3 inches and 9.8 inches, respectively, under RCP 8.5 (Table 4-3; Langridge 2018).

Climate change is anticipated to increase the frequency of atmospheric rivers: narrow regions in the atmosphere that transport most of the water vapor outside of the tropics and are the dominant drivers of locally extreme rainfall events (Dettinger 2011). At the same time, climate

change is anticipated to bring future extreme and prolonged droughts. Overall, precipitation is anticipated to have more extreme 'swings' between drought and flood; the California Central Coast region is predicted to have a 25 to 100 percent increase in extreme dry-to-wet precipitation events, despite only modest changes in mean precipitation (Langridge 2018).

Changes in precipitation and temperature are likely to reduce stream flows during the summer low-flow season, causing negative effects on aquatic systems and species including salmonids (Crozier et al. 2019). Even if there are increases in annual average precipitation, summer low flows are likely to decrease due to increased evapotranspiration caused by increased temperature, more than offsetting the potential increase in precipitation.

4.10.1.3 Fog

The impacts of climate change on coastal fog, which is an important aspect of the climate in the RCIS Area for a variety of terrestrial and aquatic systems and species including coast redwood and maritime chaparral, are difficult to predict; this is because fog is the result of interactions between ocean, air, and land systems, which have not yet been well characterized (Langridge 2018).

4.10.1.4 Sea Level Rise

Sea level in the San Francisco Bay, just north of the RCIS Area, is anticipated to rise between 7 and 33 cm by the middle of the century and 35 to 141 cm by the end of the century under RCP 4.5; under RCP 8.5, these levels are 10-38 cm and 72-240 cm, respectively (Pierce et al. 2018). Estimates for sea level rise in Monterey to the south of the RCIS Area are similar albeit slightly lower (Pierce et al. 2018). Figure 4-1 illustrates the areas along the coast of the RCIS Area that are anticipated to be affected by an 8-foot rise in sea level (NOAA 2017). Accelerating sea level rise combined with lack of sediment in the system is anticipated to 'drown' or 'squeeze' beaches between the rising sea and the backing cliffs and/or urban areas (Langridge 2018).

4.10.1.5 Interactions and Influence on Disturbance

The predicted changes to climate outlined above, along with other potential changes such as to wind, will interact to alter the landscape through complex mechanisms that will influence species and communities by altering disturbance regimes (Langridge 2018):

- Fire size, frequency, and/or severity may increase due to increases in temperature and drought, which together increase the climatic water deficits—a measure of water availability relative to water demand, which influences fuel moisture (Westerling et al. 2006, Sankey et al. 2017); and
- Flooding along the coast and streams may increase as a result of periodic El Niño, atmospheric rivers, and sea level rise.

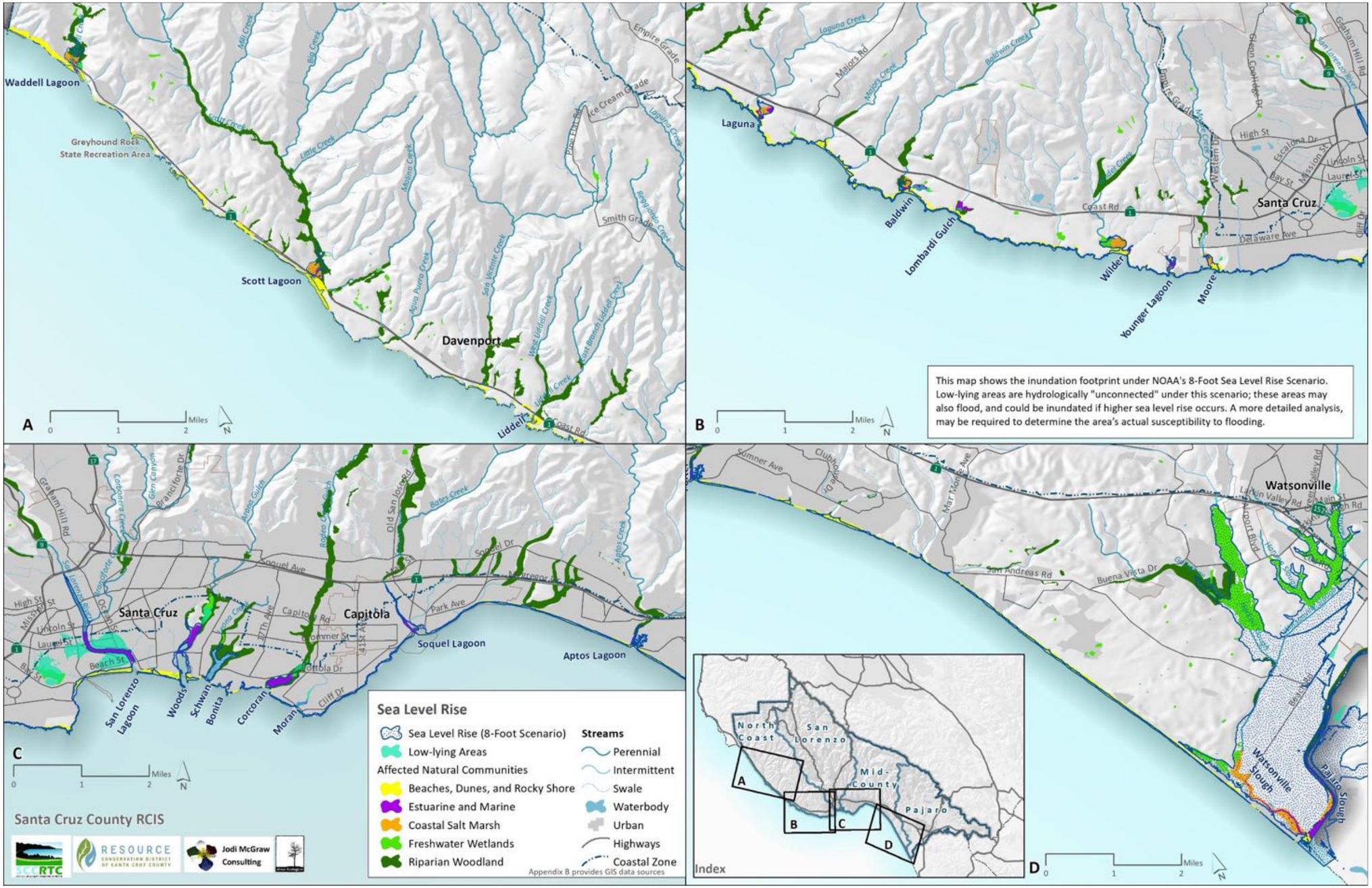

Figure 4-1: Sea Level Rise

These and other indirect effects of climate change via altered disturbance regimes are projected to have large consequences for communities and species in the Central Coast. Increased fire, in particular, can promote type conversion of forests and shrublands to grasslands, which in turn can promote more frequent fire as part of the grass-fire cycle (D'Antonio and Vitousek 1992, Syphard et al. 2019).

4.10.2 Vulnerability of Conservation Elements

Climate change will impact the conservation elements of the RCIS through a variety of direct and indirect mechanisms including by causing changes in: 1) abiotic conditions that influence suitability of the habitat directly in terms of temperature, moisture, humidity, and other factors that influence life; 2) resource availability, including soil moisture, carbon dioxide, and nutrients for plants and other primary producers, and food for animals; 3) interactions among species, including competition, predation, as well as facilitation; 4) disturbance regimes, which can influence plants and animals directly as well as indirectly, by altering habitat through the mechanisms above; and 5) alterations to human systems. These changes will interact in complex ways that render it difficult to predict the net effects on individual species and communities in many cases.

To assess the vulnerability of the conservation elements to climate change, this RCIS assesses three elements (Glick et al. 2011):

1. **Exposure:** the character, extent, and magnitude of the changes that the species or system will experience, based on extrinsic factors (i.e., the climate changes themselves);
2. **Sensitivity:** tolerance of the species or system to climate changes based on the innate characteristics (i.e., aspects of the community or species);
3. **Adaptive capacity:** ability of the species or system to accommodate or cope with climate change impacts with minimal disruption.

These climate change vulnerability analyses are outlined in the conservation strategy sections presented for each conservation element (Section 5.3), which also identify how the strategy (goals, objectives, actions, and priorities) will aid adaptation to climate change.

5 Conservation Strategy

This section presents the RCIS conservation strategy, which is comprised of a series of integrated strategies for each of the conservation elements (Section 5.3). Section 5.1 outlines the components of each strategy and how they were developed and can be used to guide conservation work in the region. Section 5.2 presents the gap analysis used to identify the additional amount of habitat to protect[4] to achieve the overall targets for habitat protection of each conservation element. The conservation strategies for each of the conservation elements are provided in Section 5.3. Section 5.4 describes how the conservation strategies are consistent with other plans and strategies, including recovery plans and habitat conservation plans in the RCIS Area, and the RCISs developed for adjacent Santa Clara and Monterey counties.

5.1 Conservation Strategy Components

The conservation strategy for each conservation element is contained in a table that is preceded by important background information that was used to develop the conservation strategy, and that can aid its implementation.

5.1.1 Background Information

Table 5-1 lists the background information provided for each conservation strategy. For each component, it outlines how it was assembled and used to develop the strategy, as well as how it can inform its implementation, including through design of specific projects.

5.1.2 Species Matrix

Table 5-2 the key ecological requirements for each of the focal and non-focal species, and identifies the conservation elements with which they are associated; specifically, communities that provide suitable habitat, or focal species with which the species generally co-occurs or share a common habitat.

Developed based on a review of the literature for the focal and non-focal in the RCIS Area, this table helps identify the focal and non-focal species anticipated to benefit from actions implemented in the conservation strategy. The tables of goals, objectives, actions, and priorities, for each conservation element (Section 5.3) identify the specific species anticipated to benefit from the individual actions, which can be used to develop mitigation credit agreements during implementation (Section 6.1.3.2.3).

[4] Habitat can be protected through a variety of mechanisms including: fee title acquisition, conservation easement, and stewardship incentives (Section 5.2.4).

Table 5-1: Background information contained within each conservation strategy

Component	Contents	Development Methods	Utility for Conservation
Status and Rarity	Indicates the special status for species and sensitive habitats based on local, state, and federal regulations Indicates the rarity of species and natural communities	Special Status • Species: State and federal listing status (CDFW 2019b, CNPS 2020) • Communities and habitats: ○ Sensitive Natural Communities (CDFW 2020c) ○ Sensitive habitats and environmentally sensitive habitat areas (County of Santa Cruz 1994) Rarity: • Species: California Natural Diversity Database (CDFW 2019d) • Communities: California Natural Communities List (CDFW 2020c)	• Special-status species and community designations indicate the rarity of species, and can be used to inform the need for protection and mitigation during permitting processes.[1] • Rarity information can guide conservation actions where they are most imperative including for species that are narrowly endemic (G1,S1) or otherwise critically imperiled.
Detailed Descriptions	Citation (Author and year) for one or more resources that describe the conservation element. Author-year citations are listed in the *References* section.	Selected based on the known resources that provide critical information about the ecology, life history, and conservation needs of the species or system	Provides additional information about the species or system used to develop the strategy and that can inform the design and implementation of conservation actions.
Distribution and Range (including map)	Identifies the extent of the conservation element in the RCIS Area	Maps and quantitative data for aquatic and terrestrial systems were developed using the best available data as described in Section 2.4. For species, California Natura Diversity Database	Illustrates available information about the distribution within the RCIS Area, which can guide efforts to avoid impacts and also develop placed-based conservation strategies, recognizing that most

Component	Contents	Development Methods	Utility for Conservation
		occurrences were mapped (CDFW 2019d).	conservation elements (particularly focal species) are not comprehensively mapped.
Key Ecological Elements	Lists of key aspects of the ecology of the conservation element to be considered in developing and implementing conservation strategies	Developed based on a synthesis and critical evaluation of available information including scientific reports and plans including the information in the *Detailed Descriptions*. Prepared with input from technical advisors.	Informed development of the conservation strategy and can be used, along with additional information in the *Detailed Descriptions* to design specific projects during RCIS implementation
Pressures and Stressors	Highlights the key pressures and stressors affecting the conservation element, emphasizing those that are most relevant to the conservation strategy. Tables 4-1 and 4-2 identify all pressures and stressors affecting the element.	Developed based on a critical review of available information for the conservation element, and analysis of anthropogenic activities and impacts in the RCIS Area. Prepared with input from technical advisors.	Informed design of the conservation strategy and can be used, along with additional information in the *Detailed Descriptions,* to design specific projects during RCIS implementation.
Climate Change Vulnerability Assessment	References existing climate change vulnerability assessments; summarizes available information about the exposure, sensitivity, and adaptive capacity of the conservation elements to climate changes; and outlines how the conservation strategy will help address the impacts of	Developed through a review of available climate change vulnerability assessments for the species, community, and other conservation element, where available, relying heavily on the *Santa Cruz Mountains Climate Change Vulnerability and Adaptation Strategies Synthesis Report* (EcoAdapt 2021). Where a prior vulnerability assessment was not available, one was conducted based on	The conservation strategy was informed by the climate change vulnerability assessment (CCVA), which was primarily used to identify goals, objectives, actions, and priorities as outlined below the CCVA. Implementers of the RCIS should review the CCVA summary and analysis of key strategies and more detailed CCVA information

Component	Contents	Development Methods	Utility for Conservation
	climate change on the conservation element.	the criteria used to assess exposure, sensitivity, and adaptive capacity, as outlined in Glick et al. 2011.	referenced in this section to inform design of climate-adapted conservation projects.
Species Associated with the Conservation Element	Lists the focal and non-focal species associated with the conservation element. The table of goals, objectives, actions, and priorities identifies specific actions anticipated to benefit the referenced species. Table 5-2 highlights the species key ecological requirements and relationship to each of the conservation elements.	Developed based on a review of the literature regarding the distribution of focal and non-focal in the RCIS Area with respect to the main geographic regions as well as specific vegetation and other land cover types. Focal and non-focal species were listed for communities that provide suitable habitat, or for focal species with which they co-occur or generally share common habitats.	This initial list, combined with the referenced tables, can be used to determine which focal and non-focal species are anticipated to benefit from actions implemented in the conservation strategy for the element. This list can be used inform mitigation projects including develop mitigation credit agreements during implementation (Section 6.1.3.2.3).
Other Actions that Benefit this Conservation Element	Lists the actions included in conservation strategies for other conservation elements, that will benefit this conservation element	Developed based on a review of the available information about the conservation elements and their associated strategies, to determine their common ecology and conservation needs.	Inform design of multi-benefited conservation projects by identifying actions that will benefit the species and/or community addressed. Can also inform the design of mitigation credit agreements by identifying the species and habitats for which credits could be generated by each action.

[1] Status information is provided for reference only and is not intended to indicate actions are subject to regulations. Status designations may change. Project proponents should contact local, state, and federal agencies to obtain information about regulations, policies, and permitting processes that may apply to actions.

Table 5-2: Focal and non-focal species key ecological requirements and conservation elements

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
Plants																									
Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*) Federally Endangered	NF	Annual plant endemic to sandhills communities found only on outcroppings of Zayante sand soil in Santa Cruz County. Preferentially occurs in open, sparsely vegetated areas away from dense exotic plants, leaf litter, and shrubs and trees in sand parkland and sandhills chaparral communities. Outcompeted by exotic plants. Ecological disturbances including fire and soil disturbances (slides, deer trails, and gopher mounds) maintain open sandy habitat and reduce herbaceous exotic plants.									✓	✓					✓					✓	✓	✓	
Monterey spineflower (*Chorizanthe pungens* var. *pungens*) Federally Threatened	NF	Annual plant that inhabits open canopy areas lacking dense litter on the soil surface or dense cover of herbaceous plants in dunes, coastal scrub, maritime chaparral, and adjacent oak woodlands in southern Santa Cruz County. Like other spineflower species in the RCIS Area, this species is a poor competitor for light and requires disturbance to maintain open areas lacking dense competitors.					✓			✓				✓								✓	✓	✓	
Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*) Federally Endangered	NF	Annual plant endemic to short-statured grasslands and meadows on thin soils overlaying Purisima sandstone and Santa Cruz mudstone outcrops or sandy seeps in Scotts Valley. Often co-occurs with Scotts Valley polygonum as well as species adapted to higher soil moisture maintained seasonally by bedrock. Threatened by development, exotic plant competition, trampling (i.e., from recreation and vehicles), pesticides, change in hydrologic regime, and climate change. Conservation grazing, fire, or other techniques are needed to remove thatch and competition from exotic plants and maintain areas of short-statured grassland habitat.						✓														✓	✓	✓	✓
robust spineflower (*Chorizanthe robusta* var. *robusta*) Federally Endangered	NF	Annual plant found in coastal and near-coastal areas from Santa Cruz to Sunset State Beach in Santa Cruz County, and in Point Reyes National Seashore. Habitat includes sandy soils associated with active coastal dunes as well as inland sites featuring sandy soils, where the species inhabits open-canopy areas with sparse herbaceous plant cover in coastal scrub, maritime chaparral, and					✓			✓				✓								✓	✓	✓	

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
		oak woodland. Requires disturbance to maintain open habitat and reduce competition.																							
Santa Cruz wallflower (*Erysimum teretifolium*) Federally Endangered State Endangered	NF	Biennial to short-lived perennial monocarpic herb endemic to sandhills communities found only on outcroppings of Zayante sand soil in Santa Cruz County. Preferentially occurs in open, sparsely vegetated areas away from dense exotic plants, leaf litter, and shrubs and trees primarily in sand parkland, but also adjacent sandhills chaparral communities. Outcompeted by exotic plants as well as native woody vegetation, the species requires recent/ongoing soil disturbance with (e.g., slides, deer trails, and gopher mounds) to maintain open, loose sand soil and reduce herbaceous exotic plants. The species is weakly self-incompatible and experiences reduced seed production in small populations due to inbreeding depression.									✓	✓					✓					✓	✓	✓	
Santa Cruz cypress (*Hesperocyparis abramsiana* var. a*bramsiana*) Federally Threatened State Endangered	NF	Closed-cone conifer endemic to four locations in Santa Cruz County, where it occurs in Santa Cruz cypress forests (stands) found on oligotrophic (nutrient poor) soils including sandstone and granite rock outcroppings that lack dense canopy cover from light-competitive trees (e.g., coast redwood). Fire promotes seedling establishment and prevents population senescence by opening seed cones, removing established plant canopy (including established individuals), and creating bare mineral soil conditions. Fire kills established individuals, so time between fires is needed for trees to produce sufficient seed to regenerate the pre-fire population.									✓	✓					✓					✓	✓	✓	
Santa Cruz tarplant (*Holocarpha macradenia*) Federally Threatened State Endangered	F	Annual herb found in grasslands on coastal terraces primarily in Santa Cruz County, with a single population just south in Monterey County; natural populations in Contra Costa County have been extirpated. Occurs in seasonally saturated areas with deep loam and sandy loam soils with a subsurface clay component, that hold moisture longer into the growing season compared to the surrounding sandy soils. Seedling establishment requires open soil created or maintained by scraping, mowing, grazing, or fire. Threatened by							✓							✓						✓	✓	✓	✓

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
		habitat loss and habitat degradation due to competition from exotic plants in the absence of grazing and fire which can cause extirpation, thought the species features a relatively dormant seed in the soil from which populations can re-establish.																							
white-rayed pentachaeta (*Pentachaeta bellidiflora*) Federally Endangered State Endangered	NF	Annual plant that inhabits grassy or rocky areas in the San Francisco Bay Area, including west of Eagle Rock, adjacent to one of the five mapped stands of Santa Cruz Cypress. Thought to be extirpated from the SCCRCIS Area (last recorded observation from 1955); however, there is potential for species rediscovery and/or reintroduction including post-CZU Lightning Complex Fire, which burned the area west of Eagle Rock.							✓			✓				✓						✓	✓	✓	
San Francisco popcornflower (*Plagiobothrys diffusus*) State Endangered	NF	Annual plant that inhabits grasslands in the San Francisco Bay Area, where it is preferentially found in seasonally moist depressions. In the RCIS Area, known from coastal prairie at and near UC Santa Cruz and in the Scotts Valley grasslands. Threatened by development, exotic plants, and trampling (i.e., from recreation and vehicles).							✓							✓						✓	✓	✓	✓
Scotts Valley polygonum (*Polygonum hickmanii*) Federally Endangered State Endangered	NF	Annual plant endemic to the Scotts Valley grasslands where it occurs on thin loam soils of the Bonnydoon Series that overlay outcrops of Santa Cruz mudstone and Purisima sandstone in Santa Cruz County. These fine-textured but shallow soils are seasonally wet. The species is known from only two occurrences one mile apart that total less than one acre. It is threatened by habitat loss due to development, competition from exotic plants and competitive native plants, trampling from recreation and vehicles, and climate change.							✓													✓	✓	✓	✓
Pacific Grove clover (*Trifolium polyodon*) State-Listed Rare	NF	Annual plant endemic to Santa Cruz and Monterey counties, where it occurs in moist swales in coastal prairie and vernally moist dune hollows, often on the edge of old roadbeds and sometimes on granitic soils. Threatened by habitat loss due primarily to development, exotic plants, and trampling caused by recreation and vehicles.							✓							✓								✓	

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
Invertebrates																									
Monarch butterfly (*Danaus plexippus*) Federal Candidate	NF	Migratory species that overwinters in groves of trees within 1.5 miles of the California coast including in Santa Cruz County. Adults cluster primarily in eucalyptus (*E. globulus* and *E. camaldulensis*) but also utilize Monterey pine, Monterey cypress (*Hespercyparis macrocarpa*), and western sycamore (*Platanus racemosa*), and coast redwood (*Sequoia sempervirens*); Monarch butterflies do not prefer eucalyptus trees to native tree species, so restoration of native trees species is recommended in the long term. Suitable overwintering habitat must provide protection from winds, absence of freezing temperatures, exposure to dappled sunlight, high humidity, and access to nectar and water. Senescence of Monterey pine, pitch canker, and associated tree pruning can reduce suitability of Monterey pine as overwintering habitat.											✓		✓							✓	✓	✓	
western bumble bee (*Bombus occidentalis*) State Candidate for Listing	NF	Occurs along the coast from the Channel Islands to southern Oregon and in the Sierra and Cascades mountains; also occurs in Nevada, Idaho, and Utah. Nests, forages, and overwinters in meadows and grasslands with bountiful floral resources; can also be found in urban environments with natural areas. In the RCIS Area, occurrences have been documented in the coastal grasslands, meadows, and urban areas (CDFW 2019d).Workers and males are active in California from early April to early November, primarily nesting in underground cavities such as old animal burrows or nests on open west-southwest slopes bordered by trees, though sometimes in logs and dead trees. Threats by habitat loss and degradation, disease, competition, toxins, loss of genetic diversity, and climate change.							✓						✓							✓	✓	✓	
Ohlone tiger beetle (*Cicindela ohlone*)	NF	A predatory beetle endemic to Santa Cruz County, where it is found only in coastal prairies with former marine terraces in and around the cities of Santa Cruz and Scotts Valley in Santa Cruz County. Primarily associated with Watsonville Loam soil with good drainage and infiltration and flat to slightly sloping topography, with exposure to warming sunlight and bare to sparely vegetated grasslands. Threats include urbanization, agriculture, exotic plant							✓						✓							✓	✓	✓	✓

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
		thatch, and high-speed recreation that tramples individuals and burrows, or causes erosion.																							
Mount Hermon June beetle (*Polyphylla barbata*) Federally Endangered	NF	Largely fossorial endemic species found in Sandhills communities outcroppings of Zayante sand soil in Santa Cruz County. Polyphagous species (generalist feeder) found in all sandhills habitat including natural communities as well as partially developed areas and modified areas including former sand quarries; also occurs in plant communities on loamy or sandy soil adjacent to Zayante soil. Occurs at highest abundance in sand parkland, silverleaf manzanita chaparral, and coast live oak woodland (on Zayante soils). Require open sand to emerge from the ground to mate. Light pollution at night distracts males from breeding and may reduce populations near development.									✓	✓					✓					✓	✓	✓	
Zayante band-winged grasshopper (*Trimerotropis infantilis*) Federally Endangered	F	Sandhills endemic found only on outcroppings of Zayante sand soil in Santa Cruz County where it is largely restricted to sand parkland communities and adjacent canopy gaps in sandhills chaparral communities. Requires open sandy habitat (<40% plant cover) and is most frequent and abundant in areas of loose sand soil that are subject to recent or ongoing soil disturbance including erosion (slides) and trails. Also occurs at high abundance in sand quarries featuring sufficiently deep and loose open sand soil supporting sparse, primarily native sandhills plant species.									✓	✓					✓					✓	✓		
Fish																									
Tidewater goby (*Eucyclogobius newberryi*) Federally Endangered State Species of Special Concern	NF	Primarily utilizes shallow water (< 1 m) at the fresh-saltwater interface in upper estuaries, where water salinity is between 1 - 12 parts per thousand, though can also occur upstream a short distance into fresh water, and downstream into water with salinity of up to about 28 parts per thousand. Relies on protected backwaters as winter refuges in lagoons including several in Santa Cruz County. Can persist and thrive in a variety of water quality conditions but requires quiet calm water for rearing and coarse sand for spawning. Feeds on benthic invertebrates and insects.	ü	✓														✓				✓	✓	✓	

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
coho salmon (*Oncorhynchus kisutch*) Federally Endangered State Endangered	F	Anadromous fish at the southern edge of its range, which historically extended to Aptos Creek. Freshwater life history requires: 1) clean loose gravels free of fine sediment for spawning, egg development, and invertebrate food production; 2) adequate pools and natural instream cover for juveniles and adults; 3) connected alcoves and off-channel habitats for juveniles to survive winter flows; 4) clean cool water; and 5) unimpaired passage to and from the ocean. Bar-built estuaries provide important transitional habitats.	✓	✓											✓			✓		✓		✓	✓	✓	✓
steelhead - Central California Coast DPS (*Oncorhynchus mykiss irideus*) Federally Threatened	NF	Anadromous fish found in streams in the RCIS Area between Waddell Creek to (but not including) the Pajaro River. Requires cool, clean, and well oxygenated water with gravel-sized substrate for successful spawning. Adults need adequate passage to spawning habitat in upper watersheds which (unlike coho salmon) they can use for spawning. Bar-built estuaries are important for juvenile rearing and smolt production. Steelhead exhibit higher plasticity in their life history than coho salmon: 1) they have a wider window of timing for adult migration into freshwater; 2) juveniles can spend 1 -3 years in freshwater, 3) adult spawners can return to sea and spawn again (rather than dying after spawning), 4) they have greater variability in time at sea, and 5) there are better able to modify life history patterns to manage fitness trade-offs between favorable foraging opportunities and physiologically stressful abiotic conditions. They can also smolt multiple times before leaving freshwater and also have a resident freshwater life history. This plasticity contributes to their greater resiliency. Steelhead also utilize food-rich estuarine habitats for rearing and may spend months in closed estuaries prior to outmigrating to the ocean.	✓	✓											✓			✓		✓		✓	✓	✓	✓
steelhead - South-Central California Coast DPS (*Oncorhynchus mykiss irideus*)	NF	In the RCIS Area, inhabits streams in the Pajaro River Watershed. Key ecological requirements are as outlined for CCC steelhead.	✓	✓											✓					✓		✓	✓	✓	✓

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
Federally Threatened																									
Amphibians																									
California tiger salamander (*Ambystoma californiense*) Federally Threatened State Threatened	NF	Inhabits temporary ponds and freshwater wetlands for breeding and adjacent upland grasslands and open oak woodlands during the nonbreeding season. Spends most of its life underground in burrows of small mammals during the summer months and emerges during rainy nights in the fall and winter to migrate to shallow, freshwater ponds and ephemeral pools. In the RCIS Area, known only from Pajaro Valley.			✓	✓			✓					✓		✓			✓	✓		✓	✓	✓	
Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) Federally Endangered State Endangered State Fully Protected	F	Endemic to southern Santa Cruz County and northern Monterey County. Inhabits temporary ponds and freshwater wetlands for breeding and adjacent shrublands and oak woodlands during the nonbreeding season. Spends most of its life in underground burrows of small mammals during the summer months and emerges during rainy nights in the fall and winter to migrate to shallow, freshwater ponds with sufficient emergent and submergent cover to breed. Leaf litter, rotten logs, fallen branches, and the root systems of trees provide temporary cover during migration.		✓	✓	✓				✓					✓					✓			✓	✓	✓	
Foothill yellow-legged frog (*Rana boylii*)	NF	Obligate stream-breeding species currently known in the RCIS Area from only the Soquel Creek Watershed. Utilizes partly shaded, shallow, perennial streams with a low gradient and rocky substrate that is at least cobble-sized. Adjacent vegetation is variable and includes riparian hardwood, conifer, and wet meadow. Non-breeding and overwintering individuals prefer sunny areas with limited canopy adjacent to the water's edge and near riffles that produce adequate food. Preferentially breeds in wide, open, sunny confluence areas or tributaries with cobble and boulder substrate. Tadpoles require habitat connectivity between breeding and rearing sites to follow the receding shoreline into areas of high productivity and lower predation risk as flows decline, to avoid becoming trapped in isolated pools with a high risk of overheating, desiccation, and predation.		✓														✓		✓			✓	✓	✓	

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
California red-legged frog (*Rana draytonii*) Federally Threatened State Species of Special Concern	NF	Omnivorous frog that breeds in wetlands, ponds, and slow-moving water in streams, including off-channel habitat (backwater, ox-bow, alcoves), deep, protected pools with significant sunlight, and emergent vegetation for egg sack attachment. Can use temporally disconnected ponds adjacent to bar-built estuaries. Utilizes a variety of upland habitats for dispersal where it benefits from downed woody vegetation, leaf litter, and small mammal burrows that provide protection from predators and desiccation drying the summer.	✓	✓	✓	✓			✓					✓	✓	✓		✓	✓	✓		✓	✓	✓	
Reptiles																									
San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) Federally Endangered State Endangered State Fully Protected	NF	Endemic to San Mateo County and northern Santa Cruz County, this subspecies inhabits aquatic and adjacent upland habitat in the from Waddell lagoon and creek in the RCIS Area. Uses Also emergent and bankside vegetation along streams and freshwater marshes for foraging and cover, and the ecotones between aquatic and uplands for basking, feeding, and for cover (e.g., rodent burrows). A specialist on ranid frogs, including California red-legged frog, which is a major component of the diet of adults; juveniles prey heavily on Pacific treefrogs.	✓		✓	✓			✓											✓		✓	✓	✓	
Southwestern pond turtle (*Actinemys pallida*) State Species of Special Concern	F	Omnivorous native turtle that occupies ponds, wetlands, and streams with low-velocity waters and deep pools where cut banks and large woody debris that provide cover from aquatic predators. Requires basking habitat including open banks, logs, and cattail mats. Overwinters in riparian, wetland, and shrubland above flood risk including near bar-built estuaries in coastal areas and valleys in Santa Cruz County. Nests in unshaded, sparse grassland or pockets in shrublands and forests above the flood risk.	✓	✓	✓	✓			✓					✓	✓			✓	✓	✓		✓	✓	✓	✓
Birds																									
Tricolored blackbird (*Agelaius tricolor*)	NF	Occurs primarily on the Pacific Coast of North America between Northern California and upper Baja California, though also patchily in Oregon and Washington. Primarily inhabits wetlands and grasslands, but also occurs in agricultural areas including farmland and pastureland. Breeds in large colonies in freshwater wetland			✓	✓			✓													✓	✓	✓	✓

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
		areas including around ponds, in association with grasslands where it is known to occur in the Pajaro Valley in Santa Cruz County.																							
Golden eagle (*Aquila chrysaetos*) Fully Protected	NF	Occurs in open country, mainly in mountains, hills, and deserts, with in Europe, North America, North Africa, Arabia, and the Himalayas. Hunts primarily for small mammals and birds and sometimes the young of larger prey. Can breed and overwinter in the Santa Cruz area; though uncommon, they occur in open grasslands and shrublands on foothills and mountain slopes away from the immediate coast. Individuals may pair for life and build stick nests, often on cliff ledges or large trees; nest sites after often reused.							✓							✓						✓	✓	✓	
Swainson's hawk (*Buteo swainsoni*) State Threatened	NF	Occurs in plains, dry grasslands, and farmland in the West and Midwest between Alaska and northern Mexico throughout the breeding season; overwinters in southern South America. Rare in Santa Cruz County where there are no records of nesting. The species favors oak savannah and pine-oak woodlands as well as open annual prairie. Builds well-hidden stick nests in large trees in open country with a vantage point. Forages mainly for small mammals and reptiles in the summer and large insects in other seasons.							✓							✓						✓	✓	✓	✓
Western snowy plover (*Charadrius alexandrinus nivosus*)	NF	Breeds on the West Coast from Central Washington to southern Baja California above the high tide line on coastal beaches, sand spits, dune-backed beaches, sparsely vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. In Santa Cruz County, nesting is currently limited to Sunset State Beach and the Pajaro River though the species historically nested further north. Overwintering occurs in many of the same beaches used for nesting, but also extends onto other beaches, in artificial salt ponds, and estuarine sand and mud flats.					✓															✓	✓	✓	
White-tailed kite (*Elanus leucurus*) Fully Protected	NF	Generally non-migratory bird that occurs within a couple hundred miles of the coast of western North America from Washington to Baja California, western and eastern Mexico, and southern Texas. Most common in open habitats with high rodent populations including grassland, open oak woodland, desert grassland, farm		✓		✓			✓							✓						✓	✓	✓	

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
		country, and marshes; requires trees for perching and nesting. In the RCIS Area, uses grasslands, riparian forests, and open habitat abutting farmland where the species is frequently observed in fall and winter, but uncommon in other seasons; nesting has been recorded in the past but not recently.																							
American peregrine falcon (*Falco peregrinus anatum*) Federally Delisted State Delisted Fully Protected	NF	Occurs from Alaska and northern Canada down through the west coast throughout much of Mexico and South America. Present in open country near cliffs often near water, especially along the coast. Limited by availability of nest sites and prey so often moves into cities, nesting on building ledges or bridges, where they commonly hunt for small to medium-sized birds. In the RCIS Area, the species is uncommon and nests infrequently, but forages in open habitats including coastal prairies and adjacent wetlands and lagoons.				✓	✓		✓							✓						✓	✓	✓	
Bald eagle (*Haliaeetus leucocephalus*) Federally Delisted	NF	Occurs throughout much of North America where it is primarily associated with estuaries, large lakes, reservoirs, rivers, and some seacoasts. Winters in California mountain and foothill forests and woodlands near reservoirs, lakes, and rivers but generally nests to the north. In Santa Cruz County, recent nesting activity has occurred in the Pajaro River Watershed (e.g., Pinto Lake and the Watsonville Sloughs). Builds large stick nests in tall trees generally near large bodies of water.	✓		✓	✓																✓	✓	✓	
California brown pelican (*Pelecanus occidentalis californicus*) Federal Delisted State Delisted Fully Protected	NF	Occur along the Pacific Coast from California to Mexico, where it roosts on islands, offshore rocks, and on beaches at the mouths of estuaries, as well as human-created structures such as breakwaters, jetties, dredge piles, and piers. Roosts are used to avoid mammalian predators for resting and for drying plumage. Hunts for ocean fish typically within five miles of the coast. The Central California Coast supports an important temporal component of their roosting habitat, and the species is common year-round in Santa Cruz County (Suddjian2016).					✓															✓	✓	✓	
marbled murrelet (*Brachyramphus marmoratus*)	F	A small seabird that inhabits the coast between Southern California and British Colombia (Canada) to Alaska. Forages in the ocean on fish and invertebrates typically within 2 kilometers of the shore.													✓							✓	✓	✓	

Species	Focal (F) or Non-Focal (NF)	Key Ecological Requirements	Bar-Built Estuaries	Riparian and Riverine	Ponds, Lakes, and Reservoirs	Wetlands	Beaches, Dunes, and Rocky Cliffs	Karst Caves	Grassland	Maritime Chaparral/ Knobcone Pine	Sandhills/Sand Parkland	Santa Cruz Cypress	Monterey Pine	Oak Woodland/Forest	Redwood/Douglas-Fir	Santa Cruz tarplant	Zayante band-winged Grasshopper	Coho Salmon	Santa Cruz Long-Toed Salamander	Southwestern pond turtle	Marbled Murrelet	Mountain Lion[1]	Bat Habitat[1]	Connectivity	Working Lands
Federally Threatened State Endangered		Nests in old-growth and older- second-growth conifer forests with large multistoried trees with moderate to high canopy closure. Nests are located on platforms created by large or deformed branches and are commonly covered in moss, lichen, or leaf litter that form a depression for their single egg. In 2016, the genetically distinct Santa Cruz Mountains population was estimated at just 657 individuals and is declining.																							
Mammals																									
ringed-tailed cat (*Bassariscus astutus*) Fully Protected	NF	Nocturnal, omnivorous, species that generally uses chaparral, oak woodlands, redwood forests, and riparian areas; preferring rocky areas with water available. Dens in rock outcroppings, hollow trees, caves, large animal burrows, and generally moves dens every few days to avoid predation. Little is known about the distribution and abundance of this elusive species in the RCIS Area.		✓				✓		✓				✓	✓			✓						✓	
mountain lion (*Puma concolor*) State Candidate	F	Wide-ranging, large carnivore that utilizes most natural and semi-natural vegetation in the RCIS Area that is in or adjacent to open space. A territorial predator with a large home range (100-150 square miles for males), mountain lion occur at low population density. The Santa Cruz Mountains population has low genetic diversity suggesting it is becoming isolated due to limited dispersal from habitat in the adjacent Gabilan and Diablo ranges. Individuals are impacted by depredation due to livestock impacts, vehicle strikes, and notoedric mange due to rodenticide exposure from development, all of which reduce the age of the population.												✓	✓							✓	✓	✓	✓

[1] Focal and non-focal species may also benefit from habitat protection, restoration, and enhancement actions in the Mountain Lion and Bat Habitat conservation strategies where they occur in their habitat

5.1.3 Conservation Strategy

For each conservation element, the background information in Table 5-1 is followed by the conservation strategy, which was developed based on a synthesis and critical evaluation of available information, including scientific reports, plans, and prior strategies in the RCIS Area. The strategies were also developed with input from technical advisors and refined based on the review by stakeholders (Section 1.7).

The strategies consist of four main components: goals, objectives, actions, and priorities (GOAP). For each action, the GOAP tables identify the pressures addressed and the focal and non-focal species that will benefit. Strategies for the natural communities are designed to promote focal and non-focal species by conserving habitat that they rely upon for key aspects of their life history and addressing their pressures and stressors. The conservation strategies for focal species build upon these community-level strategies and address unique objectives, actions, and priorities that are specific to the focal species and do not directly benefit the related community or communities.

5.1.3.1 Goals

The goals reflect broad, desired outcomes—that is, they identify what the strategy is designed to achieve in the RCIS Area. The goals for each conservation element address the following, where applicable:

1. Promoting persistence and integrity of the conservation element;
2. Connecting the conservation element within the landscape;
3. Protecting biodiversity and rare species;
4. Promoting water quality; and
5. Promoting water quantity.

The conservation strategies feature additional goals and not all of the general goals apply to each conservation element. **For standardization purposes, and to demonstrate the consistent approach across systems, the goals are sequenced in the order listed above, which does not necessarily reflect their priority or importance in the strategy**.

The RCIS explicitly does not prioritize between goals for each conservation element and instead recognizes that regional conservation often requires multiple co-equal goals that function at different spatial and temporal scales and between different local geographies. For example, while protecting and maintaining instream flows might be the most critical goal for improving ecological conditions in one stream reach within the RCIS Area, the highest priority for another reach might be improving water quality.

5.1.3.2 Objectives

The objectives generally address the 'tools in the conservation toolkit'; that is, the general ways in which the goals can be achieved. Objectives include the following:

1. Protect habitat, through acquisition of fee title or conservation easements;
2. Restore/Enhance habitat, to increase its structure and functions, and ability to support species;
3. Create/Expand habitat, particularly where habitat has been removed (e.g., wetlands); and
4. Conduct individual species/population-level actions, where needed to maintain declining populations, such as captive breeding, reintroductions, seed banking, or projects to enhance genetic diversity.

The RCIS strategies are designed to complement protection measures afforded by existing policies and regulations, which play an essential role in protecting biological systems in Santa Cruz County.

As with the goals:

- Not all objectives apply to each conservation strategy, and some strategies include additional objectives to address the unique conservation needs and opportunities.
- **Objectives are sequenced in the order they are listed above; however, that does not necessarily reflect their priority in achieving the stated goal.**

The RCIS takes an inclusive approach to achieving the conservation goals, recognizing that a diversity of actions, including habitat protection, restoration, and enhancement, as well as species-specific conservation actions, can and should be taken based on site-specific needs and opportunities.

The RCIS explicitly recognizes that habitat protection, alone, will not achieve the goals and objectives articulated in this RCIS. In order to achieve regional or landscape-scale conservation, this RCIS recommends a variety of conservation tools that include for both protecting natural communities from future impacts as well as addressing historic degradation of our ecological systems through restoration, enhancement, and stewardship. Specifically, restoration is needed to re-create the natural structure and species composition where it has been degraded, and to restore natural functions where they have been eliminated. Active habitat management is oftentimes needed to maintain the condition of habitat that is subject to ongoing stressors such as exotic plants, fire exclusion, and other factors that continued to degrade habitat (Section 5.2.4).

Protection of habitat from future impacts can be achieved through a variety of voluntary means including acquisition of fee title and conservation easements, which provide permanent protection, as well as a variety of stewardship incentives: incentive payments, tax benefits, cost

share and other programs that reward private landowners for the management of their land to achieve public benefits like clean water and wildlife habitat (Mackenzie et al. 2011). As a voluntary strategy for conservation, the RCIS habitat protection strategies are designed to complement existing policy protections by working with willing landowners to protect habitat that is identified as a priority for conservation.

This RCIS also acknowledges that regional conservation will require participation of both public and private landowners will need to be conducted on both protected and unprotected lands.

To the extent feasible, the objectives are "SMART": Specific, Measurable, Achievable, Relevant and Timebound. For habitat protection, the objectives often quantify the amount that needs protection to achieve the goal of promoting persistence and integrity of the conservation element. These quantitative habitat protection objectives were informed by the gap analysis (Section 5.2). Similar quantified objectives can be found for certain restoration, enhancement, and creation objectives.

5.1.3.3 Actions

For each objective, the conservation strategies identify one or more actions—steps that can be taken to achieve the objective. The RCIS program guidelines identify two main types of actions which are subject to different methods of crediting as part of mitigation credit agreements (CDFW 2018):

1. **conservation actions:** actions that would permanently protect or restore, and perpetually manage, conservation elements, including focal species and their habitats, natural communities, ecological processes, and wildlife corridors. In this RCIS, habitat protection constitutes a conservation action.
2. **habitat enhancement actions:** actions that would have long-term durability but would not involve acquiring land or permanently protecting habitat (e.g., improving in-stream flows, enhancing habitat connectivity, and controlling invasive species). In this RCIS, restoration and enhancement of habitat as well as enhanced management of pressures and stressors including altered disturbance regimes, exotic species, and incompatible recreation, are all types of habitat enhancement actions.

As with the goals and objectives, the RCIS does not prioritize one type of action (conservation or habitat enhancement) over the other. Instead, this RCIS acknowledges that both types of actions are needed and may be more or less preferred and/or feasible in different situations.

5.1.3.4 Priorities

For each action, the conservation strategies identify conservation priorities: conservation actions and enhancement actions selected based on their importance for benefiting and contributing to the conservation of focal species and other conservation elements. Recognizing that the actions exceed available funding and other resources, the priority actions reflect the investments that should be emphasized and prioritized.

In some cases, the priorities identify specific projects. More commonly, however the priorities identify the criteria for actions that are most likely to benefit the conservation elements. These criteria can include a variety of additional types of information including (but not limited to): 1) geographic areas, such as watersheds, general regions/locales, existing protected lands, 2) types of habitat (e.g., perennial streams), 3) types of management or restoration treatments (e.g., specific exotic plants to be controlled), and 4) ways to work to maximize benefit, such as criteria for habitat to be protected, connected, restored, enhanced, or created. These criteria-based priorities are designed to focus investments on the types of projects of greatest benefit, in situations where comprehensive lists of projects are not already available. Providing priority criteria rather than specific projects (or even locales) also enables practitioners to identify priority actions during implementation, including by assembling additional information during project design that was not available during development of the RCIS.

5.1.3.5 Pressures Addressed

For each action, the GOAP table also list the pressures addressed through implementation of the action. This list provides a 'through line' between the analysis of pressures and stressors on the conservation elements (Section 4) and the conservation strategies (Section 5.3) by demonstrating how the actions address the pressures and stressors. In most cases, these links are direct; for example, habitat protection actions are ascribed as addressing the effects of development, while habitat restoration actions are attributed to addressing specific factors that degrade habitat, such as exotic plants. In some cases, the benefits of the action are indirect: for example, many habitat protection, restoration, management, and enhancement actions will increase species populations and thus render them more resilient to many of the impacts of climate change (Heller and Zavaleta 2009).

5.1.3.6 Species Potentially Benefited

For each action, the GOAP tables also identify the focal and non-focal species that can potentially benefit from the action. This assessment is based on an analysis of the habitats and species that will benefit from the action and species associations with those habitats, which is summarized in Table 5-2.

The "Species Potentially Benefited" column provides a through line between the strategies and the focal and non-focal species to aid in the design of projects to benefit species, including mitigation projects and mitigation credit agreements designed to obtain specific mitigation credits for species (Section 6.1.3.2.3). In addition to listing focal and non-focal species by name, this column identifies additional co-benefited species as a group based on the community types in which they occur, and/or the focal species within which they co-occur (Table 5-2).

5.2 Gap Analysis

This section describes the gap analysis that was conducted to help inform the habitat protection strategies, and outlines important factors to be considered in its use (Section 5.2.4).

5.2.1 Objectives

The gap analysis was conducted to:

1. identify the degree to which the conservation elements are captured in existing protected areas including, by calculating the total acreage (or number of features) and percentage of each that is currently in conservation protection (CDFW 2018); and
2. help identify quantitative targets for habitat protection for use in the objectives for each conservation strategy (Section 5.1.2.2).

The gap analysis does not address habitat restoration, enhancement, management, or stewardship. Such targets were developed through a separate approach (Section 5.2.4).

5.2.2 Methods

The area targeted for habitat protection was calculated through the following steps, which are illustrated in Table 5-3, which presents the gap analysis:

1. selecting the best-available spatial data depicting the conservation element extent;
2. identifying an overall protection target that reflects the rarity and uniqueness of the system;
3. using spatial analyses to calculate the percentage of habitat within existing protected lands;
4. calculating the additional habitat that needs to be protected to achieve the overall habitat protection target; and
5. identifying a target for the first 10 years of implementation of the RCIS.

5.2.3 Targets

The habitat protection targets in the RCIS were based upon those presented in the *Conservation Lands Network 2.0* (BAOSC 2019) and the *Conservation Blueprint for Santa Cruz County* (Mackenzie et al. 2011) but were adjusted in some cases to reflect the relative rarity and importance of systems in the RCIS Area.

The protection targets incorporated in these prior plans and the RCIS reflect the conservation biology tenet that protection of 50% of the land and water from development or other land uses that impede its ability to support species and natural communities will be necessary to safeguard biodiversity and to sustain critical ecosystem functions (Wilson 2016, Dinerstein et al 2017). The global target is rooted in island biogeography research showing that a change in area of habitat results in a change in the sustainable number of species by approximately the fourth root and that protecting half of the global surface is expected to protect 85% or more of the species (Wilson 2016).

Higher protection targets (75% - 90%) were established for rare, diverse, and irreplaceable communities including ponds, sandhills, maritime chaparral, and habitat for focal species (Table 5-3) where 50% of the habitat would be insufficient to sustain the rare species including numerous species endemic to the RCIS Area. Higher protection targets were also used for relatively widespread but diverse communities that are important for native animals (e.g., Oak woodlands) and/or have experienced large declines in their areal extent due to habitat conversion (e.g., grasslands), since the percentage protection target is based on the amount of current habitat, rather than the original habitat available to support the species (Table 5-3). For other widespread communities, such as Redwood and Douglas-Fir Forest which covers nearly half of the RCIS Area (Table 2-8), the gap analysis uses a 50% target but provides higher protection targets for habitats within that broader community type that are essential for rare species including old-growth redwood forests and other habitat important for marbled murrelet (Table 2-8).

The RCIS also set a 10-year protection targets at one third (33%) of the total target based on the idea that the total protection goal could be achieved within 30 years and a third of that could be accomplished in the first 10 years. This near-term target is analogous to, and supportive of, the ’30 by 30’ executive orders for California and the United States, which are seen as intermediate targets to protect 50% of the habitat 2050 (BAOSC 2019).

Table 5-3: Gap analysis and habitat protection targets

Conservation Element	Habitat Feature	Units	Total in RCIS Area	Quantity Protected[1]	Percent Protected[1]	Percentage Protection Target	Protection Target (Units)	10-year Target (Units)[2]
Aquatic Systems								
Bar-Built Estuaries	Estuarine	Acres	155	46	30%	90%	94	31
	Coastal Salt Marsh	Acres	125	71	57%	90%	42	14
	Adjacent Freshwater Marsh	Acres	26	16	62%	90%	7	2
Riparian and Riverine	Streams	Miles	1,569	560	36%	50%	225	75
	Riparian Woodland	Acres	3,412	1,031	30%	50% Above Current[3]	516	170
Ponds, Lakes, and Reservoirs	Ponds	Features	445	90	20%	90%	311	103
	Lakes and Reservoirs	Features	8	6	75%	90%	1	0
Freshwater Wetlands	Freshwater Wetlands	Acres	767	490	64%	90%	200	67
	Seeps and Springs	Features	107	46	43%	90%	50	17
Aquatic Species								
Coho Salmon	Coho salmon streams	Miles	48	20	42%	90%	23	8
Santa Cruz Long-Toed Salamander	Undeveloped Habitat within the Population Area[4]	Acres	14,268	2,439	17%	90%	10,402	3,467
	Ponds and Lakes within the Population Area	Features	44	12	27%	90%	28	9
Southwestern Pond Turtle	Freshwater Wetland	Acres	767	490	64%	90%	200	67
	Ponds, Lakes, and Reservoirs	Features	453	96	21%	90%	312	104
	Stream	Miles	1,569	560	36%	50%	225	75
Terrestrial Systems								
Beaches, Dunes, and Rocky Cliff	Beaches, Dunes, and Rocky Cliffs	Acres	588	327	56%	90%	202	67

Conservation Element	Habitat Feature	Units	Total in RCIS Area	Quantity Protected[1]	Percent Protected[1]	Percentage Protection Target	Protection Target (Units)	10-year Target (Units)[2]
Karst Formation	Caves	Features	6	6	100%	100%	TBD[4]	TBD[5]
	Marble Outcrops	Acres	1,363	466	34%	90%	761	254
Grasslands	Grasslands	Acres	14,715	4,662	32%	90%	8,582	2,860
Sandhills	Sandhills	Acres	5,630	1,953	35%	75%	2,270	756
	Sand Parkland	Acres	255	149	58%	90%	81	27
Maritime Chaparral and Knobcone Pine Forest	Maritime Chaparral	Acres	8,033	2,451	31%	90%	4,779	1,593
	Knobcone Pine Forest	Acres	6,463	3,655	57%	90%	2,162	721
Oak Woodland and Forest	Coast Live Oak	Acres	19,055	5,478	29%	75%	8,813	2,938
	Coastal Mixed Hardwoods	Acres	6,326	1,680	27%	75%	3,065	1,021
Santa Cruz cypress	Santa Cruz cypress forest	Acres	208	105	50%	90%	82	27
Monterey Pine	Monterey pine forest	Acres	639	261	41%	90%	314	105
Redwood and Douglas-Fir Forest	Redwood forest	Acres	122,791	48,240	39%	50%	13,156	4,385
	Redwood-Douglas-Fir forest	Acres	11,993	5,932	49%	50%	65	21
	Pacific Douglas-Fir forest	Acres	6,883	2,602	38%	90%	840	280
	Old-growth and older second growth forest	Acres	10,306	7,173	70%	90%	2,102	701
Terrestrial Species								
Zayante band-winged grasshopper	Sand Parkland	Acres	255	149	58%	90%	81	27
Santa Cruz tarplant	Critical Habitat	Acres	2,604	652	25%	90%	1,692	564
	Nesting Range	Acres	83,736	44,479	53%	75%	18,323	6,108

Conservation Element	Habitat Feature	Units	Total in RCIS Area	Quantity Protected[1]	Percent Protected[1]	Percentage Protection Target	Protection Target (Units)	10-year Target (Units)[2]
Marbled Murrelet	Important Areas[5]	Acres	11,420	7,885	69%	90%	2,393	798
	Critical Habitat	Acres	26,880	25,440	95%	100%	1,440	480
Mountain Lion	Natural and Semi-Natural Areas[7]	Acres	226,742	86,319	38%	50%	27,052	9,017
Other Conservation Elements								
Bat Habitat	Natural and Semi-Natural Areas[7]	Acres	226,742	86,319	38%	50%	27,052	9,017
Connectivity	Significant Habitat Patches/Complexes	Acres	106,244	56,183	53%	75%	23,500	7,833
Working Lands	Rangeland	Acres	19,244	7,563	39%	75%	6,870	2,290
	Timber Protection Zone	Acres	68,306	25,008	37%	75%	26,222	8,740
	Cultivated	Acres	26,414	3,399	13%	75%	16,412	5,470

[1] Amount protected from conversion to residential or commercial development and managed for open space or agriculture by fee title or conservation easement (Section 2.2.5). This does not necessarily mean the habitat is intact or functioning; many protected lands feature habitat that is degraded and requires restoration.

[2] Target for the 10-year term of the RCIS, which was set at 33% for all targets

[3] The target for riparian woodland is to protect 50% more acres of the habitat than is currently protected. This target was set as many riparian communities have some level of protection from future impact due to legal restrictions in the form of setbacks or buffers that are part of land use regulation enforced by cities and county.

[4] Undeveloped habitat includes all communities and other land cover except urban/built-up areas

[5] All mapped caves are protected. Additional unmapped caves including any caves discovered in the future should be protected

[6] Important areas for marbled murrelet (Singer 2012b)

[7] Natural and Semi-Natural Areas include all communities and other land cover types except cultivated and urban/built up areas

5.2.4 Important Considerations

The following outlines important factors to consider in using the gap analysis and resulting quantitative targets to inform conservation actions through the RCIS.

1. **Habitat Protection Targets Overlap:** Many of the protection targets in Table 5-3 overlap (stack) within the landscape; for example, areas of oak woodland occur within the habitat patches that are important to protect for habitat connectivity and constitute habitat for mountain lion, bats, and in some places, Santa Cruz long-toed salamander. For this reason, there is no overall habitat protection goal or total for the RCIS Area.

2. **Multiple-Benefited Projects:** The overlapping nature of the conservation targets creates opportunities for those implementing the RCIS to achieve multiple habitat protection objectives when conducting land protection as well as habitat restoration and enhancement projects. This 'multi-benefit' approach to conservation is a cornerstone of the conservation strategy in the *Conservation Blueprint for Santa Cruz County* (Mackenzie et al. 2011) and can be used to achieve additional conservation goals for the region that are not addressed in the RCIS, but have been identified as important to members of the community during preparation of more comprehensive conservation plans. These other conservation values include, but are not limited to: safeguarding the water supply, protecting important cultural resources including culturally significant landscapes, providing equitable access to parks and open space, and mitigating the impacts of climate change (i.e., by conducting projects that sequester carbon).

   The spatial database developed for the RCIS gap analysis can be combined with spatial data depicting these and other conservation values to identify specific locations for conservation projects to achieve multiple conservation benefits and objectives (Section 6.1.5).

3. **Voluntary Strategies:** All of quantitative objectives in the RCIS, including those for habitat protection as well as habitat restoration, are designed to achieve the goals of this voluntary strategy. All actions to implement the RCIS will be conducted with willing landowners: the RCIS does not create, modify, or impose regulatory requirements or standards or regulate land use (Section 1.5.6).

4. **Permanent Habitat Protection:** The gap analysis assesses the percentage of habitat that is permanently protected as identified in the California Protected Areas Database (GIN 2021), which identifies land protected through fee title and/or conservation easement (Section 2.2.5). It does not reflect additional land that may be protected from land use activities that would remove or degrade habitat, including policies and regulations (e.g., zoning) or temporary open space easements (e.g., Williamson Act contracts). It also does not address habitat that might be regarded as *de facto* protected by virtue of its

topography (i.e., slopes), hydrology (i.e., inundation), or other aspects that might constrain its development or conversion to other uses. These natural constraints and policy protections should be considered in prioritizing land for permanent protection to maximize effective use of limited resources for conservation.

5. **Multiple Habitat Protection Mechanisms**: There are multiple ways to work with willing landowners to protect habitat including conservation easements and stewardship incentives. These alternative methods of habitat protection can provide many advantages to fee-title acquisition, as highlighted by Mackenzie et al. (2011). The most suitable and appropriate mechanism for habitat protection should be identified in coordination with willing landowners to prevent the loss, fragmentation, and degradation of habitat in order to safeguard native species, maintain natural communities, and sustain ecosystem processes that maintain them and provide important ecosystem services.

6. **Restoration and Enhancement Are Essential:** Due to the existing loss and degradation of habitat, restoration and enhancement are essential to achieving many of the goals and objectives for the RCIS. While the quantitative gap analysis conducted to develop the RCIS focuses on setting targets for habitat protection, habitat restoration and enhanced management are broadly recognized as essential to maintaining species, communities, and ecosystems in the face of the pressures and stressors, including to promote resiliency in the face of climate change (Heller and Zavaleta 2009).

   The conservation strategies for several natural communities and species in the RCIS feature quantitative targets for restoration. Unlike the protection targets developed through the gap analysis, these recommendations were identified through a review of restoration opportunities in the Integrated Watershed Restoration Program, a number of large restoration and conservation planning efforts currently underway in the County, as well as dialogue with technical advisors.

   Where quantitative targets for restoration and enhancement are not included, due to lack of comprehensive spatial data to indicate the area of habitat that is impaired, the RCIS strategies specify the specific areas, or the criteria that can be used to identify and prioritize areas for restoration. These strategies are recommended for existing protected lands, as well as private lands (in coordination with willing landowners), where the restoration and enhancement project benefits can be sustained.

   Where quantitative targets are not provided, the RCIS recommends that restoration and enhancement be conducted in as broad an area as practicable, given inherent constraints including the need to balance restoration and enhancement with other strategies to ensure that conservation resources are applied to the maximum beneficial effect for achieving the goals and objectives. The spatial database developed for the

RCIS gap analysis can be combined with other spatial data, to help identify specific locations for restoration and enhance projects to achieve these targets and inform development of quantitative targets as part of step-down processes to implement the RCIS, including by convening working groups (Section 6.1.2).

7. **Use of Best Available Data:** The gap analysis used the best available data to depict the areal extent of the species, natural communities, and other aspects of the conservation elements address in the strategy. As new data are developed and can more accurately depict the conservation elements, the quantitative targets, including the habitats targeted for protection and their percentage protection targets, may need to be adjusted to reflect the new information. Most notably, the forthcoming fine-scale vegetation map for the Santa Cruz Mountains is anticipated to provide greater resolution (and accuracy) in depicting the natural communities within the RCIS Area including by identifying different types of communities within the broader types (Section 2.4.5). Such higher-resolution information can be used to set more precise goals for widespread communities such as Redwood and Douglas-Fir and Oak Woodland, to protect the numerous distinct community types mapped therein, which support different assemblages of native plants, animals, fungi, and other biota.
8. **Gaps in Existing Scientific Information:** This RCIS was developed through a review of scientific information about the RCIS Area and the ecological systems and species therein. There are gaps in scientific information that, once filled, could be used to modify, or improve the RCIS conservation strategy, including the goals, objectives, actions, and priorities. The RCIS strategies themselves include actions to fill data gaps to promote their long-term effectiveness. The following are some of the key gaps in scientific information. Other system-specific data gaps are noted in the sections conservation strategies.
    - Focal species, non-focal species, and co-benefited species population distributions, abundances, and trends;
    - The distribution of natural communities, which are described and illustrated in this document based on the best available information for the RCIS, with new mapping data are anticipated to be available in 2023 (Section 2.4.5);
    - The condition of the natural communities within the landscape, in terms of anthropogenic features that degrade them such as exotic plants and animals, to comprehensively assess the need for, and to prioritize, restoration;
    - The natural disturbance regimes for communities, to which species have adapted, including the type, severity, intensity, and return intervals of fire and floods; and

- The long-term, net effects of climate change on natural communities and focal species, which will be mediated by a host of direct and indirect effects and thus are difficult to predict.

5.3 Strategies for the Conservation Elements

This section contains the conservation strategies which are organized by community type beginning with the aquatic systems, followed by the terrestrial systems the other conservation elements. The focal species strategies follow the community or other conservation elements with which they are most closely tied, recognizing that most focal species are associated with more than one natural community or other conservation element.

5.3.1 Bar-Built Estuary

Bar Built Estuary

Status and Global and State Ranks

- Bar Built Estuaries (BBE) are Sensitive Natural Communities, and can include:
    - Pickleweed mats (52.215.00): G4, S3
    - Salt marsh bulrush marshes (52.215.00): G4, S3
    - Sea lyme grass patches (41.260.00): G4, S2
    - Cattail marshes (52.050.00): G5, S5
    - Arroyo willow thicket (61.201.00): G4, S4
- County of Santa Cruz Sensitive Habitat (lagoons, stream corridors, beaches)
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone (coastal salt marsh, lagoon, wetland)

Detailed Descriptions

Smith 1990

Clark, R and K. O'Connor 2019

Heady et al. 2014

Largier et al. 2019

Distribution and Range

- 306 mapped acres in the RCIS Area (Figure 5-1):
    - 155 acres of estuarine and marine waters
    - 125 acres of adjacent coastal salt marsh
    - 26 acres of freshwater wetlands that is direct adjacent to either coastal salt marsh or estuarine and marine waters

- BBEs in Santa Cruz County range from minimally disturbed systems that continue to support a mosaic of dune, lagoon, pond, and marsh plain habitat to heavily modified urban BBEs that no longer support a mosaic of habitat types and have severely impacted ecological function from on-going modification and management.

The key BBEs in the RCIS Area include:

- The non-urbanized BBEs of Waddell, Scott, Laguna, Baldwin (Mile 3 Beach), Lombardi (Mile 4 Beach) and Wilder creeks, as well as Younger Lagoon and Moore's Lagoon (Natural Bridges) along the North Coast;
- The urbanized BBEs of San Lorenzo, Soquel, and Aptos creeks in the San Lorenzo and Mid-County regions; and
- The Pajaro River BBE in the Pajaro Watershed Region, which includes the tidal portions of the Watsonville Slough.

There are also five smaller, urbanized lagoons that historically functioned as BBEs including Woods Lagoon in the City of Santa Cruz, and Schwan Lake, Bonita Lagoon, Corcoran Lagoon, and Moran Lake in the County of Santa Cruz. In their current form, Schwan Lake is essentially permanently closed with freshwater outflow and tidal influence significantly muted by a small culvert and Woods Lagoon is essentially permanently open. These systems, like their counterparts in the San Lorenzo and Mid-County, are significantly impacted by poor water quality, lack of connectivity to other natural aquatic and terrestrial communities, constrained natural processes, etc. Of these five, only Corcoran Lagoon is considered to be functioning in a relatively 'natural state' (SCCRA 2021), and it is also considered critical habitat for the federally endangered tidewater goby.

Key Ecological Elements

- BBEs are found at the mouths of riverine systems and represent the connection between the marine environment and freshwater environment. BBEs are defined by the presence of a wave-built sandbar that seasonally forms, causing a pond to form upstream of the bar. The BBE sand bar breaches periodically during periods of large waves and/or strong stream flow, reestablishing freshwater connectivity with the marine environment (Clark and O'Connor 2019). The term BBE refers to the entire system that experiences marine and freshwater mixing including associated dune/beach, marsh plain, lagoon, pond, and tidally influenced riverine habitats.
- Based on local geology and the degree of natural or human created confinement by adjacent uplands, these systems may support spatially extensive coastal or freshwater wetland habitats (e.g., Scott Creek) or they may support only a narrow estuary comprised of an open water channel (e.g., Aptos Creek).
- All of the BBEs in the RCIS program have been significantly altered by transportation, agriculture, urban development, historic logging practices, and hydrologic modifications

resulting in a reduction of the overall surface area of marsh plain and open water areas as well as reduction in dry season inflows. BBEs within the RCIS Area have been estimated to currently occupy 20% or less of their historic area (2nd Nature 2006).

- Habitat and niche diversity within BBEs is driven primarily by the cycle of opening and closing of the sandbar that results in major shifts in conditions such as depth and duration of inundation, water temperature, salinity, dissolved oxygen, hydrologic connectivity, and velocity. The process of bar closure and breaching creates significant temporal and spatial variability, which can lead to greater complexity in BBEs that are less constrained and impacted by development. Complexity can include vegetation diversity, channel complexity (i.e., alcoves, backwater habitat, marsh plain ponds, etc.), sediment-sorting complexity, shading complexity and other components that will increase the diversity of the physical setting. A more diverse physical lagoon with freshwater inflow regimes that are less impacted is more likely to possess a greater number of biological niches and directly increase opportunities for increased species diversity (2nd Nature, 2006).
- Water quality in BBEs, in terms of water temperature, salinity, and dissolved oxygen relationships, is heavily driven by salinity stratification. The stratification effects are driven by the amount of freshwater inflow after bar formation and to some degree by wind mixing. Sufficient inflow can convert a closed BBE to a cooler, mixed, freshwater system (Smith 1990). Prolonged or persistent stratification in a closed BBE tends to result in a warm lower saline layer, which because of limited mixing with more oxygenated freshwater, may develop dissolved oxygen issues. Nutrient loading from upstream land uses and other sources can further exacerbate problems with low dissolved oxygen by creating conditions for algal blooms that can result in subsequent peaks in oxygen demand during decomposition.
- Sandbar closure is generally driven by coastal dynamics and the ability of the coastal swell to deliver sediment to the beach berm and exceed the elevation of the lagoon water surface. The timing and extent of bar closure is also affected by freshwater discharge with bars closing earlier during drought periods with very low inflows and staying open longer in water years with high spring and summer discharges. BBE closure events generally occur in the late spring or summer as ocean swells increase and freshwater inflows are reduced by limited run-off and/or increased human water use.
    - The timing of closure influences both the ability of smolting salmonids and adult steelhead to emigrate to the sea, as well as the potential for seasonal inundation of marsh plains and the resulting hydrologic connectivity between the main lagoon/creek channel and the marsh plain, ponds, backwater areas, etc. (Largier et al. 2019, Clark and O'Connor 2019). While early bar formation can impact emigration of salmonids, late bar formation can impact whether freshwater inflows are sufficient to inundate adjacent marsh plains.

- Late fall or winter breaching is critical to enable adult coho salmon and steelhead to enter watersheds to spawn.
- The seasonal connectivity between inundated areas in closed BBEs, generally occurring in the summer and fall, is critical for rearing of steelhead, breeding, and foraging of California red-legged frog, and access to breeding and rearing habitat for tidewater goby. Inundation can also occur during late fall and early winter rainfall events that provide enough flow to inundate the marsh plain, but less than what is required to breach the sandbar or through wave overwash events that deliver large volumes of seawater to the lagoon.
- Summer and early fall are the times when water quality problems that influence lagoon ecology (and human health) are most likely to occur, especially when circulation is reduced due to sandbar formation and reduced inflows and salinity stratification. Stratification and anoxia can lead to both direct mortality of focal and non-focal species as well as metabolic impacts through loss of prey species such as mysid shrimp and amphipods.

- While breaching is a natural process, it can result in fish and wildlife impacts due to rapid mobilization of anoxic or hypoxic water if the water column has not "freshened" and de-stratified prior to breaching. Breaching can also result in the flushing of aquatic species, e.g., tidewater goby or juvenile salmonids, into the ocean during the rapid evacuation of water during a breach. Anecdotal evidence suggests that BBEs that support a mosaic of instream habitats that are protected from the high energy associated with rapid draining during breaching (e.g. off channel alcoves, pools with cover, etc.) may provide more resilient habitat for a suite of aquatic species (J. Smith, pers. comm. 2021).
- Benefits in terms of ecosystem services from BBEs accrue to local human communities and include recreation, flood attenuation, buffering of marine storm surge, reducing damage to surrounding lands, and water filtration.

Pressures and Stressors

Pressures and stressors affecting Riverine and Riparian communities are highly likely to either directly or indirectly impact habitat quality and quantity of downstream BBEs. "By being at the bottom of catchments, estuaries accumulate environmental stresses from the entire watershed, including altered flows of water and sediment, pollution and eutrophication" (Clark and O'Connor 2019). Table 4-1 highlights the pressures and stressors affecting BBEs, which include the following most critical ones:

- BBEs have been heavily impacted by urban development (i.e., homes, roads, etc.), flood control and recreational infrastructure, and agriculture practices that have resulted in significant reductions in the acreage, loss of complexity, reduction of dry-season freshwater inflows, fragmentation of habitat and water quality degradation. Cross-

sectional constrictions of river mouths, such as bridge structures, road crossings, floodplain development, and flood control levees, impact the formation and breaching regime of sandbars, which directly impacts ecological functions.

- Eutrophication resulting from human-induced nutrient loading is a critical stressor influencing the ecology in the urban BBEs. Issues related to BBE eutrophication can be amplified in systems with high degrees of salinity stratification and mitigated with high degrees of wind or inflow driven mixing (2nd Nature 2006).
- Water quality degradation and contamination from upstream riverine systems impacts both biogeochemical cycling, water temperature, sediment transport dynamics, and lead to the accumulation of contaminants and pathogens such as *Toxoplasma gondii* in BBEs and blooms of toxic algae. A number of BBEs in the RCIS Area are either directly listed as impaired under Section 303d of the Clean Water Act or are receiving waters for impaired riverine systems (e.g., San Lorenzo, Pajaro, etc.)
- Water management practices including instream water diversions and groundwater pumping can greatly reduce freshwater inflows during closed bar conditions in the late spring through early fall, impacting the ecologically crucial transition from brackish to freshwater during closure; this can reduce habitat availability and compound water quality issues.
- Authorized and unauthorized breaching of closed systems for flood control, water quality purposes, and/or recreation can result in a wide array of impacts to plants and animals through rapid draining of lagoons and marsh plains and unseasonal changes in salinity levels. Rapid draining can result in mobilization of anoxic or hypoxic water, stranding or flushing of fish and wildlife species, desiccation of marsh plain vegetation, and changes to fish and wildlife behavior from unintended hydrologic cues. Breaching can have different impacts on salmonids and other aquatic species, based on their life histories and water quality in a given lagoon, depending on the season. Authorized breaching (mechanical or manual) is occasionally implemented specifically to protect native animals from degraded water quality and to facilitate access between the freshwater and the marine environments.
- Invasive exotic plant species both within coastal salt marsh/tidal marsh habitats and natural areas adjacent to BBEs can impact both the structure and function of BBEs. Trees such as eucalyptus that have significantly higher water demand than native species can directly impact the amount of freshwater entering BBEs from the surrounding watershed. Ice plant can invade the adjacent dune and marsh plain habitats, leading to the exclusion of native plants and loss of sediment transport.
- Invasive exotic animals including striped bass, New Zealand mudsnail, red-eared slider, and American bullfrog, impact the aquatic food web and prey on native species including rare species such as southwestern pond turtle, juvenile steelhead, and coho salmon, and both tadpole and juvenile California red-legged frog, etc.).

- Unauthorized camping along the heavily urbanized San Lorenzo Lagoon and other lagoons can result in significant impacts to water quality, and native plants and animals.

Climate Change Vulnerability Assessment

- Hutto et al. (2015) assesses climate change vulnerability for coastal species and habitats along the north-central California coast, including BBEs. The assessment ranks BBEs as being moderate to high in terms of sensitivity, high in terms of exposure, moderate to high for adaptive capacity and moderate to high for overall vulnerability to climate change. Sea level rise (SLR; Figure 4-1), increases in sea surface temperature and wave action, and changes in precipitation are key drivers for both climate change sensitivity and exposure. From an adaptive capacity perspective, coastal salt marsh and freshwater wetlands that have room to migrate inland will have significantly higher adaptive capacity than coastal areas that are constrained by geology or infrastructure (Hutto et al. 2015).
- Collison and Behrens (2019) developed a Sediment Transport Conceptual Model for the Scott Creek BBE to assess the vulnerability of the system to SLR. The conceptual model looks at the relationship between SLR, sedimentation rates, and sediment trapping efficiency. The results are potentially applicable to other BBEs and suggest the following three possible future scenarios:
    - **Lagoon sedimentation keeps up with SLR**. The process likely occurs as a dynamic equilibrium with periods of the marsh 'catching up' or 'falling behind' SLR and requires higher than historic sedimentation to maintain pace with SLR until 2100.
    - **SLR exceeds lagoon sedimentation rate, drowning the lagoon and marsh**. If SLR exceeds a critical rate, and watershed sediment yield remains close to current levels, the marsh will not be able to keep up with SLR even if trap efficiency reaches 100%. In this scenario the lagoon would probably initially expand as marsh plain is drowned out, until ultimately it would become permanently open and convert to open water habitat
    - **Lagoon sedimentation exceeds SLR and the lagoon and marsh fill in with sediment**. Climate change or human-induced land use change is hypothesized to cause watershed sediment yield to increase to a level where SLR temporarily cannot keep up, even if trap efficiency is reduced. This would likely take the form of a number of episodic deposition events occurring after major increases in watershed sediment exposure, either from fires or extended droughts. There is a wealth of agreement from different climate change models and downscaling models that northern California will experience drier summers, lower soil moisture, more drought-stressed vegetation, and more wildfires, all of which are expected to result in higher sediment yields (Flint and Flint 2012). The predictions for rainfall are more diverse between models, but a common

prediction is for more extreme winter rainfall events. Both these findings suggest that sediment yield could increase compared to current and historic conditions. If several fires or prolonged droughts were followed by large flood events, it is possible that the main lagoon channel and marsh would be overwhelmed by the supply of sediment, causing the marsh areas to become a fluvial floodplain and ultimately a more terrestrial landscape.

The goals, objectives, actions, and priorities for the BBE (Table 5-4) will help address the impacts of climate change by:

1. Protecting adjacent, undeveloped open space and agricultural lands to provide space for BBEs to migrate inland and/or expand as climate conditions change to improve adaptive capacity.
2. Restoring and enhancing habitat, specifically through both: (a) removing infrastructure that constrains the ability of the system to migrate inland or behave naturally and restores natural physical processes; and (b) restoring upstream watershed processes that will result in more natural freshwater inflows and reduced occurrence of water quality degradation. These efforts will increase the area of suitable BBE habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and the potential for increased prevalence of low probability events.
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate the effects of (Heller and Zavaleta 2009), including alterations to the natural fire and sediment transport regimes, hydrologic change, exotic plants, and incompatible recreation.
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat to increase its suitability for species and permeability for their movement between the marine, estuarine, and fluvial environments enabling species to migrate seasonally and stay within their adapted climate envelope.
5. Critically assessing the role of sediment in addressing climate change vulnerability and adaptive capacity of BBEs. The role of sediment is particularly critical in light of recent wildfire impacts and potential for significant sediment and debris transport through many of the Riparian and Riverine systems and into these BBEs.
6. Evaluate the current and future management actions related to BBEs.

Species Associated with the Bar Built Estuary Community Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-4 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Coho salmon (*Oncorhynchus kisutch*) [F]
- Steelhead – Central California Coast and South-Central California Coast DPS (*Oncorhynchus mykiss irideus*) [NF]
- Tidewater goby (*Eucyclogobius newberryi*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- Southwestern pond turtle (*Actinemys pallida*) [F]
- San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) [NF]
- Western snowy plover (*Charadrius nivosus nivosus*) [NF]

Other Actions that Benefit this Conservation Element

The BBE communities, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of natural communities in or adjacent to BBE as part of CONNECT-A1 through CONNECT-A4 will help the goals and objectives for the BBE Conservation Element and improve adaptive capacity of BBEs within the RCIS Area.
- **Riparian and Riverine:**
    - Actions associated with Objectives RR-O1 through RR-O5 that focus on protection, restoration, enhancement of riparian and floodplain habitats will directly benefit downstream BBEs through restoration of natural sediment transport regimes, natural hydrological regimes including increased groundwater recharge, increased natural buffering capacity for water quality, and reduced transport of invasive plant species propagules downstream.
    - Actions to Restore unfettered access for aquatic species to naturally accessible reaches of riverine habitat between estuaries and headwaters to increase habitat availability and improve climate resilience for aquatic species, including during drought conditions (Objective RR-O9) will directly benefit BBEs.
    - Actions associated with Objective R-O14 through RR-O17 will directly benefit water quality in downstream BBEs.
    - Actions associated with RR-O20 that focus on protecting, restoring, and enhancing instream flows and groundwater recharge are critical for maintaining connectivity between BBEs and riparian and riverine communities as well as improving ecological function and water quality during closed bar conditions.
- **Freshwater Wetlands:** Actions related to Freshwater Wetland objectives FW-O1, FW-O2, FW-O4, FW-O5 are applicable to freshwater wetland communities that are part of a BBE.

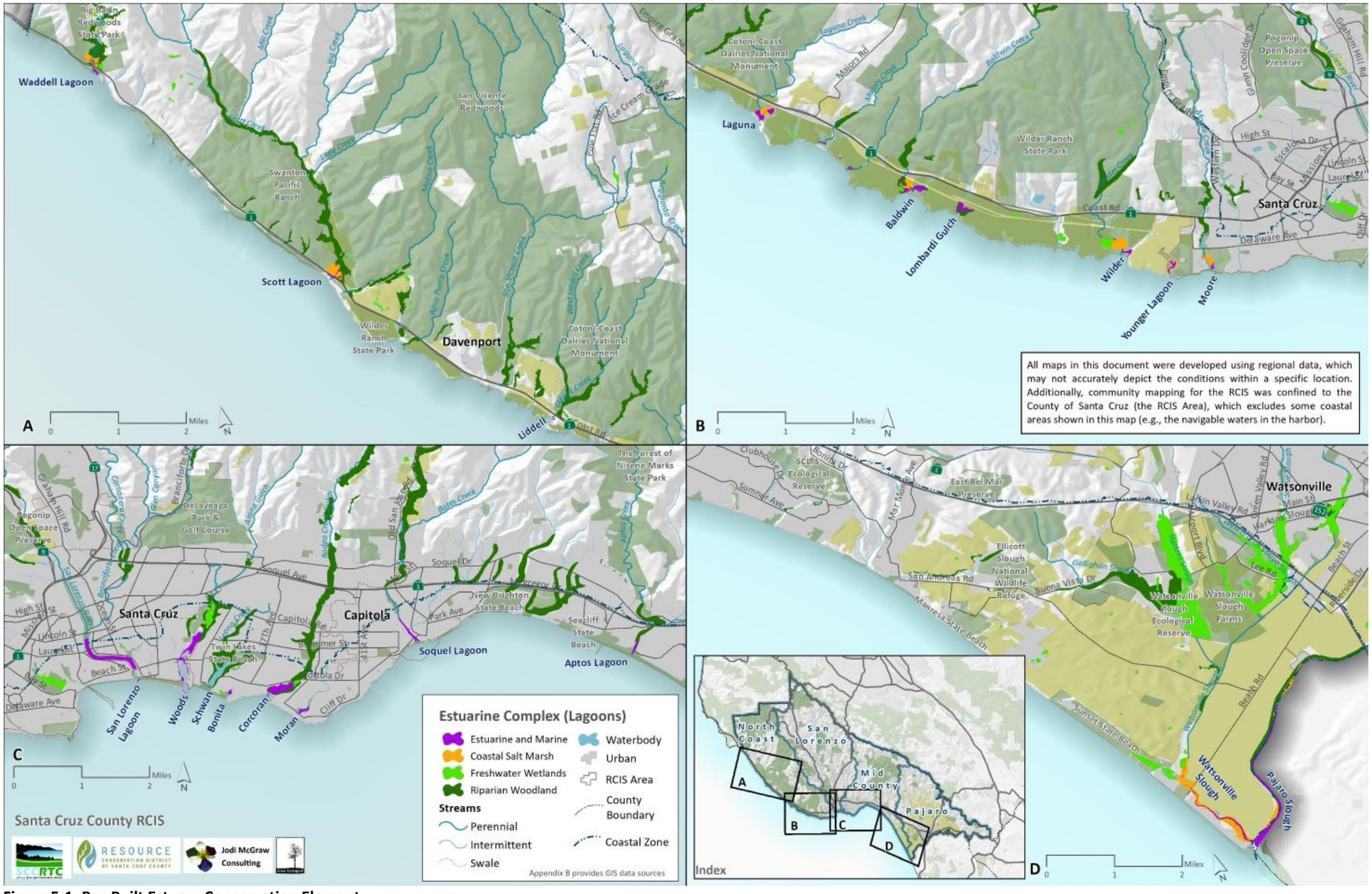

Figure 5-1: Bar-Built Estuary Conservation Element

Table 5-4: Conservation Strategy for Bar-Built Estuaries

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
BBE-G1: Promote persistence and ecological integrity of BBE ecosystems, the rare species they support, and the natural processes that sustain them.	**BBE-O1: Protect** an additional 49 acres of coastal salt marsh and freshwater wetland adjacent to the BBE, to achieve the 90% target for conservation of this element (Table 5-3), and protect undeveloped and open space lands adjacent to existing BBEs in order to buffer BBEs from impacts from adjacent land-use (e.g., impervious surfaces, contaminated run-off, etc.), allow BBE migration to adapt to SLR., and provide and/or expand habitat for rare species that rely on that ecosystem, that protect upland freshwater habitat from saltwater conversion. Measure progress toward achieving this objective by the number of acres of marsh within BBEs that are protected over the next 10 years.	**BBE-A1:** Identify and then protect via fee-title or conservation easement, existing unprotect freshwater wetland and coastal salt marsh within BBE, and undeveloped areas adjacent to BBEs in the RCIS Area that provide the highest potential ecological value and that increase potential adaptive capacity.	BBEs that provide known habitat for tidewater goby and southwestern pond turtle and rearing habitat for CCC and SCCC steelhead. • North Coast: Scott Creek and Majors Creek • Pajaro: Watsonville Sloughs and lower Pajaro River	• Development • Working lands • Increased fine sediment • Water use • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Southwestern pond turtle • Western snowy plover • Numerous co-benefited species
	BBE-O2: Protect/Enhance existing upland habitat and riparian corridors adjacent to BBEs to increase landscape permeability and the ability of wildlife to move between headwaters and the ocean. Measure progress toward achieving this objective by number of acres of habitat restored or enhanced adjacent to BBEs.	**BBE-A2:** Implement actions in the Riparian and Riverine OCE GOAP and Connectivity GOAP that increase connectivity between BBEs and adjacent communities	BBEs in anadromous fish bearing watersheds and BBEs that support tidewater goby.	• Development • Working lands • Water use • Increased fine sediment • Exotic plants/animals • Incompatible recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • San Francisco garter snake • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	BBE-O3: Restore, Enhance, and Expand 50 acres of BBE communities by removing or modifying existing development and infrastructure from areas within or adjacent to BBEs that that impact natural function or adaptive capacity, or that require chronic interventions that lead to ecosystem degradation. Measure progress toward achieving this objective by number of acres of habitat restored, enhanced and/or expanded	**BBE-A3:** Fund and implement priority restoration projects that enhance natural dynamism of BBEs, support recovery of multiple special-status species and enhance a mosaic of coastal salt marsh, freshwater wetlands, and open water.	• North Coast: Complete the Scott Creek Coastal Resiliency Project; Fund a feasibility study for replacement of the Highway 1 Bridge at Waddell Creek; Analyze feasibility of modifying the Hwy 1 crossing at Liddle Creek and restoration opportunities at Majors Creek. • San Lorenzo/Mid-County: Implement key ecological recommendations from Santa Cruz County Park's forthcoming Moran Lake Restoration and Public Access Plan. Continue efforts in enhance Soquel Creek and Aptos Creek, where feasible. • Pajaro: Implement the Watsonville Sloughs Ecological Restoration Project currently undergoing feasibility analysis in collaboration with the County, PVWMA, Army Corps of Engineers and others.	• Development • Working lands • Increased fine sediment • Exotic plants/animals • Incompatible recreation • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover • Numerous co-benefited species
		BBE-A4: Evaluate then implement, where feasible, multi-benefit projects that will reduce localized flooding and danger to life/property while remediating the ecological risks of mechanical or manual dry season breaching.	• San Lorenzo River: Complete the San Lorenzo Lagoon Culvert Project and evaluate the feasibility of using large woody debris (LWD) and other natural structures to create dunes on the western shore to reduce concerns related to meandering and erosion. • Mid-County: Continue management of the Soquel Lagoon by the City of Capitola for the benefit of native animal species; Develop a Lagoon Enhancement Plan that evaluates the costs/benefits of potential solutions for Aptos Creek BBE. • Pajaro River: Implementation of the Pajaro River Flood Risk Management Project should improve conditions in the estuary and remediate the risks associated with the current management.	• Development • Incompatible recreation • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Western snowy plover • Numerous co-benefited species
		BBE-A5: Evaluate and then implement, where feasible in light of SLR, a coastal adaptation strategy that focuses on removing development and derelict infrastructure that is prone to chronic	• North Coast: Lower Laguna Creek. • San Lorenzo River: Analyze the feasibility and trade-offs related to ecological function for	• Development • Water use • Increased fine sediment • Exotic plants/animals	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		flooding or coastal erosion to proactively remove stressors and allow BBEs to expand/migrate.	potential levee setbacks or other adaptation strategies. • Mid-County: Aptos, including State Parks infrastructure and Soquel; Schwann Lagoon which drains to Twin Lakes Beach. Replace East Cliff road crossings at Corcoran and Moran lagoons. • Pajaro: Pajaro River, Watsonville Slough	• Incompatible recreation • Climate change	• California red-legged frog • Western snowy plover • Numerous co-benefited species
		BBE-A6: Implement priority habitat restoration actions for estuaries in Santa Cruz County articulated in the recovery plans for 'CCC steelhead (NMFS 2016b), SCCC Steelhead (NMFS 2013) and CCC Coho salmon (NMFS 2012)	All watersheds in Core, Phase 1, and Phase 2 recovery areas for CCC coho salmon and CCC steelhead, and the Pajaro River and Corralitos Creek as Core 1 for SCCC Steelhead.	• Development • Working lands • Water use • Increased fine sediment • Exotic plants/animals • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
	BBE-O5: Expand/Create coastal salt marsh habitat and estuarine habitat adjacent to existing or historic BBEs to improve structure and function of plant communities and enable tidal BBE communities to adapt to SLR and migrate inland. Measure progress toward this objective through planning and implementation of projects focused on creating areas for future BBE progression inland.	**BBE-A7:** Implement, following assessment of feasibility, projects expand existing BBE or to create "analogue" coastal salt marsh and estuarine habitat inland of existing or historic marshes and BBEs to allow for future expansion of these systems in areas that are significantly constrained by Highway 1 or other essential infrastructure. Utilize an eco-geomorphic feedback lens (Kirwan and Megonigal 2013) to evaluate feasibility prior to project implementation.	• North Coast: San Vicente Creek, Molino Creek, Majors Creek, Laguna Creek, and Liddell Creek. • San Lorenzo River: Lower reaches of San Lorenzo River. • Mid-County: Lower reaches of Arana Gulch • Pajaro River: Watsonville Sloughs system	• Development • Water Use • Working lands • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefitted species
	BBE-O6: Reduce impacts to BBE function and habitats associated with beach recreation**,** to the greatest extent practicable**.** Measure progress toward meeting this objective through annual tracking of unauthorized	**BBE-A8:** Install educational signage in multiple locations along access routes and on the beaches of BBEs to discourage manual breaching of closed systems to protect aquatic and marsh flora and fauna.	• North Coast: All • San Lorenzo/Mid-County: San Lorenzo, Corcoran Lagoon, Moran Lake, and Aptos Lagoon	• Development • Water use • Incompatible recreation • Unauthorized activities	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	breaches for recreational purposes (via time lapse camera and reporting) and install educational signage at key BBEs throughout the RCIS Area.				• Numerous co-benefited species
		BB-A9: Create or continue use of controlled access zones on dunes and other sensitive beach resources associated with BBEs to avoid damage to sensitive resources (e.g., Western snowy plover nests) from people and pets and/or inadvertent transport of invasive species or pathogens into BBEs.	• North Coast: Waddell Creek and Scott Creek • South Coast: Pajaro River	• Exotic plants/animals • Incompatible Recreation • Unauthorized activities	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover • Numerous co-benefited species
	BBE-O7: Monitor BBEs to assess ecological conditions, measure success in achieving RCIS objectives, and design conservation actions to address emerging impacts and stressors. Measure success toward meeting this objective through the number of California Rapid Assessment Method (CRAM) assessment conducted annually in BBEs, implementation of key RCIS actions and priorities, and acquisition of water rights in high priority watersheds.	**BB-A10:** Utilize CRAM to track conditions in BBEs at least every 5 years.	Continue tracking BBE structure and function in all BBEs with existing CRAM scores/data, which include: Waddell, Scott, Laguna, Baldwin, Lombardi, Wilder, Younger, Moore's, Corcoran, San Lorenzo, Soquel, Aptos, and Watsonville Sloughs/Pajaro.	• Development • Working lands • Water use • Increased fine sediment • Exotic plants/animals • Incompatible recreation • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover • Numerous co-benefited species
BBE-G2: Maintain and enhance landscape connectivity to promote dispersal, and other ecological processes including gene flow and facilitate	**BBE-O9:** Implement BBE O1-O5.	**BBE-A11:** Implement actions associated with BBE-O1 through BBE-O5 and BBE-O19 that enhance connectivity and the ability for organisms to move into and out of BBEs**.**		• Development • Working lands • Water use • Incompatible recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
migration in response to climate change.	**BBE-O10: Restore natural breaching and closure dynamics for BBEs** to the greatest extent practicable to enable both seasonal connectivity with the ocean and non-estuarine stream reaches. Measure progress toward meeting this objective through development of mouth management plans for key BBEs.	**BBE-A12:** In support of planning projects to enhance priority BBE, build on current research in Scott Creek, Russian River, and elsewhere, data from the Comparative Lagoon Ecological Assessment Project (2nd Nature 2006), and new technologies to gain a stronger understanding of the physical drivers controlling breaching and closure to enable restoration of those processes and/or ecologically based management plans when human intervention is essential.	All BBEs that support runs of coho salmon and steelhead (CCC and SCCC) and tidewater goby.	• Development • Working lands • Water use • Sediment • Recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Coho salmon • Steelhead • Tidewater goby
	BB-O11: Restore unfettered access for aquatic species to naturally accessible aquatic habitat between estuaries and non-tidal stream reach to increase habitat availability and improve climate resilience for aquatic species, including during drought conditions. Measure progress toward meeting this objective through development of engineering designs and implementation plans for priority sites.	**BBE-A13:** Remove or modify any instream barriers that could impede movement between BBEs and upstream habitat. Prioritize instream barriers for removal in Santa Cruz County through an update of the PAD data and associated county-wide passage assessments with information from County Environmental Health, the Integrated Watershed Restoration Program Technical Advisory Committee, FishPAC (Passage Advisory Committee) and local experts.	• North Coast: Hwy 1 and railroad fill prisms that impede BBE function and movement; low flow barriers in lower Laguna and Liddle. • San Lorenzo: Riverine reach of lower mainstem, Branciforte Creek Flood Control Channel. • Pajaro: Watsonville Sloughs including at Shell Road pump station.	• Development • Water use • Sediment • Climate change • Loss of genetic diversity	• Coho salmon • Steelhead • Tidewater goby • Co-benefited fish species
		BBE-A14: Implement actions and priorities related to *Goal BBE-G5* (below) that will protect and improve aquatic connectivity through instream flow between lower reaches of riverine habitat and estuaries during low flow conditions.		• Development • Working lands • Water use • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Tidewater goby • Co-benefited fish species
	BBE-O12: Protect and Expand connectivity between coastal salt marsh within BBEs and adjacent uplands to enable landscape permeability. See metrics associated with BBE-O1 through BBE-O4.	**BBE-A15:** Implement actions and priorities related to *Objectives BBE-O1 through BBE-O4* that focus on protecting, restoring, and expanding adjacent habitats.	BBEs with known populations of southwestern pond turtle, San Francisco garter snake, and California red-legged frog.	• Development • Working lands • Sediment • Exotic plants/animals • Recreation • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
				• Loss of genetic diversity	• Numerous co-benefited species
BB3-G3: Promote the recovery and long-term persistence of both rare and common native species, including focal and non-focal species that rely on BBE communities.	**BBE-O13: Protect and restore** the natural processes that create habitat complexity and habitat heterogeneity in estuarine systems. See associated goals and objectives (above) for measure of progress toward achieving this objective.	**BBE-A16:** All actions and priorities from BBE-G1, BBE-G2, BBE-G4 and BBE-G5 that address structure and function of BBEs	• BBEs in coho salmon and steelhead watersheds • BBEs that support known populations of tidewater goby.	• Development • Working lands • Mining • Water use • Sediment • Exotic plants/animals • Recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Western snowy plover • Numerous co-benefited species
	BBE-O14: Protect and recover state and federally listed and special-status species (focal, non-focal, and co-benefited species) that rely on BBE communities within the RCIS Area for one or more critical life history stages. Measure progress toward achieving this objective through RCIS-wide surveys to establish presence/absence in BBEs and track population and abundance of special status species such as tidewater goby, southwestern pond turtle, coho salmon, and steelhead.	**BBE-A17**: All actions and priorities from BBE-G1, BBE-G2, BBE-G4 and BBE-G5 that address structure and function of BBEs	Increase sampling and surveys for tidewater goby, southwestern pond turtle, San Francisco garter snake, California red-legged frog in BBEs.	• Development • Working lands • Mining • Water use • Increased fine sediment • Exotic plants/animals • Incompatible recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho • Steelhead • Tidewater goby • California red-legged frog • Western snowy plover • San Francisco garter snake • Numerous co-benefited species
		BBE-A18: Implement recovery actions contained in the recovery plans for tidewater goby (USFWS 2005b), recommendations for the local Tidewater Goby Working Group, and recommendations based on genetics and sampling contained in Mendonca and Smith (2017) to guide prioritization.	• Areas identified by the USFWS as critical habitat for tidewater goby (Laguna, Baldwin, Corcoran, Aptos, and Pajaro) as well as Moran Lake. • Scott Creek Coastal Resiliency Project • Assess potential for modifying connection between Moore Creek and Antonelli's Pond to support additional freshwater inflows during drought condition to support the local population and the genetically linked population in Baldwin. • Assess potential for adding some velocity and drought refugia via LWD or other structures in currently occupied BBEs.	• Development • Working lands • Water use • Increased fine sediment • Exotic plants/animals • Incompatible recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Tidewater goby

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		BBE-A19: Continue existing research and develop/implement new long-term research to better understand population and range dynamics for focal and non-focal species that utilize BBE habitats.	• Support funding to continue and expand monitoring and research of steelhead and coho salmon use of BBEs; • Expand lagoon/estuarine sampling for tidewater goby and California red-legged frog in BBEs throughout the RCIS Area; • Develop and implement distribution and abundance research for southwestern pond turtle; • Survey annually for western snowy plover nesting on beaches with BBEs.	• Development • Working lands • Water use • Sediment • Exotic plants/animals • Recreation • Unauthorized activities • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Western snowy plover
		BBE-A20: Assess the feasibility of developing captive breeding and re-introduction programs in collaboration with CDFW, USFWS, and NMFS for species that are range limited by habitat fragmentation, genetically limited by population bottlenecks, or in need of this type of intervention for other scientifically validated reasons.	• Expand the existing coho salmon broodstock program, as habitat conditions allow and guided by adaptive management principles, to include out-planting of juveniles, smolts, and spawning adults to additional Core, Phase 1, and Phase 2 watersheds. • Re-introduce tidewater goby and southwestern pond turtle into BBEs that were historically occupied but are currently unoccupied but have suitable habitats to support self-sustaining populations and/or provide source populations for re-colonization of nearby watersheds. • Utilize genetic information developed by Mendonca and Smith (2017) to inform opportunities for goby re-introduction.	• Development • Working lands • Water use • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Tidewater goby
	BBE-O15: Restore coastal salt marsh structure and composition through removal of high priority non-native invasive plants and revegetation with native plants. Measure success by the number of invasive plant removal projects completed in BBEs.	**BBE-A21.**Prioritize eradication of known non-native invasive plant species that create documented ecological impacts through changes in disturbance regime, nutrient cycling, direct mortality or displacement of native plants, and related impacts on nesting and foraging success for native riparian birds and other native animals.	Strategically remove eucalyptus and acacia stands in the ecotones adjacent to BBEs to enable native tree restoration, reduce fire risk, and reduce water use while reducing potential site-specific impacts to raptor nesting or monarch overwintering. • Consider re-use of large eucalyptus for BBE LWD projects. • Prioritize removal of groves that do not provide breeding and roosting habitat for egrets, herons, or monarch butterflies. Where such groves are removed, maintain habitat structure through phasing tree removal and planting native canopy	• Development • Working lands • Water use • Exotic plants • Climate change	• Southwestern pond turtle • California red-legged frog • San Francisco garter snake • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			trees like sycamore and, where appropriate, Monterey cypress.		
		BBE-A22: Conduct outreach to reduce the potential sources for new invasions of known non-native invasive plant species	Nurseries, landscaping firms, farmers, and private landowners near BBEs.	• Development • Working lands • Water use • Exotic plants • Climate change	• Numerous co-benefited species
		BBE-A23: Implement early detection and rapid response for new invasive species hazards (plant and animal) and/or new infestations, through partnership with the Santa Cruz Weed Management Area, CDFW, and other local partners.	Countywide or Regionally	• Development • Working lands • Water use • Exotic plants • Climate change	• Numerous co-benefited species
	BBE-O16: Protect and recover native fauna through removal and eradication of non-native invasive animals that directly compete with, prey upon, or displace native aquatic animals and alter native cold or warm water fish assemblages. Measure success toward meeting this objective through the number of projects to remove invasive fauna that are planned and implemented.	**BBE-A24:** Develop and implement a Countywide American bullfrog eradication training and authorization program for public and private landowners and managers that are responsible for ponds, sloughs, and perennial wetlands to increase the pace and scale of bullfrog control/eradication efforts.	Countywide/RCIS Area with priority to areas located in close proximity to BBEs.	• Exotic Animals	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • San Francisco garter snake • Numerous co-benefited species
		BBE-A25: Identify and control/eradicate key source populations for carp, centrarchids, mosquito fish, and other warm water non-native fish species that can invade BBE and alter ecosystem processes and impact native fish and amphibian assemblages.	• Support current policies of the County Mosquito Abatement District to avoid use of mosquito fish in and near estuaries that support native warm-water or cold-water fisheries as well as focal and non-focal amphibian species. • During severe drought conditions when water levels are low and movement is constrained, utilize seining, boat-based electrofishing, or other means to capture and remove non-native invasive fish from lentic open water areas (sloughs, reservoirs) connected to BBEs and riverine communities such as the Watsonville	• Exotic Animals	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			Sloughs and College Lake as well as Antonelli Pond.		
		BBE-A26: Prevent invasions and control known populations of invasive invertebrates such as New Zealand mudsnail that may displace native species (e.g., California floater) and disrupt the BBE food webs.	• Expand prevention efforts for New Zealand mudsnail in habitats that have already invaded. • Continue control and prevention efforts to stop invasion into watersheds that are currently not known to support New Zealand mudsnail, especially North Coast coho salmon streams. Note that there is emerging research that suggests that New Zealand mudsnail may be a target prey species for tidewater goby.	• Exotic Animals	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby (?) • Numerous co-benefited species
BBE-G4: Protect and improve BBE water quality to reduce habitat degradation and support long-term persistence of native aquatic species	**BBE-O17: Protect and improve water quality** to meet adopted TMDL standards, basin plan standards, and delist systems currently listed under the state's 303d list for sediments and nutrients. Measure success through delisting of BBEs under 303d and obtaining TMDL compliance.	**BBE-A27:** Work directly with Central Coast Regional Water Quality Control Board staff to identify priority projects within TMDL/303d-listed waterbodies that will have a maximum benefit for focal and non-focal species in BBE communities (e.g., beneficial uses such as cold water and warm water fisheries)	• San Lorenzo River: 303d listed for sediment, temperature, nutrients, and pathogens; San Lorenzo River Sediment TMDL and San Lorenzo River Nitrite TMDL (CCRWQCB 2019). • Mid-County: Soquel Lagoon is 303d listed sediment, nutrients, and pathogens. • South Coast: Pajaro is 303d listed for sediment, nutrients, and pathogens and the Watsonville Sloughs are 303d listed for pathogens, pesticides, and sediment; Pajaro River Sediment TMDL and Pajaro River Nutrient TMDL (CCRWQCB 2019).	• Development • Working lands • Mining • Water use • Sediment • Exotic plants/animals • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefited species
		BBE-A28: Work with landowners and the Integrated Watershed Restoration Program Technical Advisory Committee to design, permit, fund, and implement Central Coast Regional Water Quality Control Board (CCRWQCB) priorities for fish and wildlife related beneficial uses in BBEs.	• San Lorenzo River: 303d listed for sediment, temperature, nutrients, and pathogens; San Lorenzo River Sediment TMDL and San Lorenzo River Nitrite TMDL (CCRWQCB 2019). • Mid-County: Soquel Lagoon is 303d listed sediment, nutrients, and pathogens. • South Coast: Pajaro is 303d listed for sediment, nutrients and pathogens and the Watsonville Sloughs are 303d listed for pathogens, pesticides, and sediment; Pajaro River Sediment TMDL and Pajaro River Nutrient TMDL (CCRWQCB 2019).	• Development • Working lands • Mining • Water use • Increased fine sediment • Exotic plants/animals • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	BBE-O18: Protect urban BBEs from nutrient and contaminant loading. Measure progress toward meeting this objective through trends toward improving water quality using urban BBE monitoring data.	**BBE-A29:** Work with the cities of Santa Cruz and Capitola and the County of Santa Cruz to upgrade or repair leaking sewer lines and RV dumping to remediate impacts of contaminated run-off through implementation of storm drain best management practices (BMPs) and citizen education programs	San Lorenzo and Mid-County: San Lorenzo River Lagoon, Aptos and Soquel lagoon, and the small urban lagoons on the west side of Santa Cruz (Corcoran, Moran, etc.)	• Development • Water use • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefited species
BBE-G5: Improve instream flow conditions (natural hydrographs) to support the long-term persistence of aquatic native species and coastal salt marsh communities.	**BBE-O19: Protect** and **improve** instream flows in riverine communities that flow into BBEs. See RR-G5 objectives for measures of success.	**BBE-A30:** Implement actions and priorities associated with Riparian and Riverine RR-G5.	Rivers and creeks flowing into BBEs that support Focal and Non-Focal species, specifically coho salmon and steelhead.	• Development • Working lands • Water use • Unauthorized activities • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefitted

5.3.2 Riparian and Riverine

Riparian and Riverine

Status and Global and State Ranks

- Riparian Communities are Sensitive Natural Communities, and include:
  - White alder groves (61.420.00): G4, S4
  - Red alder forest (61.410.00): G5, S4
  - Arroyo willow thicket (61.201.00): G4, S4
  - California sycamore woodlands (61.310.00): G3, S3
  - Redwood forest and woodland (86.100.00): G3, S3
- County of Santa Cruz Sensitive Habitat (Riparian and Riverine)
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone (Riparian and Riverine)

Detailed Descriptions

- Riparian Communities: NRCS 1996, NRC 2002
- Riverine Communities: Leopold 1994, 14 CCR § 1.72 (provides a legal definition of rivers and streams in California)

Distribution and Range

- 884 linear miles of intermittent (317 miles) and perennial (567 miles) streams, and an additional 684 linear miles of swales (e.g., ephemeral headwater reaches of streams; Figure 5-2).
- 3,412 acres of mapped broadleaf riparian communities, with other forests, including oak and redwood forests, lining many streams and constituting additional riparian communities

Key Ecological Elements

- Riparian and Riverine communities provide habitat for a wealth of focal, non-focal, and co-benefited species including: salmonids, tidewater goby, native resident fish such as speckled dace; native ranid frogs; the only native turtle (Southwestern pond turtle), Pacific giant salamander; ring-tailed cat; bat species; and an array of birds including both resident and neotropical migratory species that forage and nest in riparian communities.
- Riparian and Riverine communities vary greatly across the county and even within a watershed depending on geology, slope, aspect, adjacent land use, the level of connectivity between the stream and its riparian corridor, and the depth to water table. They can include a range of types from steep and narrow intermittent headwater reaches dominated by boulder cascades and flowing through dense redwood forests to low gradient, meandering perennial reaches with pools, riffles, and runs flanked by alder and willow-dominated riparian communities.
- Riparian communities provide essential services to the rivers they flank by moderating stream temperatures, buffering effects of adjacent land-use, contributing large woody debris that is a critical channel-forming element in streams, providing critical nutrients through litter-fall (insects and leaves), dissipating stream energy during floods, and creating high-flow refugia for aquatic species.
- Riparian and Riverine communities are adapted to disturbance, especially high flows that result in channel changes and flooding. These processes, sustain both instream and riparian habitat complexity and heterogeneity by constantly mobilizing, transporting, and depositing nutrients, propagules, and sediment throughout the system.
- While dense riparian canopy is critical for maintaining water temperatures in adjacent streams, disturbance patterns that create open areas within the riparian corridor increase ecological complexity by creating edge habitat. This benefits specific species such as foothill yellow-legged frog, a non-focal species that thrives in cobble and gravel bars with direct sunlight which may be caused by disturbances such as aspect, tree falls, and natural meander patterns.
- As valley slopes decrease, riparian and riverine communities occur in lower gradient stream valleys where width and length become critical aspects of ecological value (Figure 5-2). Wider riparian corridors provide a larger array of ecosystem services, groundwater recharge, flood risk reduction, habitat for nesting birds, and both movement and foraging habitat for mammals, amphibians, and reptiles. When riverine systems have the space to meander, stream length can increase along with floodplain connectivity, resulting in improved Riparian and Riverine habitat complexity.
- Riverine and riparian communities in Santa Cruz County are highlighted in the Conservation Blueprint for Santa Cruz County (Mackenzie et al. 2011) as a Priority Multi-benefit Conservation Area due to its importance to overall conservation of regional biodiversity, role in connectivity between the coast and mountains as well as between

different terrestrial habitats, and both current and future function of providing both water and cooler microclimates as refugia for a wealth of native fauna.

- Critical Linkages: Bay Area and Beyond (Penrod et al. 2013) highlights the uniqueness of riverine and riparian habitats as essential corridors for movement of species and energy through watersheds. “Rivers, streams and ephemeral drainages span elevation gradients in a way that increases interspersion and promotes ecological processes and flows, such as movement of animals, sediment, water, and nutrients.”
- Riparian and Riverine communities provide myriad ecosystem services that are critical to people such as groundwater recharge, flood reduction, improved water quality, local drinking water, and many others. These needs can be integrated in conservation planning to develop strategies that support multiple-benefits for both human and ecological communities.

Pressures and Stressors

- Riparian and Riverine communities have been heavily fragmented and reduced in area and extent by development, including commercial and residential development, roads and other infrastructure, and other land uses including forestry, mining, and agriculture.
- Flood control, agricultural production, legacy timber operations, and development in riparian areas have also significantly impacted Riparian and Riverine communities through straightening of channels, loss of disturbance associated with meander development and natural sediment transport regimes (e.g., bars, ox-bows, and deep meander bends), removal of instream wood, loss of late-seral riparian forests, hardening of banks, narrowing of riparian corridors, and hydro-modification (including channelization, incision, and impermeable surfaces) resulting in increased inputs of fine sediments, lack of floodplain connectivity, increased erosion and flashier run-off events.
- Installation and maintenance of infrastructure associated with roads and water can create fish passage barriers that prevent fish migration up and downstream as well as interrupt natural sediment transport processes.
- Water management practices including flood control (e.g., dams, levees, etc.), water diversions, groundwater pumping, and both agricultural and urban/suburban runoff and return flows have significantly degraded these water-dependent communities through reduced dry-season (and, to a lesser extent, wet-season) surface water connectivity, chronic drought stress on native riparian flora, and a lack of critical disturbance from periodic flooding of riparian areas and floodplains that is needed to sustain complexity and critical ecosystem niches.
- Water quality impacts from increased loading of fine sediment either from incision or adjacent land uses; increased water temperatures from reduced surface flows, groundwater contributions, and riparian canopy; and elevated nutrient and/or contaminant inputs from agricultural, urban development, and rural septic systems

directly degrade instream habitat and impact foraging, reproductive success, and competitive advantage of native aquatic species.

- High rates of erosion and the resultant sedimentation after winter storms or wildfire can have tremendous impacts on instream habitat complexity through the loss of deep pools and pulses of fine sediment modifying substrate and the benthic macro-invertebrate community.
- Invasive exotic plant species impact both the structure and function of Riparian and Riverine communities; for example, cape ivy and Himalayan blackberry interrupt natural sediment transport dynamics on riparian floodplains, arundo promotes fire, and ivy, vinca, eucalyptus, acacia, and tree of heaven outcompete native riparian trees and limit sapling recruitment.
- Invasive exotic fish and wildlife directly impact the aquatic food web (e.g., New Zealand mudsnail) and increase predatory pressure on native species; for example, red-eared slider outcompetes Southwestern pond turtle; American bullfrogs prey upon juvenile steelhead, Southwestern pond turtle hatchlings, and both tadpole and juvenile California red-legged frog.

Climate Change Vulnerability Assessment

Thorne et al. (2016) provide an overview of climate change vulnerability of riparian communities based on sensitivity, exposure, and adaptive capacity. The closest analogues of riparian communities in the RCIS Area are Vancouverian Flooded and Swamp Forest Macrogroup (MG034) and Warm Southwest Riparian Forest Macrogroup (MG036), which include the Central Coast willow and alder-dominated woodlands in the RCIS Area. Key findings include:

  - The two different types are modelled to have very different responses to climate change.
  - With the projected 'hot and dry' scenarios, large areas mapped as 'currently suitable' for MG034 become 'no-longer suitable', while suitability is much more stable in the 'warm and wet' scenario regardless of emissions. This reflects the RCIS Area's location near the southern extent of the range of this community.
  - Unlike MG034, MG036 is much less climate exposed and climate sensitive in the RCIS Area: across all four scenarios (hot and dry vs. warm and wet at low emissions vs. high emissions), this type is generally predicted to be either stable or expanding in the RCIS Area over the next 100 years.

- An empirical hydrologic climate change model for the San Lorenzo River, and Laguna, Majors and Liddell creeks (City of Santa Cruz water-supply streams), predicts the following changes (City of Santa Cruz 2021, S. Chartrand pers comm. 2021):
  - higher air temperatures, accentuated by higher nighttime temperature lows, more prolonged and intense droughts, and wetter wet periods, which could include more intense individual storms;

  - future higher air temperatures and more intense droughts will increase instream water temperatures, reduce winter and summer daily average streamflows, and reduce connectivity of flows within streams (i.e., more isolated pools and longer distances of dry streambed).
  - a wetter and more concentrated (fewer months) wet season, which suggests individual flood events will be larger, with the potential of posing more difficult conditions for survival of redds (salmonid spawning nests) due to physical destruction by flood flows, or burial under higher implied instream sediment loads.

- EcoAdapt (2021) provides details on vulnerability, exposure, sensitivity and adaptive capacity of numerous habitat types and species in the Santa Cruz Mountains, including riparian, streams, and floodplains. This work concluded that Riparian and Riverine systems are highly vulnerable to climate change and moderately adaptive.

The goals, objectives, actions, and priorities for the Riparian and Riverine communities (Table 5-5) incorporate the recommendations provided in EcoAdapt (2021) and will help address the impacts of climate change by:

1. Protecting adjacent undeveloped open space and agricultural lands to provide space for Riparian community expansion as climate conditions change to maximize opportunities to create resilience or increase adaptive capacity through temperature moderation, increased groundwater recharge, reduction in energy from high flows, opportunities to buffer the effects of increased sediment transport, wildfire, and other stressors;
2. Increasing both Riparian and Riverine habitat complexity and accessibility as well as the processes that sustain complexity to increase niche availability and climate refugia for native species and facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, changes in hydrologic patterns, expansion of exotic plants, and incompatible recreation; and
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat to increase its suitability for species and permeability for their movement between and within aquatic environments as well as between aquatic and terrestrial environments, to enable species to migrate seasonally and stay within their adapted climate envelope. Moreover, increasing connectivity through protection, restoration, and enhancement will increase the adaptive capacity of these systems through enabling natural watershed-scale sediment, large wood, and nutrient cycling.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-5 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Tidewater goby (*Eucyclogobius newberryi*) [NF]
- CCC Coho salmon (*Oncorhynchus kisutch*) [F]
- Steelhead – Central California Coast and South-Central California Coast DPS (*Oncorhynchus mykiss irideus*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- Foothill yellow-legged frog (*Rana boylii*) [NF]
- Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) [F]
- San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) [NF]
- Southwestern pond turtle (*Actinemys pallida*) [F]
- White-tailed kite (*Elanus (Elanus leucurus*) [NF]
- Ringed-tailed cat (*Bassariscus astutus*) [NF]

Other Actions that Benefit this Conservation Element

The Riparian and Riverine community, along with their associated focal, non-focal, and co-benefited species will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Bar Built Estuary:** Actions and priorities associated with multiple BBE goals and objectives will directly or indirectly benefit conservation of the Riparian and Riverine conservation element and associated focal and non-focal species. Key objectives include: BBE-O2, -O10, -O11, -O13, -O14, -O16, -O17 and -O19. These objectives address habitat complexity, connectivity, species conservation, and both water quality and water quantity.
- **Redwood and Douglas Fir Forest:** In areas with Riparian and Riverine communities flow through Redwood and Douglas-Fir Forest, these forest types and traditional hardwood (willow, maple, alder, etc.) riparian habitats intergrade and/or transition to a redwood dominated riparian corridor. As such, actions and priorities associated with multiple objectives are likely to either directly (when redwood is the dominant riparian species) or indirectly (when redwood forest is adjacent to hardwood riparian) help achieve many of the Riparian and Riverine Goals and Objectives. Redwood-O1 through -O8 focus on protecting, restoring, enhancing redwood forests, the permeability and connectivity within forest patches and species that depend on these forests.

- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of key riparian corridors (Penrod et al. 2013) and natural communities adjacent to Riparian and Riverine communities as part of CONNECT -O4, -O5, and -O6 will also help achieve the goals and objectives for this conservation element.
- **Working Lands:** All actions associated with WORKING-O2 will help achieve the goals and objectives of this conservation element by addressing habitat fragmentation, habitat degradation, invasive plant species, water quality, and water quantity.
- **Bat Habitat:** Action BAT-A3 within objective BAT-O3, which focuses on restoration of plant community structure and composition and retention of large diameter trees to support cavity-dwelling bats will support actions in the Riparian and Riverine strategy.

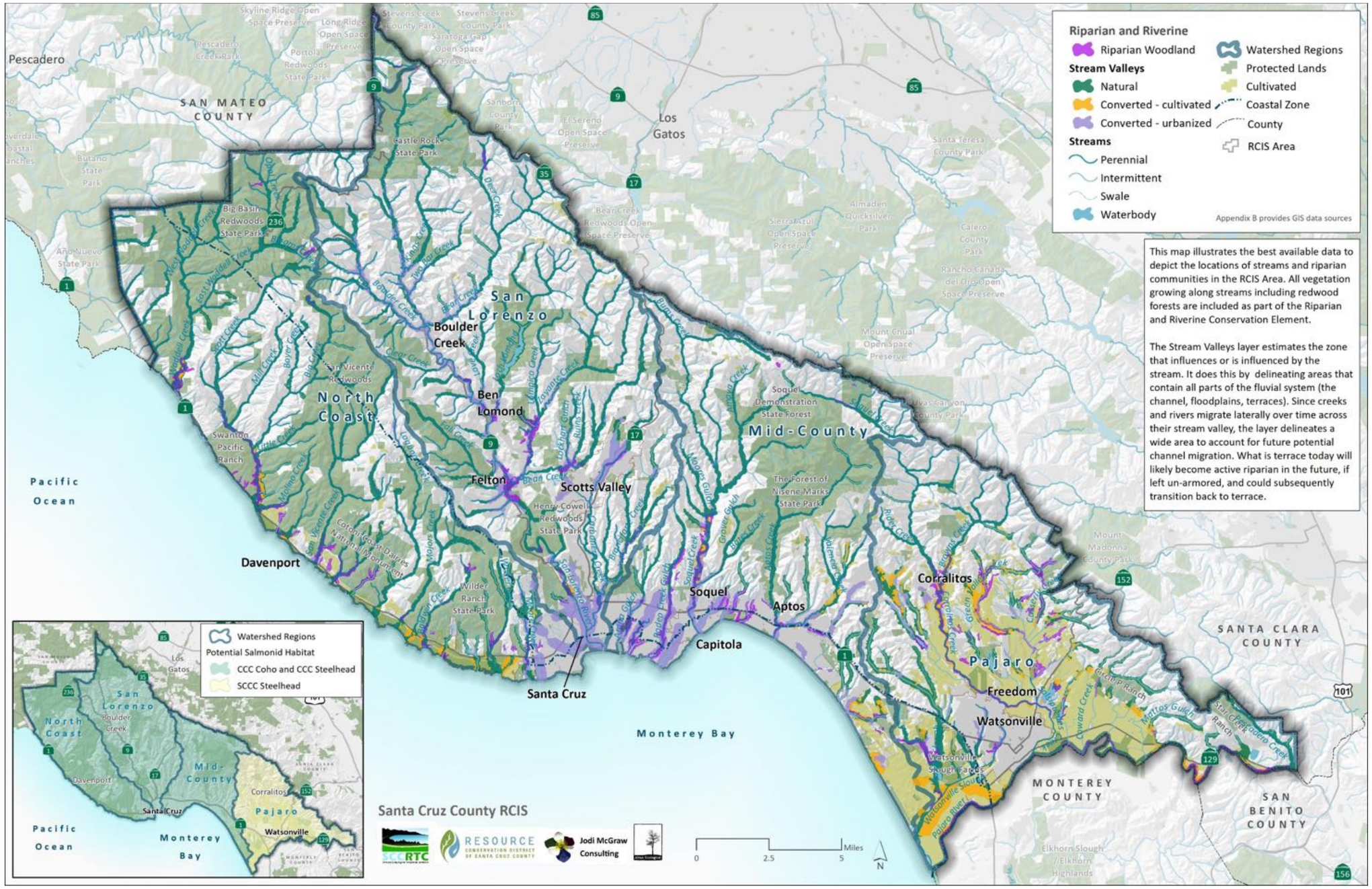

Figure 5-2: Riparian and Riverine Conservation Element

Table 5-5: Conservation Strategy for Riparian and Riverine Communities

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
RR-G1: Promote persistence and ecological integrity of riparian and riverine ecosystems, the rare species they support, and the natural processes that sustain them.	**RR-O1 Protect** at least 516 additional acres of riparian communities to increase protection of this community by 50% over the current level (Table 5-3). Measure progress toward this objective based on the acres of habitat protected. While mapping of this community is not inclusive of all riparian habitats in the RCIS Area, this would increase the acreage of mapped riparian woodland within protected lands by nearly 50%.	**RR-A1:** Protect habitat through fee title acquisition, conservation easements, development of riparian mitigation banks, and/or riparian license agreements to permanently protect undeveloped riparian areas from conversion or other degradative land uses and activities. [This action is consistent with and can complement policies, incentives, and other programs to maintain riparian habitat including the County Riparian Corridor and Wetlands Protection ordinance, City of Santa Cruz City-wide Creeks and Wetlands Management Plan which help protect riparian and riverine communities using setbacks.]	• North Coast: Scott Creek and Lower Laguna Creek • San Lorenzo River: Zayante, Bean, Branciforte, and lower mainstem (Lower San Lorenzo River Riparian Conservation Program); • Mid-County: Soquel mainstem and east and west branches; • Pajaro: College Lake, Casserly Creek, and lower Pajaro River.	• Development • Working lands • Mining/quarrying • Incompatible recreation • Unauthorized activities	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A2: Create, fund, and implement a County-wide riparian enhancement and restoration incentives program to protect, enhance and restore riparian communities. Build on early efforts by the County of Santa Cruz, Resource Conservation District and City of Santa Cruz.	• North Coast: CZU Fire Area and Lower Laguna Creek. • San Lorenzo River: Zayante, Bean, Branciforte, and mainstem (San Lorenzo River Riparian Conservation Program) as well as other karst-origin subwatersheds; • Mid-County: Soquel mainstem, east and west branches; • Pajaro: College Lake/Casserly Creek, lower Pajaro; Corralitos	• Development • Working lands • Increased fine sediment • Climate change • Mining/quarrying • Incompatible recreation • Unauthorized activities • Exotic plants/animals	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
	RR-O2: Restore/Enhance 150 acres of **riparian habitat** within legal setbacks or buffers in developed areas to maximize the ecological and ecosystem service values (e.g., native tree canopy and understory for nesting, shade, litterfall, buffering of runoff). Measure progress toward achieving this objective through tracking acreage restored and enhanced and using	**RR-A3:** Develop a County-wide (including cities) incentive program that could include mechanisms like technical assistance; assistance with removal of non-native plants and replanting areas with long-lived conifers; and tax break, grants, development credits, and/or regulatory relief, to implement restoration and enhancement actions within existing protected stream setback areas to maximize functional riparian habitat. Consult the agricultural unit of the Central Coast	Urban, suburban, and agricultural areas in the RCIS Area, where riparian corridors are generally narrow and degraded.	• Development • Working lands • Increased fine sediment • Mining/quarrying • Exotic plants/animals • Unauthorized activities	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	CRAM for wetlands to track functional and structural improvements.	Regional Water Quality Control Board to understand how this action might dovetail with their agricultural policies.		• Incompatible recreation • Climate change	• Numerous co-benefited species
	RR-O3: Restore/Enhance and Expand/Create at least 500 acres of **riparian habitat** outside of legal setbacks/buffers to expand width of existing riparian corridors, improve the complexity of riparian vegetation stand structure and complexity, enable connectivity between existing riparian corridors, improve runoff buffering capacity for riparian corridors, and provide natural floodplains. Measure progress toward achieving this objective through tracking acreage restored, enhanced, and expanded. Use CRAM for wetlands to track functional and structural improvements. (Linked to RR-O5)	**RR-A2:** (see above)	• Streams listed at Core, Phase 1 and Phase 2 recovery in the CCC Coho salmon Plan (especially SLR and tributaries); • Streams listed as sediment or temperature impaired by the State Water Resources Control Board; and • Lower Pajaro River and Salsipuedes Creek, including Casserly Creek, and San Lorenzo River.	• Development • Working lands • Increased fine sediment • Exotic plants/animals • Climate change • Mining/quarrying	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A3: (see above)	Urban, suburban, and agricultural areas in the RCIS Area, where riparian corridors are generally narrow and degraded.	• Development • Working lands • Increased fine sediment • Exotic plants/animals • Unauthorized activities • Incompatible recreation • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • White-tailed kite • Numerous co-benefited species
		RR-A4: Assess, prioritize, and implement riparian restoration projects in areas impacted by the CZU Lightning Complex Fire to enhance native riparian species recruitment, especially conifers, and ensure that riparian areas are functioning as buffers to reduce impacts from upland fire damage (erosion, pollution, etc.).	Areas of impacted riparian habitat within the CZU fire area.	• Increased fine sediment • Exotic plants/animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A5: Enhance and expand existing high-quality riparian habitat within existing protected lands.	Headwater streams and tributaries in the San Vicente Creek, upper San Lorenzo, West Branch of Soquel Creek, and Aptos Creek watersheds	• Increased fine sediment • Exotic plants/Animal • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
					• Foothill yellow-legged frog • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A6: Implement the recommendations in the San Lorenzo River Riparian Conservation Program (City of Santa Cruz et al. 2018) related to mapping, inventorying, and developing restoration actions for areas of high multi-benefit conservation value.	San Lorenzo River: Zayante, Bean, and Branciforte creeks, and the lower mainstem (Central Coast Wetlands Group and County of Santa Cruz 2021).	• Development • Working lands • Increased fine sediment • Exotic plants/Animal • Unauthorized activities • Incompatible recreation • Climate change • Mining/quarrying	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR1-A7: Identify and restore areas with the potential to create riparian forests “hubs” within existing riparian corridors that would be large enough (i.e.,> 250’ in width and >500’ in length) to provide functional habitat for a wide suite of nesting birds such as the co-benefited yellow warbler, mammals such as the non-focal ring-tailed cat, and co-benefited SF dusky-footed woodrat.	• North Coast: Lower Scott Creek, private portions of Waddell Creek, San Vicente, Lower Laguna Creek, Yellowbank Creek, and Molino Creek. • San Lorenzo: lower and middle mainstem; • Mid-County: Soquel mainstem and east and west branches, Aptos mainstem and Valencia Creek; • Pajaro: Pajaro lower mainstem, College Lake, and Corralitos Creek.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants/animals • Unauthorized activities • Incompatible recreation • Climate change	• Southwestern pond turtle • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		R-A8: Identify and remove or modify, where feasible, hardscape (e.g., rip-rap, old cars, and defunct sakrete) in riparian areas to enable restoration of native riparian communities. Replace unnatural hardscape that is creating critical scour with natural scour objects.	• North Coast: Remove defunct sakrete and automobiles from Molino Creek; Laguna Road bridge and associated hardscape; • San Lorenzo River: historic rail pier in Ben Lomond; historic structures in tributaries including Branciforte, Bear, Zayante creeks • Pajaro: Cars that were used as bank revetment in Pajaro tributaries including on Corralitos Creek downstream of Browns Valley Road.	• Development	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
					• Ring-tailed cat • Numerous co-benefited species
		R-A9: Where feasible and ecologically critical, remove invasive plants from riparian communities to support native plant establishment and restore natural physical processes such as scour, deposition, and native vegetative regeneration.	• North Coast: Cape ivy in Scott and San Vicente creeks; Clematis in San Vicente Creek. • San Lorenzo: Arundo, Vinca, Cape ivy, and English ivy. • Mid-County: English ivy and cape ivy as mapped in watersheds plans for Soquel and Aptos creeks as well as vinca in these watersheds. • Pajaro: Arundo in the Pajaro River and tributaries.	• Development • Working lands • Exotic plants • Climate change • Mining/quarrying	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A10: Monitor the effects of alder bark beetle and other pathogens on the health of alder-dominated riparian forests and develop restoration and remediation plans to address riparian conditions if major die-offs occur.	North Coast: Scott and San Vicente creeks	• Climate change	• Southwestern Pond Turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	RR-O4: Protect existing, undeveloped **floodplain** properties adjacent to riverine communities within the modeled 100-year floodplain. Measure progress toward achieving this objective through tracking acquisitions within the modeled 100-year floodplain.	**RR-A11:** Identify and protect, via fee-title, easement (conservation or hydraulic), or riparian license agreement, key floodplain areas that would provide the highest potential ecological benefit for expanded riparian habitat and reconnected riverine habitat as well as both ecological and community resilience to critical natural disturbances such as flooding, fire, landslides, debris-flows, and drought. Avoiding creating an attractive nuisance for illegal camping in protected riparian floodplain areas.	Throughout county, where feasible, focus on natural floodplain areas in lower watersheds or low gradient sections of larger tributaries. Specific priorities include: • North Coast: Scotts, Waddell, and San Vicente creeks. • San Lorenzo lower mainstem; Branciforte Creek. • Mid-County: Soquel mainstem, East Branch and West Branch. • Pajaro: Pajaro lower mainstem, Salsipuedes Creek and Corralitos Creek.	• Development • Working lands • Mining/quarrying • Water use • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A12: Develop and implement funding mechanism in Santa Cruz County to acquire, via fee-title or easement (conservation or hydraulic), critical floodplain lands that provide multiple benefits to the community and ecosystem.	• North Coast: Natural and agricultural land along Scott, Waddell, Laguna, and Majors creeks. • San Lorenzo: mainstem and tributaries (Branciforte, Zayante, Bean, Bear and Boulder creeks); • Mid-County: Soquel mainstem and East Branch, in areas of high percolation. • Pajaro: Lower Pajaro River, Salsipuedes Creek/College Lake, tributaries in high percolation zones.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
	RR-O5: Restore/Enhance and **Expand/Create** 500 acres of active floodplain habitat to support riparian communities. Measure progress toward achieving this objective through tracking acreage restored, enhanced, and expanded. (Linked to RR-O3)	**RR-A13:** Where practicable from a public safety perspective, reconnect riverine systems with their historic floodplains via implementation of incision reversal projects, removal of levees, lowering of floodplain surfaces, and increasing localized roughness, while avoiding creating an attractive nuisance for illegal camping in riparian floodplain areas.	• North Coast: Waddell, Scott, San Vicente, Liddell, Majors, and Lower Laguna creeks. • San Lorenzo: mainstem and tributaries (Branciforte, Zayante, Bean, Bear, and Boulder creeks); • Mid-County: Soquel mainstem and East Branch and mainstem Aptos Creek. • Pajaro: Opportunities identified in the Pajaro River Flood Risk Management Project (USACOE 2019) in the Pajaro and Salsipuedes Creek/College Lake.	• Development • Working lands • Increased fine sediment • Climate change • Mining/quarrying • Unauthorized activities.	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A14: Identify and restore natural floodplain habitat in coordination with local flood control agencies to identify areas of elevated flood risk and conduct spatial and hydraulic analysis to determine upstream or downstream areas of floodplain that could be utilized to provide multiple community benefits in terms of ecosystem services such increased hydraulic capacity, sediment storage, groundwater recharge, and habitat restoration.	• San Lorenzo: San Lorenzo River, Branciforte Flood Control Channel, Bean Creek and other tributaries. • Mid-County: Soquel mainstem and branches, and Aptos Creek. • Pajaro: Lower Pajaro River, College Lake, Soda Lake and Corralitos Creek.	• Development • Working lands • Increased fine sediment • Water use • Exotic plants • Climate change • Mining/quarrying	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A15: Design and implement floodplain restoration and expansion projects that (a) contain areas that will inundate over a range of flows to ensure that areas of restored/expanded floodplains activate across a range of flows, if possible, support areas that will inundate for 30+ days to maximize groundwater recharge and/or ecological productivity (depending on soils) and (b) restore natural sediment transport dynamics, channel evolution, and channel complexity by restoring energy and material exchange between streams and their floodplains.	• North Coast: Private properties along Waddell Creek; Scott Creek at CalPoly Swanton Ranch; San Vicente Creek at the lower Pond and near confluence with Mill Creek (as per San Vicente Salmonid Restoration Plan (RCD 2014); Laguna at existing Floodplain Restoration site; Majors Creek, Liddle Creek, Wilder Creek, Baldwin Creek • San Lorenzo: Fall, Branciforte, and Zayante creeks and other salmonid-bearing tributaries; • Mid-County: Lower Arana Gulch, Soquel Creek in Soquel Demonstration Forest; Aptos Creek in the Forest of Nisene Marks State Park and Aptos Village County Park • Pajaro: Pajaro River Flood Risk Management Program (USACOE 2019) projects in Pajaro River and Salsipuedes Creek	• Development • Working lands • Mining/quarrying • Increased fine sediment • Unauthorized activities • Exotic plants/animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
	RR-O6: Restore/Enhance the physical processes that maintain and create in-stream complexity including bar formation, thalweg meander, instream wood recruitment and loading, scour and pool formation, and hydraulic complexity. Measure progress toward achieving this objective through miles of streams that feature greater complexity and/or through habitat typing at periodic intervals.	**RR-A16:** Implement priority habitat complexity actions for Santa Cruz County watersheds articulated in the recovery plans for CCC steelhead (NMFS 2016), SCCC Steelhead (NOAA 2013), and CCC Coho salmon (NMFS 2012 and CDFW 2004).	All watersheds in Core, Phase 1, and Phase 2 recovery areas for CCC coho salmon or CCC steelhead, and the Pajaro, Salsipuedes/Casserly, and Corralitos Creek as Core 1 for SCCC Steelhead.	• Development • Working lands • Increased fine sediment • Exotic plants/animals • Exotic animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A17: Develop multi-benefit flood management projects that result in removal or modification of existing hardened infrastructure and improve instream habitat complexity.	• San Lorenzo: Branciforte Creek Flood Control Channel, hardened sections of Zayante Creek, and mainstem San Lorenzo River. • Mid-County: Soquel mainstem and Lower Aptos Creek. • Pajaro: Implement project developed through the Pajaro River Flood Risk Management Program (USACOE 2019).	• Development • Working lands • Mining/quarrying • Increased fine sediment • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A18: Expand the County of Santa Cruz Stream Wood Program that evaluates instream wood and provides free technical evaluations and assistance to modify, if needed, stream wood with a goal of reducing wood removal and increasing natural wood loading.	• Core, Phase 1 and Phase 2 recovery areas for CCC Coho salmon and CCC Steelhead. • Pajaro: perennial reaches of Corralitos Creek and Casserly Creek.	• Development • Working lands • Increased fine sediment • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A19: Implement large wood debris projects (anchored and unanchored) to increase instream complexity.	• Core, Phase 1 and Phase 2 recovery areas for CCC Coho salmon and CCC Steelhead. • North Coast: Waddell, Scott, San Vicente, Laguna, Liddell, and Majors creeks • San Lorenzo: Branciforte, Zayante, and Bean creeks, and all other steelhead-bearing tributaries. • Mid-County: Forest of Nisene Marks in Aptos, Soquel Demo Forest and lower East Branch of Soquel. • Pajaro: perennial reaches of Corralitos Creek and Casserly Creek.	• Development • Working lands • Increased fine sediment • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A20: Increase shelter ratings for pools in low gradient mainstem and tributary riverine habitats to optimal levels (>80 pool shelter value; NOAA 2013)	• Low gradient reaches of Core, Phase 1, and Phase 2 watersheds for CCC Coho salmon and CCC steelhead • Core 1 areas for ’SCCC steelhead.	• Development • Working lands • Water use • Exotic animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A21: Restore slack-water habitats such as historic ox-bows, side channels, secondary channels, and alcoves to provide winter refuge for fish as well as breeding and foraging habitat for native herps.	• Low gradient reaches of Core, Phase 1 and Phase 2 watersheds for CCC coho salmon and CCC steelhead, and Core 1 areas for SCCC steelhead. • North Coast: Lower Scott and Waddell creeks; Lower San Vicente Pond location; Improve/Expand Lower Laguna Creek Floodplain Project. • Mid-County: Multiple locations along Soquel and East Branch Soquel • Pajaro: Disconnected oxbow on lower Pajaro upstream of Highway 1 (right bank)	• Development • Roads • Mining/quarrying • Working lands • Increased fine sediment • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • Numerous co-benefited species
	RR-O7: Restore populations of key "ecosystem engineers" that help create complexity in riparian and riverine systems, where determined appropriate	**RR-A22:** Assess the feasibility for experimental re-introduction of beavers into watersheds and sub-watersheds with limited urban development and risk of enhanced flooding, identify high-priority locations for introductions, and then implement introductions where feasible and appropriate.	North Coast: Waddell, Scott, San Vicente, and Laguna creeks.	• Development • Working lands • Increased fine sediment • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Numerous co-benefited species
RR-G2: Maintain and enhance landscape connectivity to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**RR-O8:** Implement actions and priorities associated with Objectives **RR-O1** through **RR-O6**	As in RR-O1 through RR-O6	As in RR-O1 through RR-O6	As in RR-O1 through RR-O6	As in RR-O1 through RR-O6
	RR-O9: Restore unfettered access for aquatic species to naturally accessible reaches of riverine habitat between estuaries and headwaters to increase habitat availability and improve climate resilience for aquatic species by modifying or removing anthropogenic fish passage barriers including: at least 14 of the remaining 18 complete barriers (~75%); 5 of the 7 significant partial barriers (~70%); and 12 of the 23 partial barriers (~50%). Measure progress toward achieving this objective through tracking fish passage projects.	**RR-A23:** Remove or modify anthropogenic instream fish passage barriers (total and temporal) to allow unimpeded access into and out of riverine habitats and restore natural sediment transport processes.	• Generally prioritize barrier removal from downstream to upstream and prioritize key recovery watersheds from CCC coho salmon and both CCC and SCCC steelhead. For San Lorenzo mainstem, prioritize working with willing landowners. • Regularly review passage priorities with the IWRP TAC and use the Ross Taylor and Associates (2004) Passage Assessment to prioritize high or medium priority crossings that still require improvement for passage. • Conduct periodic passage assessments of culverts and bridges in key steelhead and coho salmon streams in the RCIS Program Area following water years with major storm events (>25-year return interval) to determine is new impediments have developed following storms.	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Incompatible recreation • Climate change • Loss of genetic diversity	• Coho salmon • Steelhead • Tidewater goby (of low in the system) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	[See BBE-G2 for strategies related to protecting and restoring seasonal movement between estuaries and the ocean		• North Coast: Assess potential to restore fish passage through the defunct quarry that is a total passage barrier to the upper half of San Vicente Creek; ensure the permanent fix to the Molino Creek crossing on Swanton Road is passable and remove the existing dam on Molino Creek if deemed appropriate during an assessment; and work with Caltrans to modify the Highway 1 culvert at Molino Creek; assess ecological trade-offs between focal and non-focal species related to dam removal at Yellowbank, implement if deemed appropriate. • San Lorenzo: Remove existing mainstem flashboard dams and work with Caltrans to address impediments on the mainstem at Waterman Gap and Highway 9 at Gold Gulch; remove or modify all passage impediments on Branciforte Creek, especially the dams at Casa de Montgomery and address passage at Branciforte Flood Control Channel; implement Lompico Creek PM2.0 Bridge Replacement for Fish Passage; • Mid-County: Work with Caltrans to address barriers at Valencia Creek stream crossing and highway; upgrade crossing on West Branch Soquel at Redwood Road following a re-assessment, if deemed appropriate and re-design water diversion at Summit Mutual Water Company dam to provide fish passage (likely need to complete Redwood Road and Summit Mutual projects together to provide necessary conservation value). • Pajaro: Implement priority fish passage projects identified by Ross Taylor and Associates (2004) within Core 1 SCCC steelhead recovery areas including Green Valley, Browns Valley, and Casserly creeks in the Corralitos Watershed		
		RR-A24: Implement actions and priorities related to **Goal RR-G5** that will increase connectivity between reaches of riverine	As in actions for RR-G5	As in actions for RR-G5	As in actions for RR-G5

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		habitat during low flow conditions and improve connectivity between lower reaches of riverine habitat, estuaries, and the ocean during low flow conditions. These actions are also linked to BBE conservation element.			
		RR-A25: Update all existing fish ladders in the RCIS Area to meet current fish passage guidelines and standards and ensure they function year-round.	• San Lorenzo: Implement designed retrofit of Fall Creek Fish Ladder, assess functionality of Tait and Felton diversions, and evaluate potential to upgrade crossing and remove the fishway on Zayante Creek. • Mid-County: Restore access to Valencia Creek Fish Ladder at Soquel Drive. To manage, maintain, and assess functionality (the trail was destroyed by erosion). • Pajaro: Corralitos Ladder, Browns Valley Fish Ladder, and Shingle Mill Gulch Fishway	• Development • Water use • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
	RR-O10: Protect and Expand connectivity between riparian and riverine habitats and adjacent uplands including Grasslands, Oak Woodland and Forests Redwood and Douglas-Fir Forests which are often contiguous with riparian and riverine communities. Measure progress toward achieving this objective through tracking acquisitions. (Linked to RR-O1)	**RR-A26:** Implement actions and priorities related to Objectives **RR-O1** through **RR-O5** that focus on protecting, restoring and expanding riparian habitats.	Prioritize habitat protection in upland communities to include on areas that contain functional riparian communities and/or high potential for restoring and enhancing riparian communities.	• Development • Working lands • Mining/quarrying • Unauthorized activities • Incompatible recreation • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A27: Protect intact riparian and riverine corridors to enable movement of aquatic and terrestrial species between the coast and headwaters and between watersheds and eco-regions (linked to CONNECT-A1 for CONNECT-O4). Protection includes not just acquisition or preventing direct impacts, but also avoid anthropogenic barriers to movement in and out of riparian areas (e.g., fences).	Priorities articulated in Penrod et al. 2013 for Key Riparian Corridors (Figure 5-21) • Protect riparian corridors. • Maintain or restore riparian vegetation to maintain contiguity along streams. • Retain natural fluvial processes. • Eradicate invasive plants and animals. • Promote base flows and maintain groundwater levels. • Increase and maintain water quality. • Manage grazing to ensure compatibility with streams and riparian habitats.	• Development • Working lands • Mining/quarrying • Unauthorized activities • Incompatible recreation • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Enforce existing regulations that protect systems. Priorities in the RCIS Area include: • Tier 1: All steelhead and/or coho salmon streams • Tier 2: All critical habitat for steelhead and/or coho salmon.		• Numerous co-benefited species
		RR-A28: Identify, protect, restore, and expand natural communities and tributaries to increase opportunities for native animals to safely move though riparian and riverine habitats and into terrestrial habitats to improve landscape permeability. This action also includes outreach to riparian property owners so they understand value of wildlife corridors and can manage their lands for maximum benefit.	Prioritize corridors through suburban, ex-urban, and cultivated areas to directly benefit the focal, non-focal and co-benefited species including mammals such as ring-tailed cat, American badger, cougar, San Francisco dusky-footed woodrat, as well as herpetofauna including California red-legged frog, foothill yellow-legged frog, Southwestern pond turtle, and San Francisco garter snake. Prioritize work to address conflicts between wildlife movement and food safety in areas of cultivated agriculture as outlined in WORKING-A6.	• Development • Working lands • Mining/quarrying • Unauthorized activities • Incompatible recreation • Exotic plants/animals • Climate change	• Southwestern pond turtle • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
RR-G3: Promote the recovery and long-term persistence of both rare and common native species, including focal and non-focal species, that rely on riparian and riverine communities.	**RR-O11: Protect and restore** the natural processes that create habitat complexity and habitat heterogeneity in riparian and riverine systems. Measure progress toward achieving this objective through the acres of watershed lands draining into key riverine habitats that are protected and the miles of streams that are restored or enhanced. (Linked to RR-O6)	**RR-A29:** All actions and priorities from **RR-O3** through **RR-O7** and **RR-O20**	All priorities from **RR-O3** through **RR-O7** and **RR-O20**	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
	RR-O12: Protect and recover state and federally listed and other special-status species (focal, non-focal, and co-benefited) that rely on riparian and riverine communities for one or more critical life history stage. Measure progress toward achieving this	**RR-A30**: All actions and priorities from **RR-O3** through **RR-O7** and **RR-O15** through **RR-O20**	All priorities from **RR-O3** through **RR-O7** and **RR-O15** through **RR-O20**	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Exotic plants	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	objective through surveys and monitoring of species population and range dynamics.			• Exotic animals • Climate change	• White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A31: Continue existing research and develop/implement new long-term research to better understand population and range dynamics for riparian and riverine focal and non-focal species.	• Where feasible, implement eDNA sampling in riverine systems throughout the RCIS Area to identify presence/absence of key focal and non-focal aquatic species. • Implement spawning (adult) and snorkel (juvenile) surveys for coho salmon and steelhead; • Continue and, if feasible, expand life cycle monitoring stations and regional PIT tagging for coho salmon and steelhead and couple this work with eDNA to better understand (as in COHO-O7) • Expand/build on Mendonca and Smith's (2017) lagoon/estuarine sampling and genetic analysis for tidewater goby; • Develop and implement distribution and abundance sampling for Southwestern pond turtle and foothill yellow-legged frog; Implement range-wide research and recovery program for SFGS (Tuday and Robins 2020).	• Loss of genetic diversity	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake
		RR-A32: Work with property owners on East Branch Soquel and middle and upper mainstem of Soquel (and possible Aptos if populations are confirmed) to educate and protect existing, known populations of foothill yellow-legged frog in Santa Cruz Co.	Soquel Creek Watershed and possible Aptos Creek.	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Exotic plants/animals • Loss of genetic diversity	• Foothill yellow-legged frog

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A33: Develop and/or improve existing captive breeding and re-introduction programs in collaboration with CDFW and USFWS/NMFS for species that are range limited by habitat fragmentation, genetically limited by population bottlenecks, or in need of this type of intervention for other scientifically validated reasons.	• Implement priorities actions for CCC coho salmon broodstock program as habitat conditions allow and guided by adaptive management principles (COHO-O6). • Assess feasibility and, if appropriate, develop a captive breeding and/or re-introduction program for foothill yellow-legged frogs to experimentally re-populate appropriate habitat within the species historic range (CDFW 2019c) that is currently unoccupied in an effort to expand their range locally and work toward meeting recovery goals. • Assess feasibility and, if appropriate, develop a captive breeding and/or re-introduction program for southwestern pond turtle to experimentally re-populate appropriate habitat within the species historic range that is currently unoccupied in an effort to expand their range locally. • Evaluate and implement, where appropriate, reintroductions for extirpated native mussels such as the California winged floater (co-benefitted species) to restore the aquatic food web and improve water quality and other ecosystem functions historically provided by these species. The San Francisco Presidio piloted a similar reintroduction (Jeanette Howard, pers com, 4/1/21). Historic and recent records indicate a number of genera come from the Pajaro River and San Lorenzo River, highlighting these locations as potential priorities for re-introduction (Howard et al. 2015).	• Development • Working lands • Mining/quarrying • Water use • Climate change • Genetic Bottleneck	• Southwestern pond turtle • Coho salmon • Foothill Yellow-Legged Frog
	RR-O13: Restore riparian community structure and composition through removal of high-priority invasive plants and native plant revegetation within at least 150 acres. Measure progress toward achieving this objective based on the acres of habitat	**RR-A34:** Prioritize, where feasible and ecologically critical, eradication of invasive riparian plant species that create documented ecological impacts through changes in disturbance regime, nutrient cycling, direct mortality or displacement of native riparian plants, and related impacts on nesting and foraging success for native riparian birds.	• Eradicate *Clematis vitalba* from the San Vicente Watershed, where it occupies 40 acres. • Eradicate *Arundo donax* from the watersheds it is currently found in, including Soquel and San Lorenzo. • Control the spread and reduce the cover of Cape Ivy and English Ivy in Scott Creek, San	• Development • Mining/quarrying • Working lands • Water use • Exotic plants/animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	restored. (Linked to RR-O1, -O2, and -O3)		Lorenzo, Soquel, and Aptos creeks and in riparian and floodplain areas to reduce competition with native species, restore native canopy where it has been impacted and restore natural geomorphic processes that these species interrupt. • Strategically remove eucalyptus and acacia stands in riparian and floodplain habitats to restore of native tree species, reduce fire risk, and reduce water use, while avoiding potential impacts to nesting raptors and overwintering monarchs. Consider re-use of large eucalyptus for instream LWD projects (with measures to avoid resprouting). • Control periwinkle, spiderwort, jubata grass, and tree of heaven.		
		RR-A35: Conduct outreach to nurseries, landscape firms, and private landowners to reduce the potential sources for new invasions of known non-native invasive plant species	Countywide or Regionally	• Development • Working lands • Exotic Plant/Animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A36: Create an early detection and rapid response program to detect new invasive species (plants and animal) and/or new infestations, through partnership with the Santa Cruz Weed Management Area, CDFW, and other local partners.	Countywide or Regionally	• Increased fine sediment • Water use • Exotic plants/animals	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		RR-A36 (see above)	Same as for RR-37	Same as for RR-37	As for RR-37

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	RR-O14: Protect and Recover native species through removal and eradication of non-native invasive fish and wildlife that directly compete with, prey upon, or otherwise displace native aquatic wildlife including cold and warm water native fish assemblages. Measure progress toward achieving this objective through tracking eradication and control efforts.	**RR-A37:** Control or, where possible, eradicate American bullfrog populations throughout riverine systems (and adjacent ponds, sloughs, and other wetlands) in the RCIS Area and collaborate with adjacent regions through active depredation program. (Linked to PLR-A4 and FW-A3)	Develop and implement a Countywide bullfrog eradication training and authorization program for public and private landowners and managers that are responsible for ponds, sloughs, and perennial wetlands, specifically those in close proximity to riparian and riverine areas, and that support American bullfrog.	• Development • Mining/quarrying • Working lands • Water use • Exotic plants/animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A38: Identify key source population for carp, centrarchids, mosquito fish, bass, and other warm water non-native fish species that can invade riverine systems and alter ecosystem processes and impact native fish and amphibian assemblages.	• Support current policies of the County Mosquito Abatement District to avoid use of mosquitofish in and near riverine habitats that support native warm-water or cold-water fisheries. • Work with local agricultural producers and ranchers to avoid planting non-native fish in stock ponds or agricultural reservoirs that could be hydrologically connected to riverine habitats during high flows to avoid unintentional releases of non-native fish into riverine habitats. • During severe drought conditions, utilize seining, boat-based electrofishing, or other means to capture and remove non-native invasive fish from lentic open water areas (sloughs, reservoirs) connected to riverine habitat such as the Watsonville Sloughs and College Lake.	• Development • Working lands • Water use • Exotic plants/animals • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefited species
		RR-A39: Avoid spread of invasive invertebrates such as New Zealand mudsnail that may displace native species (e.g., California floater) and disrupt the riverine food web.	• Continue management and prevention efforts to stop invasion into watersheds that are currently not known to support New Zealand mudsnail, especially north coast coho salmon streams; • Implement recommendations from the National Management and Control Plan for the New Zealand Mudsnail (2007)	• Exotic Plant/Animals • Unauthorized activities • Incompatible recreation • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A40: Control populations of feral/domestic mammals that feed on native riparian and riverine fish and wildlife.	• Capture and fix feral cats in urban and ex-urban areas, and work with pet owners to	• Development • Exotic plants/animals • Climate change	• Ring-tailed cat • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			place bells on domesticated cats to reduce predation of birds. • Control, manage, and reduce, where possible, feral pig populations that are impacting riparian corridors through trampling, rooting, and vegetation destruction.		
		RR-A41: Identify populations of brown-headed cowbird and areas with abundant corvid populations and determine appropriate means for control and/or eradication in an effort to recover native birds.	Prioritize actions in and around riparian areas known to support nesting of the native riparian birds such as the co-benefitted yellow warbler and where cowbirds occur.	• Exotic plants/animals • Climate change	• Numerous co-benefited species
RR-G4: Protect and improve riverine water quality to reduce habitat degradation and support long-term persistence of native aquatic species	**RR-O15: Protect** and i**mprove** water quality to meet adopted TMDL standards, basin plan standards, and delisted systems currently listed under the state's 303d list for sediments and nutrients. Measure progress toward achieving this objective by working with the CCRWQCB, CDFW, and NOAA to track voluntary projects that improve water quality, improve instream flows, and track delisting of 303d listed waterbodies in the RCIS Area.	**RR-A42:** Work directly with Central Coast Regional Water Quality Control Board staff to identify priority projects within TMDL/303d listed streams that will have a maximum benefit for focal and non-focal species in riverine communities (e.g., beneficial uses such as cold water and warm water fisheries)	• San Lorenzo River: San Lorenzo River Sediment TMDL and San Lorenzo River Nitrite TMDL (CCRWQCB 2019). • Pajaro: Pajaro River Sediment TMDL and Pajaro River Nutrient TMDL (CCRWQCB 2019). • Work with landowners and the Integrated Watershed Restoration Program Technical Advisory Committee to design, permit, fund, and implement CCRWQCB Basin Plan priorities for fish and wildlife related beneficial uses	• Development • Mining/quarrying • Working lands • Increased fine sediment • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
	RR-O16: Protect riverine habitat from introduction of fine sediments and reduce fine sediment loads in salmonid bearing streams. Measure progress toward achieving this objective through the universal soil loss equation (USLE) and/or other tools to estimate sediment saved through implementing sediment reduction projects.	**RR-A43:** Implement priority sediment, water quality, and road/railroads actions watersheds identified in the recovery plans for CCC Coho salmon (NMFS 2012), CCC steelhead (NMFS 2016), and SCCC steelhead (NMFS 2012).	Prioritize watershed areas that generate sediment which impacts downstream salmonid habitat and have the potential to provide spawning and, rearing habitat for cold-water-fish species and are vital for recovery of the endangered CCC coho salmon and/or steelhead.	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A44: Implement actions and priorities associated with **RR-O2** and **RR-O3** to improve runoff buffering functions of riparian corridors and **RR-O4** and **RR-O5** that restore natural sediment transport (depositional) processes on floodplains.	As described for the referenced actions	As described for the referenced actions	As described for the referenced actions
		RR-A45: Implement rural road and rural drainage sediment control projects in fire-impacted watersheds and other priority recommendations from the RCD's Sediment Reduction Technical Advisory Committee to reduce sediment loading into riverine areas. Also, work in the same locations to increase wood loading in nearby riverine areas to provide instream sediment storage.	• Annual priorities developed through the Sediment Reduction TAC. North Coast: Areas impacted by the CZU Lightning Complex Fire. • San Lorenzo: Areas impacted by the CZU Lightning Complex Fire, and sediment TMDL including Gold Gulch, and Bean, Zayante, Bear, Kings and Fall creeks (CCRWQCB 2019). • Mid-County: Soquel and Aptos/Valencia (focus on incision and bank failure on Valencia Cr). • Pajaro: Corralitos and Salsipuedes (College Lake and its drainages)	• Development • Mining/quarrying • Working lands • Increased fine sediment • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A46: Work with CalFire, timber operations and active THPs to ensure areas of active timber harvest and post-timber harvest implement effective erosion control BMPs and road improvements to reduce erosion and transport of fine sediments in adjacent creeks and streams. Where possible, recommission and restore historic and abandoned roads that are known sources of sediment. (Linked to WORKING-A7)	All THPs within priority coho salmon recovery and water supply watersheds with an emphasis on areas impacted by the CZU Lightning Complex Fire and areas highlighted in both the SLR sediment TMDL (CCRWQCB 2019) and Zayante Area Sediment Study (Swanson Hydrology and Geomorphology 2001) including Kings, Boulder, Zayante and Bear creek basins.	• Working lands • Increased fine sediment • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Numerous co-benefited species
		RR-A47: Work with landowners and land managers to manage agricultural lands, cannabis operations and adjacent uplands in a manner that will reduce soil loss and transport of fine sediments and other pollutants in watercourses (*Linked to Working Lands conservation element*)	Countywide including: • North Coast: Waddell, Scott, Molino, Laguna, Majors, and Baldwin creeks. • San Lorenzo River: subwatersheds with high concentrations of cannabis production. • Pajaro: Pajaro River, Salsipuedes Creek/College Lake, and Corralitos Creek	• Working Lands • Increased fine sediment • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • California red-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A48: Reduce fuel loads in watersheds with high fire hazard severity (Calfire 2021) and/or areas prioritized in the Community Wildfire Protection Plan (CALFIRE et al. 2018) and through the regional prioritization process (forthcoming) to proactively reduce the risk of catastrophic wildfire and associated post-fire erosion hazard. Design projects to minimize impacts to Riparian and Riverine biological resources.	FRAP and CWPP priorities and outputs from the on-going regional prioritization effort.	• Development • Mining/quarrying • Working lands • Water use • Increased fine sediment • Exotic plants/animals • Unauthorized activities • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
	RR-O17: Protect and **restore** instream temperature and dissolved oxygen conditions to support habitat for native cold-water fish. Measure progress toward achieving this objective through partner agency's monitoring efforts and CCRWQCB reporting.	**RR-A49:** Implement actions associated with **RR-O1, RR-O2, and RR-O3** (riparian canopy) and RR-O4 and RR-O5 (floodplains) Note: some forested stream reaches may benefit from management actions that decrease canopy cover in order to increase heterogeneity, sunlight and primary production, especially in reaches that support foothill yellow-legged frog. Actions that selectively reduce canopy cover could also result in accelerated recruitment of LWD and improved forest health.	• San Lorenzo: Stream reaches in CCC Coho Core and Priority 1 watersheds that provide critical rearing habitat for cold water fish species and are vital for recovery of the endangered CCC coho salmon; tributaries in the upper watershed of karst-origin • Mid-County: Soquel and Aptos as identified in the CCC steelhead recovery plan (NMFS 2016).	• Development • Mining/quarrying • Working lands • Increased fine sediment • Unauthorized activities • Water use • Exotic plants • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species • Foothill yellow-legged frog (avoid negative impacts)
		RRA-50: Implement actions and priorities associated with **RR-G5** (instream flows)	As for Actions in RR-G5.	As for Actions in RR-G5.	As for Actions in RR-G5.
	RR-O18: Protect and **enhance** water quality in riverine communities to support long-term persistence of aquatic species through control of nutrient and pathogen loading. Measure progress toward achieving this objective through partner agency's monitoring efforts and CCRWQCB reporting.	**RR-A51:** Implement existing and/or forthcoming updated recommendations of the Wastewater Management Plan for the San Lorenzo Valley (County of Santa Cruz 1995).	• Upgrade failing septic systems in rural communities in the San Lorenzo Valley; • Address illegal RV septic dumping and potential contamination for illegal camping in riparian areas. • Enhance manure management by working with livestock owners to develop and implement manure management plans.	• Development • Working lands • Water use • Unauthorized uses. • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A52: Continue implementing on-farm projects to reduce nitrate and phosphate loading from agricultural return flows (such as wood chip bioreactors, biochar treatment systems, vegetated ditches, and wetland filtration) and maintain and improve riparian buffers within agricultural setbacks.	Pajaro: Pajaro, Watsonville Sloughs, Salsipuedes Creek/College Lake	• Working lands • Water use • Climate change	• Southwestern pond turtle • Steelhead • Tidewater goby • California red-legged frog • Numerous co-benefited species
	RR-O19: Protect riverine communities and aquatic species from impacts related to known contaminants and emerging contaminants.	**RR-A53:** Work with municipal wastewater utilities, the County of Santa Cruz Environmental Health, and industry groups to create an early warning system to monitor for and then remove/filter/avoid contaminants of emerging concern as defined by US EPA.	All Watershed Regions: Work with US EPA, Water Boards, and County Environmental Health to develop and fund a monitoring program to understand the distribution and levels of contamination of endocrine disrupters in the waters of Santa Cruz County. North Coast, San Lorenzo, and Mid-County: Work with industry groups, drainage districts, and other appropriate parties to limit the introductions of 6PPD (tire preservative) into coho salmon streams due to emerging research on toxicity (Tian et al. 2021).	• Development • Water use	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

RR-G5: Improve instream flow conditions (natural hydrographs) to support the long-term persistence of aquatic native species and riparian vegetation.	**RR-O20: Protect and improve** instream flows condition within at least 50 miles of riverine habitat through 1707 dedications, acquisition of water rights, forbearance agreements, improved recharge, and new bypass flow agreements to protect water quality and enable movement of aquatic species to higher-quality habitat during periods of low flow and/or poor water quality. Measure progress toward achieving this objective through implementation of local Groundwater Management Plans and water agency conjunctive use and sustainability projects, miles of riverine habitat protected through acquisition of water rights, water rights dedications, increased efficiency of pipes and other	**RR-A54:** Utilize the existing IWRP TAC, fisheries recovery plans, Integrated Regional Water Management Plans (Santa Cruz and Pajaro), and local streamflow assessments to identify high priority stream reaches that are significantly impacted by human water use for instream flow augmentation projects including 1707 dedications, off-stream storage, acquisition or modification of water rights, development of forbearance agreements and increased enforcement of illegal water diversions.	• All stream reaches that support listed anadromous fish species (CCC coho salmon, CCC steelhead, SCCC steelhead) and are in Core, Phase 1, or Phase 2 Priority watersheds including:
			  ○ North Coast: Waddell, San Vicente Cr, Laguna, and Scott creeks.
			  ○ San Lorenzo River: Branciforte, Bean, Boulder, Zayante creeks and karst-origin upper watershed tributaries.
			  ○ Mid-County: Implement recommendations from the 2019 Soquel Creek Streamflow Assessment Study (RCD 2019). Lower Aptos/Valencia
			  ○ Pajaro: College Lake, Corralitos Creek, and flows from Uvas Dam.
			• Focus on lower mainstem reaches of Waddell, Scott, and Laguna creeks; San Lorenzo River; Soquel Creek; Aptos Creek; and Pajaro River to protect/enhance lagoon water quality during
				• Development
				• Mining/quarrying
				• Working lands
				• Water use
				• Unauthorized activities
				• Climate change
					• Southwestern pond turtle
					• Coho salmon
					• Steelhead
					• Tidewater goby
					• California red-legged frog
					• Foothill yellow-legged frog
					• Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	infrastructure, forbearance agreements, and modification of water rights.		closed-bar conditions and enable aquatic species - including focal and non-focal anadromous fish and tidewater goby - to move between estuarine and freshwater habitats, as-needed.		
		RR-A55: Continue to develop and implement instream flow protection measures and facility upgrades for water purveyors and other large diverters throughout the RCIS Area that utilize surface flow.	• North Coast: San Vicente Creek (Santa Cruz County Public Works/Davenport Sanitation District, CEMEX, and the Davenport North Coast Association on upgrades and modifications to the system to reduce leakage and waste); • North Coast and San Lorenzo: Implement upgrades articulated in the City of Santa Cruz Water Department's Anadromous Salmonid HCP at Laguna, Liddell, and Majors creeks and the San Lorenzo River; San Lorenzo Valley Water District facilities and pipelines. • Mid-County: Work with Soquel Water District and City of Santa Cruz Water Department to minimize impacts of groundwater withdrawals on in-stream flows; • Pajaro: City of Watsonville's Corralitos and Browns Valley creek Diversion and Treatment Facility, and PVWMA's College Lake Project.	• Development • Mining/quarrying • Working lands • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A56: Work with RCD, IRWM, local water agencies and smaller mutual water companies to promote water use efficiency through development and implementation of water use efficiency plans for high-water-use businesses (e.g., agriculture, campgrounds, and sports fields).	All riverine reaches that support listed anadromous fish species (CCC coho salmon, CCC steelhead, SCCC steelhead) and are considered Core, Priority 1 and Priority 2 recovery watersheds including: • North Coast: San Vicente, Laguna, and Scott creeks. • San Lorenzo: mainstem, Branciforte, Bean, and Zayante creeks as well as upper watershed karst-origin tributaries. • Mid-County: Soquel and Aptos creeks Pajaro: Lower Pajaro River and Salsipuedes/Corralitos Creek	• Development • Mining/quarrying • Working lands • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		RR-A57: Assist riparian homeowners with development and implementation of alternative water source and storage options to reduce impacts to dry season flows.	All stream reaches that support listed anadromous fish species (CCC coho salmon, CCC steelhead, SCCC steelhead) and are considered Core, Priority 1 and Priority 2 recovery watersheds including: • North Coast: Waddell, San Vicente, Laguna, and Scott creeks. • San Lorenzo: Branciforte, Bean, and Zayante creeks. • Mid-County: Soquel and Aptos creeks • Pajaro: Lower Pajaro River and Salsipuedes/Corralitos Creek	• Development • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A58: Implement projects designed to restore natural hydrographs through removal of impervious surfaces in urban, ex-urban, and agricultural settings; putting unused roads to bed; and adding roughness, sinuosity, and/or infiltration basins to local drainage systems.	All stream reaches that support listed anadromous fish species (CCC coho salmon, CCC steelhead, SCCC steelhead) and are considered Core, Priority 1 and Priority 2 recovery watersheds including: • North Coast: San Vicente, Laguna, and Scott creeks. • San Lorenzo: Branciforte, Bean, and Zayante creeks. • Mid-County: Soquel and Aptos creeks • Pajaro: Lower Pajaro River and Salsipuedes/Corralitos Creek	• Development • Mining/quarrying • Working lands • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		RR-A59: Work with the regional groundwater management agencies (PVWMA, MCGA, SMGA, etc.) to design and implement managed aquifer recharge projects to reduce dry season diversion and/or elevate dry season water tables in stream systems that are heavily impacted by human water use and have high aquatic biodiversity.	• San Lorenzo River: Implement priorities from Sustainable Groundwater Management planning efforts. • Mid-County: Design and implement priorities from the Sustainable Groundwater Plan produced by/for the Mid-County Groundwater Agency (SCMCGA 2019) that will result in improved instream flow conditions and elevated riparian water tables. • Pajaro: Implement high-priority aquifer recharge projects in PVWMA's Basin Management Plan (PVWA 2014) that will result in improved instream flow conditions and elevated riparian water tables.	• Development • Mining/quarrying • Working lands • Water use • Climate change	• Southwestern pond turtle • Coho salmon • Steelhead • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

5.3.3 Coho Salmon

Central California Coast Coho Salmon

Status and Global and State Ranks

- Federally endangered (ESA)
- State endangered (CESA)

Detailed Descriptions

California Department of Fish and Game 2004

National Marine Fisheries Service 2012

Distribution and Range

- Central California Coast Coho salmon DPS extends from Usal Creek in northern Mendocino County to Aptos Creek in Santa Cruz County.
- In Santa Cruz County, extends from Waddell Creek in the north to Aptos Creek in the south (Figure 5-3). All of these watersheds are part of the Santa Cruz Mountain Diversity Stratum.
- Coho salmon have been observed in Waddell, Scott, San Vicente, Laguna, Liddell, Majors, San Lorenzo, and Soquel creeks on multiple occasions over the past 10 years. Coho salmon streams total 48 miles in the RCIS Area.
- Scotts Creek and San Vicente Creek are the only two watersheds in Santa Cruz Mountains that continue to support all three brood years of CCC coho salmon (aided by ongoing hatchery efforts).

- The San Lorenzo River population is considered by NMFS (2012) to be at extreme risk of extinction or extirpation and is the only historically independent population in the County (NMFS 2012).

Key Ecological Elements

- Coho salmon prefer low-gradient stream reaches that are complex and contain: 1) deep and complex pools for feeding and refugia, 2) inundated riparian floodplains, 3) freshwater marsh habitat, and 4) alcoves that also provide ideal feeding areas, as well as refuge from predators, high-velocity flows, and high summer water temperatures. This complexity enables juveniles to utilize different habitat elements as flow and climate conditions change. They generally prefer deep pools (greater than 3 ft) with cover (large wood) during summer periods of low flow and higher stream temperatures and pools associated with large wood, alcoves, and off-channel habitats during high winter flows.
- While CCC steelhead and CCC coho salmon have a significant overlap in their range, coho's distribution is more limited than steelhead's both within the range and within local watersheds due to reduced swim strength, preference for lower gradient stream reaches, reliance on deep pools and slack water habitat, as well as cooler stream temperatures.
- Coho salmon have a relatively rigid three-year life history, which results in three brood years (cohorts). Adult coho salmon generally enter freshwater in the winter and generally spawn between December and February; juveniles (fry) emerge from gravel substrate after 2-3 months and must over-summer and over-winter in freshwater until they leave freshwater as smolts the following spring. Smolt out migration extends from April to early June with a peak generally in early May. After 2 years in the ocean, they return to freshwater.
- Timing of sandbar breaching in the bar-built estuaries (Section 5.3.1) is critical for adult coho salmon entering watersheds to spawn and smolts exiting freshwater to enter the ocean. Late onset of rains can delay entry to freshwater and increase the risk of predation by marine mammals. Low spring flows can lead to early bar closure that traps smolts in lagoons and lower watersheds until the following fall or winter.
- While coho salmon are known for their "rigid" life history, recent research and observations illustrate that CCC coho salmon display some level of life history plasticity. Spawning coho salmon have been observed in Santa Cruz County as late as March (J. Robins, pers. obs., 2011) and juveniles have been observed spending two years in freshwater (Osterback 2018 and NMFS 2012). The importance of two-year freshwater fish in rebuilding weak or failed cohorts has been demonstrated on the Mendocino Coast (B. Spence, pers. comm. 2021) and may be a key climate adaption strategy. In addition, two-year-old reproductive individuals (male "jacks" and occasional female

"jills") help maintain genetic diversity through spawning outside of their traditional three-year cohort.

- While Scott Creek appears to sustain the largest population of coho salmon in the Santa Cruz Mountains Diversity Stratum, San Vicente Creek is unique in the diversity stratum in that it no longer has a bar-built estuary so fish can get in or out of the stream any time of the year; additionally, its karst geology leads to higher and colder flows than in nearby watersheds, even during severe droughts (RCD 2014)

Pressures and Stressors

- The 1996 Listing of CCC coho salmon, highlights land use activities associated with logging, road construction, urban development, mining, agriculture, and recreation having significantly altered coho salmon habitat quantity and quality. The listing goes on to say that "*impacts of concern associated with these activities included the following: alteration of streambank and channel morphology, alteration of ambient stream water temperatures, elimination of spawning and rearing habitat, fragmentation of available habitats, elimination of downstream recruitment of spawning gravels and large wood, removal of riparian vegetation resulting in increased stream bank erosion, and degradation of water quality* (NMFS 1996)".
- Flood control, agricultural production, and development have also significantly impacted coho salmon populations through reductions in habitat complexity through straightening channels, installing levees, and reducing roughness. These changes have resulted in the loss of middle channel bars, ox-bows, deep meander bends, and alcoves; removal of instream wood and loss of wood recruitment sources; loss of floodplain connectivity; and changes in sediment transport dynamics.
- Water management practices including flood control (e.g., dams and levees), water diversions, groundwater pumping, and both agricultural and urban/suburban return flows have significantly degraded habitat for coho salmon through reduced dry-season flows, elevated instream water temperatures, degraded water quality, and barriers to movement in terms of dams and disconnected pools.

Climate Change Vulnerability Assessment

A detailed assessment of climate vulnerability for California's salmon and steelhead populations concluded the following (Crozier et al. 2019):

- CCC coho salmon were ranked as the highest risk population in terms of sensitivity and exposure and the lowest in terms of adaptive capacity.
- CCC and South-Central California Coast (SCCC) steelhead were both ranked moderate in terms of sensitivity and exposure and moderate in terms of adaptive capacity.

These results reflect the following aspects of the species exposure and sensitivity to climate change:

- August mean stream temperature and mean summer water deficit drives the vulnerability of anadromous fish populations by directly affecting juvenile success.
- Changes to hydrologic regime may also be a key driver of climate pressure in the RCIS Area. As examples of this:
    - Adult CCC coho salmon entry to local streams has been delayed in recent years to as late as mid-February due to lack of early winter rains and sandbars failing to breach.
    - Shift in storms to the late winter and spring leads to tremendous risk of redd scour or poor fry-juvenile survival.
    - At the other end of the seasonal hydrograph, rapid decline of flows in spring has led to earlier sandbar closures, forcing smolts to either migrate earlier when ocean conditions may not be favorable or spend a second year in fresh water increasing exposure and risk to droughts.

The goals, objectives, actions, and priorities for CCC coho salmon (Table 5-6) aim to address impacts of climate change to this species through a combination of species-specific actions focused on expanding hatchery production of juveniles and smolts to assist recover; a wide range of habitat protection, enhancement and restoration actions described in the Riparian and Riverine, Bar Built Estuary, and Redwood and Douglas-Fir Forest conservation elements will further address the impacts of climate change on this species.

Species Associated with Coho Salmon

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-6 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Tidewater goby (*Eucyclogobius newberryi*) [NF]
- Steelhead – Central California Coast DPS (*Oncorhynchus mykiss irideus*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- Foothill yellow-legged frog (*Rana boylii*) [NF]
- Southwestern pond turtle (*Actinemys pallida*) [F]
- Ringed-tailed cat (*Bassariscus astutus*) [F]

Other Actions that Benefit this Conservation Element

CCC coho salmon will directly benefit from community-level actions to achieve the goals and objectives for the following list of conservation elements. These other strategies, which were developed, in part, to promote recovery and long-term persistence of rare species (Section

5.1.2), contain the majority of the conservation and enhancement actions for CCC coho salmon and their associated focal, non-focal, and co-benefitted species.

- **Riparian and Riverine:** All of the goals articulated in the RR conservation element directly benefit coho salmon and associated non-focal and co-benefits species; in particular, these species are anticipated to benefit from: objectives RR-O1 through RR-O5 (protection and restoration of riparian habitats and floodplains); objectives RR-O6 and RR-O7 (protection and restoration of physical processes that create habitat complexity); RR-O9 (connectivity and movement from estuaries to headlands); RR-O14 through RR-O16 (protection of water quality); and RR-O20 and RR-O17 (protection and restoration of instream flow, temperature and DO). RR-O12 (RR-A33) focuses on captive breeding and is further developed for CCC coho salmon below. While many of the actions and priorities associated with these goals include both systems within and outside of the range of CCC coho salmon, the actions within CCC coho salmon watersheds are the fundamental conservation actions for this species.
- **Bar Built Estuary:** Similar to Riparian and Riverine, all of the Bar-Built Estuary goals and many of the objectives and actions will directly benefit CCC coho salmon where they occur in geographies that currently support CCC coho salmon or have high intrinsic potential for coho salmon. The BBE and RR goals and objectives are also directly linked since these two conservation elements are physically linked. In particular, coho salmon will benefit from the following objectives: BBE-O1 through BBE-O6 (protection and restoration of BBE habitats); objectives BBE-O10 and BBE-O11(protect and enhance connectivity between BBE and riverine communities and BBE and oceans through season breaching); objective BBE-O13 (protection and restoration of physical processes that create habitat complexity); objectives BBE-O17 and BBE-O18 (protection of water quality); and BBE-O19 (protection and restoration of instream flow, temperature and DO).
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of natural communities to Bar-Built Estuary and Riparian and Riverine communities as part of the actions under CONNECT-A1 through CONNECT-A4.
- **Working Lands:** All actions associated with WORKING-O2 will help achieve the goals and objectives of this conservation element by addressing riparian habitat fragmentation and degradation, improving water quality, and increasing instream flows through surface and groundwater conservation efforts.

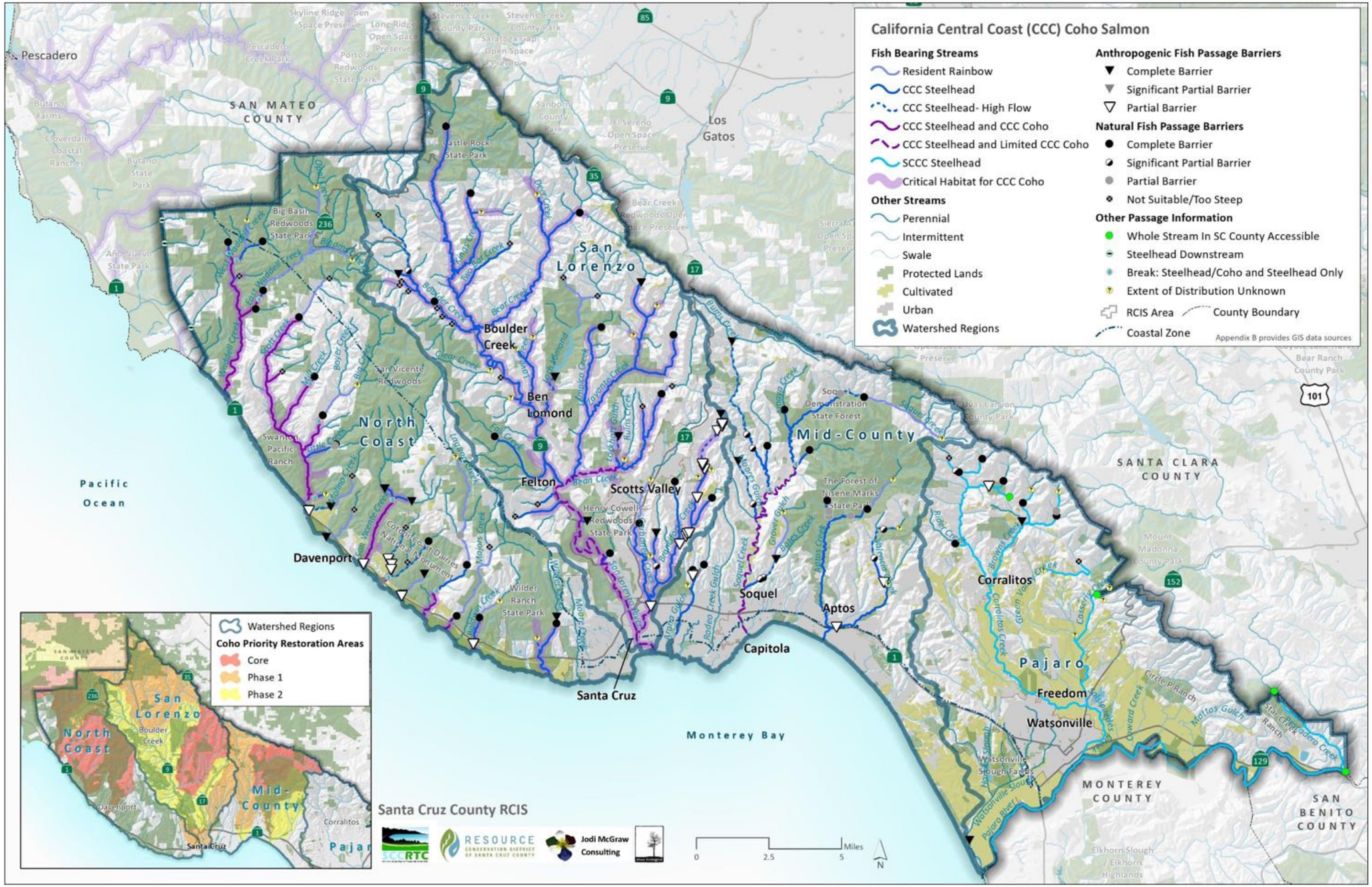

Figure 5-3: Coho Salmon Conservation Element

Table 5-6: Conservation Strategy for Coho

Goal	Objective	Action	Priority	Pressures Addressed	Species Potentially Benefited
Coho-G1: Promote the recovery and long-term persistence of CCC coho salmon	**Coho-O1**: Protect and improve instream flow conditions in at least 23 miles (90%) of riverine habitat within CCC coho salmon watersheds during the low flow season (e.g. July-October) to provide viable refugia, improve water quality (temperature and dissolved oxygen), and enable movement into areas of higher quality habitat. Measure progress toward achieving this objective through implementation of local Groundwater Management Plans and water agency conjunctive use and sustainability projects, acquisition of water rights, water rights dedications, increased efficiency of pipes and other infrastructure, forbearance agreements, and modification of water rights. (Linked to RR-O20)	**Coho-A1**: Implement actions articulated in RR-A53 through RR-A59 that promote recovery and long-term persistence of CCC coho salmon.	Priorities listed for RR-A53 through RR-A59 that are in CCC Coho Core, Phase 1, and Phase 2 Priority recovery watersheds.	• Development • Mining/quarrying • Working lands • Water use • Unauthorized activities • Climate change	• Southwester Pond Turtle • Steelhead • Coho salmon • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
	Coho-O2: Restore and **enhance** the physical process and structures that maintain and create in-stream complexity in terms of bar formation, thalweg meander, scour and pool formation, and hydraulic complexity in CCC coho watersheds. Measure progress toward achieving this objective through implementation of restoration and enhancement projects in coho salmon watersheds.	**Coho-A2:** Implement actions articulated in RR-A16 through RR-A22 and BBE-A6 that promote recovery and long-term persistence of CCC coho salmon through restoring and enhancing the natural processes that create habitat complexity include alcoves, floodplains, and large wood.	Priorities listed for RR-A16 through RR-A22 and BBE-A6 in CCC Coho Core, Phase 1, and Phase 2 Priority recovery watersheds.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Water use • Exotic plants/animals • Unauthorized activities • Climate change	• Southwester Pond Turtle • Steelhead • Coho salmon • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species

Goal	Objective	Action	Priority	Pressures Addressed	Species Potentially Benefited
	(Linked to RR-O6, RR-O7 and O4 BBE-O13)				
	Coho-O3: Protect, expand, and/or restore native riparian habitats and reconnect and restore 375 acres (75% of the floodplain objective in Riparian and Riverine) of active floodplains in CCC coho salmon watersheds. Measure progress toward achieving this objective through tracking acreage of riparian and floodplain restoration and reconnection projects in coho salmon watersheds. (Linked to RRO1 through RR-05)	**Coho-A3:** Implement actions articulated in RR-A1 through RR-A15 that promote recovery and long-term persistence of CCC coho salmon through restored riparian habitat and reconnected floodplain habitat (e.g., providing winter refuge, food sources, shelter, shade, wood loading, and sediment sorting).	Priorities listed for RR-A1 through RR-A15 in CCC Coho Core, Phase 1, and Phase 2 Priority recovery watersheds. For potential floodplain reconnection projects, evaluate the ability of reconnected floodplains to inundate for longer than 30-days to allow for coho salmon rearing.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Water use • Exotic plants/animals • Unauthorized activities • Incompatible recreation • Climate change	• Southwester Pond Turtle • Steelhead • Coho salmon • California red-legged frog • Foothill yellow-legged frog • San Francisco garter snake • Ring-tailed cat Numerous co-benefited species
	Coho-O4: Restore unfettered access for CCC coho salmon to naturally accessible stream reaches between estuaries and headwaters and seasonally appropriate access between riverine and estuarine habitat and the marine environment for spawning and smolt outmigration. Measure progress toward this goal by removing all complete barriers and partial barriers within coho salmon streams to allow access to reaches with high Intrinsic Potential for CCC coho salmon habitat (NMFS 2012). (Linked to RR-O9 and BBE-O10 and -O11)	**Coho-A4:** Implement actions articulated in RR-A23 through RR-A25 and BBE-A11 through BBE-A13 that promote removal of all anthropogenic barriers to fish passage within reaches of CCC coho salmon watersheds with high intrinsic potential (NMFS 2012).	Priorities listed for RR-A23 through RR-A25 and BBE-A11 through BBE-A13 in CCC Coho Core, Phase 1, and Phase 2 Priority recovery watersheds.	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Unauthorized activities • Incompatible recreation Climate change	• Steelhead • Tidewater goby • Numerous co-benefited species

Goal	Objective	Action	Priority	Pressures Addressed	Species Potentially Benefited
	Coho-O5: Protect and improve water quality in CCC coho salmon watersheds to support recovery and long-term persistence. Measure progress toward achieving this objective through partner agency's monitoring efforts and CCRWQCB reporting. (Linked to RR-O15 through RR-O19 and BBE-O17 and BBE-O18)	**Coho-A5:** Implement actions articulated in RR-A42 through RR-A53 and BBE-A27 through BBE-A30 that address water quality in CCC coho salmon watersheds.	Priorities listed for RR-A42 through RR-A53 and BBE-A27 through and BBE-A30 in CCC Coho Core, Phase 1, and Phase 2 Priority recovery watersheds.	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Unauthorized activities • Incompatible recreation • Climate change	• Southwester Pond Turtle • Steelhead • Coho salmon • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
	Coho-O6: Upgrade and expand the existing CCC coho salmon captive broodstock program in the Santa Cruz Mountain Diversity Stratum. Measure progress via either additional funding and reconstruction of the Kingfisher Flat Hatchery and/or identification and feasibility analysis of a new location(s) for an upgraded facility.	**Coho-A6**. Work with Monterey Bay Salmon and Trout Project (MBSTP), the NOAA Science Center, CDFW, and private landowners to repair the existing facility and associated infrastructure that was damaged or destroyed in the CZU Lightning Complex Fire to ensure that the existing broodstock program continues to produce fish.	Kingfisher Flat	• Development • Mining/quarrying • Working lands • Water use • Unauthorized activities • Genetic diversity • Climate change	• Coho salmon
		Coho-A7: Work with partners across the ESU to identify opportunities to expand the captive broodstock program through development of a new location, funding sources, and designs to build a new state-of-the-art captive broodstock hatchery facility, or a series of smaller satellite facilities, to recovery CCC coho salmon populations south of the Golden Gate Bridge.	Possible location could include: NOAA Science Center Lab, Cemex Cement Plan, CalPoly's Swanton Ranch, Loch Lomond, Warm Springs, and other locations	• Development • Mining/quarrying • Working lands • Water use • Unauthorized activities • Genetic diversity • Climate change	• Coho salmon
		Coho-A8: Expand, as habitat conditions allow and guided by adaptive management principles, the watersheds that can receive releases of juvenile, smolt, and possibly adult coho salmon from the captive broodstock program.	• San Lorenzo: Tributaries to the San Lorenzo River such as Bean, Zayante, and Branciforte creeks as well as others higher in the watershed. • Mid-County: East Branch of Soquel Creek and Aptos Creek in the Forest of Nisene Marks.	• Development • Mining/quarrying • Working lands • Water use • Unauthorized activities • Genetic diversity • Climate change	• Coho salmon
	Coho-O7: Continue/expand long-term research to better understand population and	**Coho-A9** Continue existing research and develop/implement more expansive research throughout the CCC coho salmon watersheds to	• CCC Coho Core, Phase 1, and Phase 2 Priority recovery watersheds.	• Development • Mining/quarrying	• Coho salmon

Goal	Objective	Action	Priority	Pressures Addressed	Species Potentially Benefited
	range dynamics as well as species recovery trajectory. Measures to track progress on this objective will focus on expansion of NOAA Science Center and CDFW research stations in additional coho salmon watersheds throughout the RCIS Area.	better understand population trends, dynamics, and response to land use changes, landscape-scale disturbances, and restoration actions.	• Maintain existing life-cycle station and estuary sampling in Scott Creek. • Additional spawner and juvenile surveys for coho salmon within their historic range and areas that received outplanted juveniles and smolts from the broodstock program. • Broaden and expand strategic use of eDNA and PIT tag arrays throughout CCC coho salmon watersheds to determine presence (eDNA and PIT tag arrays) and estimate population (PIT tag arrays).	• Working lands • Increased fine sediment • Water use • Exotic animals • Climate change	
	Coho-O8: Protect and Recover CCC coho through removal and eradication of non-native invasive fish and wildlife that could compete with, prey upon, displace, or otherwise impact the riverine food web, directly or indirectly impacting coho recovery and long-term persistence. Measure progress toward achieving this through both (a) the number of projects completed that focus on control or eradication of fish and wildlife that threaten coho and (b) continued control and monitoring efforts to track existing infestations. (Linked to RR-O14 and BBE-O16.	**Coho-A10:** Implement actions articulated in RR-A37 through RR-39 and BBE-A24 and BBE-25 to control and, where possible, eradicate aquatic invasive species that could directly or indirectly impact recovery of CCC coho including American bullfrog, striped bass, carp, mosquito fish, centrarchids, other non-native fish, and New Zealand mudsnail.	• Develop and implement a bullfrog eradication training and authorization program for public and private landowners and managers that are responsible for ponds and perennial wetlands, specifically those in close proximity to streams that support coho salmon. • Support current policies of the County Mosquito Abatement District to avoid use of mosquito fish in and near streams that support coho salmon. • Work with local agricultural producers, ranchers and other landowners to avoid planting non-native fish in stock ponds, agricultural reservoirs, or ornamental ponds that could be hydrologically connected to riverine habitats during high flows to avoid unintentional releases of non-native fish into riverine habitats that support coho salmon. • Expand prevention efforts to stop invasion into watersheds that are currently not known to support New Zealand mudsnail, especially North Coast coho streams (note: NZMS have been reported in Liddell Creek).	• Development • Mining/quarrying • Working lands • Increased fine sediment • Water use • Exotic plants • Exotic animals • Climate change	• Coho salmon • Steelhead • Foothills yellow-legged frog • California red-legged frog • San Francisco garter snake • Southwestern pond turtle • Numerous co-benefited species

5.3.4 Ponds, Lakes, and Reservoirs

Ponds, Lakes, and Reservoirs

Status and Rarity

- Ponds, Lakes, and Reservoirs include the following Sensitive Natural Communities:
  - Cattail marshes (52.050.00): G5, S5
  - Arroyo willow thicket (61.201.00): G4, S4
  - Spikerush marshes (45.230.00): G4, S4
- County of Santa Cruz Sensitive Habitat (Lakes)
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone (Reservoirs and Ponds)

Detailed Descriptions

CNPS 2021

Distribution and Range

- 828 acres (0.3% of the RCIS Area) of mapped waterbodies, as well as additional smaller (unmapped) ponds (Figure 5-4)
- Countywide, with the greatest concentration in the Pajaro Region

Key Ecological Elements

- Formed naturally in low-lying depression, restrictive layers, or as a result of accumulated material, or human-made for recreation, water supply, or other uses, ponds, lakes, and reservoirs provide habitat for a diverse array of native plants and animals.
- Ponds, lakes, and reservoirs support focal, non-focal, and numerous co-benefited species, including native plants, salamanders, ranid frogs, and snakes, southwestern

pond turtle (the only native turtle in the RCIS Area), and foraging and nesting birds including waterbirds and raptors, such as bald eagle. Ponds, lakes, and reservoirs are an important component (primary constituent element) of designated critical habitat for several listed species including California red-legged frog and California tiger salamander (Figure 5-5).

- Ponds vary greatly across the RCIS Area, depending on geology, slope, aspect, soils, and surrounding land use. They include deep, perennial, bermed systems, as seen often on grazing lands, or shallow, ephemeral systems, formed as a result of natural depressions, poorly drained, clay or peat soils.
- Strategically located ponds, lakes, and reservoirs have the potential to capture high intensity, less frequent storm events, recharge aquifers, and supplement downstream flows or provide an alternative to stream diversions as a source of domestic and agricultural water supply.
- Water quality in the county's lakes, ponds, and reservoirs affects downstream rivers, streams, and the broader Monterey Bay ecosystem. Polluted urban and agricultural runoff degrades water quality and can harm freshwater and marine species. High nutrient loads attributed to nitrate runoff from fertilizers can create harmful algal blooms that were linked to the death of at least 21 sea otters in 2010 (Mackenzie al. 2011). High water temperatures can threaten salmonid and other aquatic wildlife.

Pressures and Stressors

Table 4-1 highlights the pressures and stressors affecting Ponds, Lakes, and Reservoirs in the RCIS Area, which include the following most critical ones:

- Natural ponds and their surrounding habitat have been lost through habitat conversion for agriculture, residential commercial development, and infrastructure.
- Ponds, lakes, and reservoirs have been degraded by changes in hydrology, including water diversions, decreasing groundwater levels, or increased surface runoff; the introduction of exotic species; and the inflow of sediment, pesticides, and pathogens.
- The habitat surrounding ponds, lakes, and reservoirs has been degraded by the introduction of exotic plant species, particularly eucalyptus, and vegetation conversion (e.g., grasslands to coastal scrub).
- Open water habitat has been lost or degraded due to increased emergent marsh vegetation, azolla/duckweed/cyanobacteria blooms, loss of solar radiation due to canopy succession (typically eucalyptus or willow), increased water temperatures and associated oxygen-deficient conditions, and loss of macroinvertebrates.
- Lakes and reservoirs are impacted by incompatible recreational use that impacts native plants and animals and introduces exotic species.

- Ponds, lakes, and reservoirs and their surrounding habitat have been affected by climate change that has altered runoff frequency and intensity and modified plant community structure and species composition.

Climate Change Vulnerability Assessment

Freshwater wetlands and ponds have "High" vulnerability to climate change (EcoAdapt 2021) due to:

- Exposure to projected temperature increases and highly variable precipitation including drought, which together can affect water temperature, decrease plant growth, increase native plant morality, and altered plant species composition.
- High sensitivity to changes to stressors and disturbances that impact water levels, hydroperiods, and water quality, which alter habitat suitability for plant and animal species and drive changes in wetland and pond structure and function.
- Moderate adaptive capacity due to the following:
    - Many ponds have been eliminated or degraded by human stressors:
    - There is reduced resistance to climate change in fragmented and degraded systems.

The goals, objectives, actions, and priorities for the Ponds, Lakes, and Reservoirs (Table 5-7) will help address the impacts of climate change by:

1. Protecting habitat with existing water storage capacity or opportunities to construct new ponds with adequate hydrology;
2. Restoring and maintaining natural hydrologic regimes to support native plant communities and pond-breeding species;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and incompatible recreation;
4. Increasing habitat connectivity, by protecting habitat and restoring and managing upland and dispersal habitat, to facilitate the movement of species and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency; and
5. Introducing rare species into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations or extinctions due to demographic and environmental stochasticity.

Species Associated with the Ponds, Lakes, and Reservoirs Element

- Santa Cruz long-toed salamander *(Ambystoma macrodactylum croceum)* [F]
- California tiger salamander *(Ambystoma californiense)* [NF]
- California red-legged frog *(Rana draytonii)* [NF]
- San Francisco garter snake *(Thamnophis sirtalis tetrataenia)* [NF]
- Southwestern pond turtle *(Actinemys pallida)* [F]
- Tricolored blackbird (*Agelaius tricolor)* [NF]
- Bald eagle *(Haliaeetus leucocephalus)* [NF]

Other Actions that Benefit this Conservation Element

The Ponds, Lakes, and Reservoirs Communities, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Connectivity**: Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of ponds, lakes, and reservoirs as part of CONNECT A1 through CONNECT-A4 will also help the goals and objectives for the adjacent aquatic communities.
- **Working Lands:** Actions to improve water quality as part of WORKING-A2 will also help the goals and objectives for ponds, lakes, and reservoirs.
- **Grasslands:** Actions to protect, and restore/enhance upland habitat as part of GRASS-A1 through GRASS-A6 will also help achieve the goals and objectives for adjacent ponds, lakes, and reservoirs.
- **Oak Woodlands and Forest:** Actions to protect, and restore/enhance, upland habitat as part of OAK-A1 through OAK-A5 will also help achieve the goals and objectives for adjacent ponds, lakes, and reservoirs.
- **Riparian and Riverine:** Actions to protect, restore/enhance and manage riparian and riverine habitat as part of RR A1 through RR-A3 and RR-A7 through RR-A9 will also help the goals and objectives for ponds, lakes, and reservoirs.

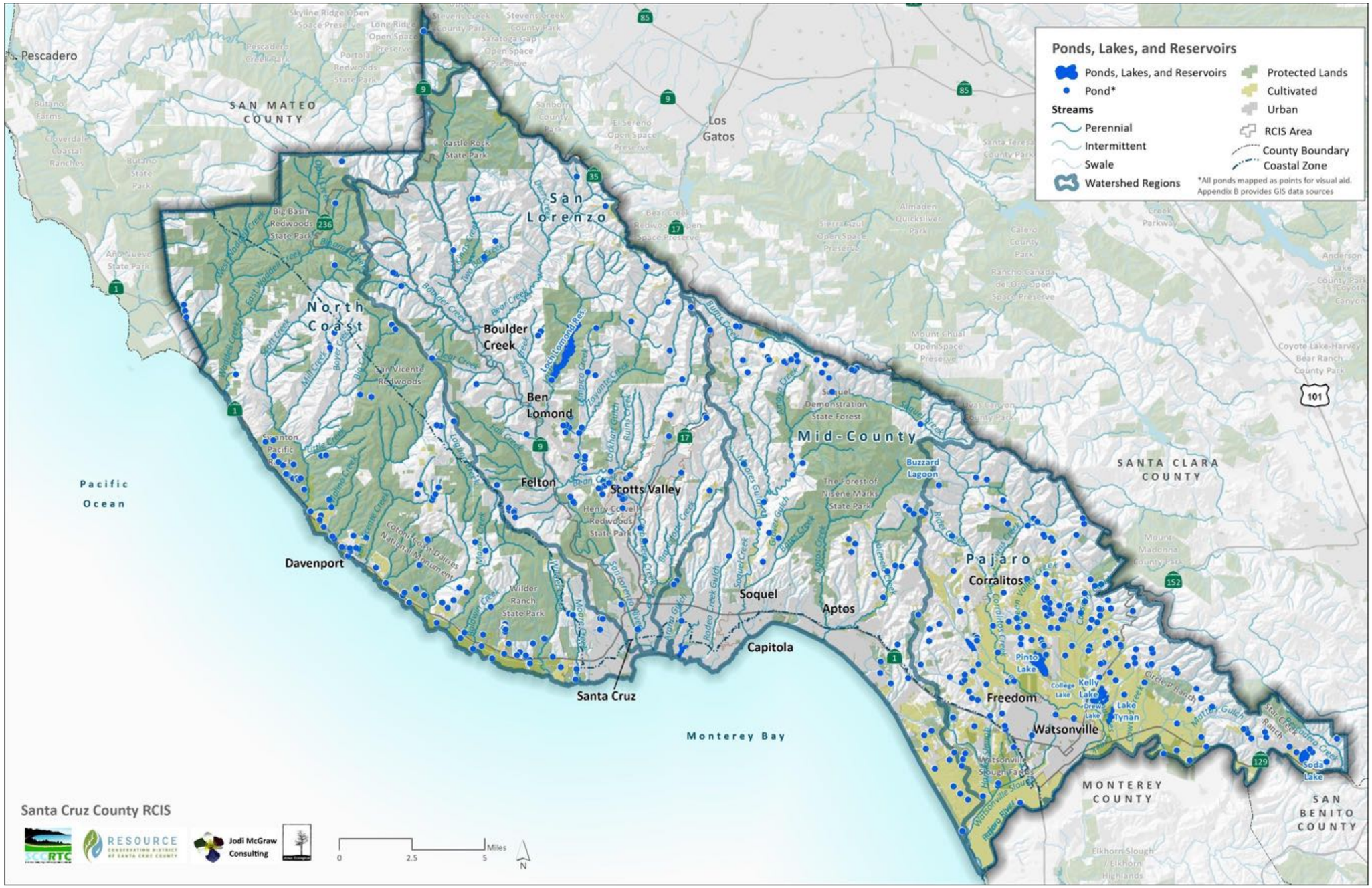

Figure 5-4:Ponds, Lakes, and Reservoirs Conservation Element

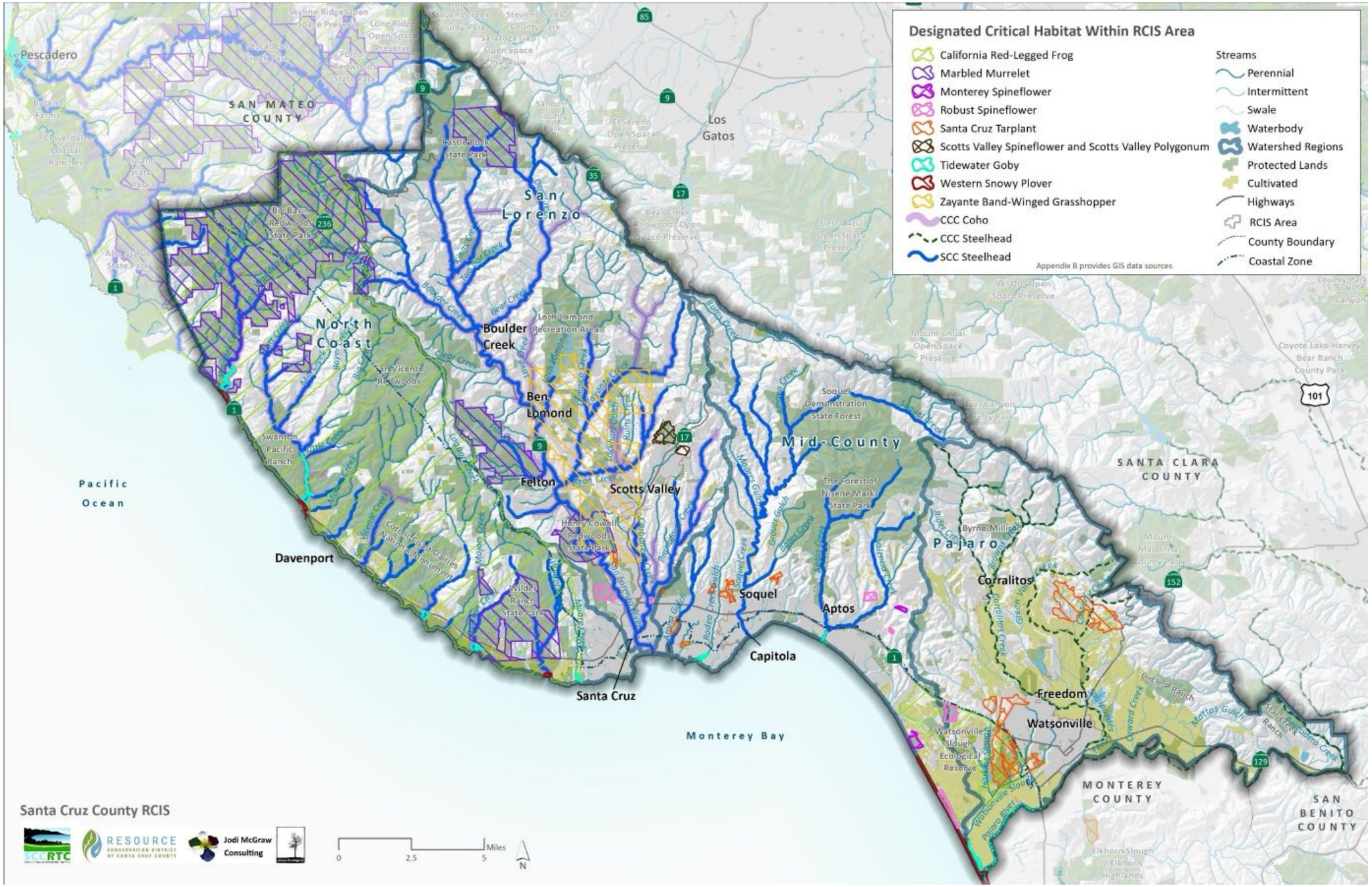

Figure 5-5: Designated Critical Habitat

Table 5-7: Conservation Strategy for Ponds, Lakes, and Reservoirs

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
PLR-G1: Promote persistence and ecological integrity of ponds, lakes, and reservoirs, the rare species they support, and the ecological processes that sustain them.	**PLR-O1:** Protect at least 311 additional ponds and lakes, to achieve the 90% target for conservation of these communities (Table 5-3). Measure progress toward achieving this objective by the number of acres of habitat and adjacent/ associated acres protected.	**PLR-A1:** Use fee title acquisition or conservation easements to protect existing ponds, lakes, and reservoirs or properties that could support ponds.	Properties: • With ponds that are intact or have the physical features (hydrology, topography, etc.) that can support ponds in anticipation of the effects of climate change. • With ponds, lakes, and reservoirs that support the focal, non-focal, and other co-benefitted species that rely on this aquatic ecosystem. • That enhance connectivity and are within dispersal distance of focal, non-focal, and other benefit species for genetic exchange and to strengthen population dynamics. • That are adjacent to other intact properties and/or properties in conservation that can be effectively managed, achieve multiple benefits; and/or were identified in prior conservation plans. • Properties that are within USFWS critical habitat designations for California red-legged frog and California tiger salamander (Figure 5-5).	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	PLR-O2: Restore and enhance pond and lake habitat to promote early successional stages, suitable vegetation structure (Meese and Beedy 2015, USFWS 1986a, b), provide quality vegetation as food, shade, cover, reproductive medium, macroinvertebrate production, adequate hydrologic period, control predators, and other ecosystem functions where they have been degraded or eliminated through prior land use, management, or time. Measure progress toward achieving this objective by number of acres of habitat	**PLR-A2: Restore and enhance habitat** that has been degraded by prior or ongoing land use, management, and natural system processes, by removing vegetation to increase open water habitat (Meese and Beedy 2015, USFWS 1986 a, b) and sunlight exposure, planting emergent vegetation for egg-laying and cover, installing infrastructure to drain ponds if necessary, lining ponds to increase hydroperiod, repairing and/or rebuilding aged embankments, and preventing flooding of nests.	• Ponds, lakes, and reservoirs that are protected through acquisition easements, and/or are managed by conservation partners. • Ponds, lakes and reservoirs that, if restored or enhanced, can support rare species, expand their distribution and abundance, and provide connectivity to existing protected habitat (e.g., Freedom Lake). • Ponds (and their upland habitat), lakes, and reservoirs that are adjacent to other intact properties and/or properties in conservation, that can be effectively managed and maintained; achieve multiple benefits; and/or were identified in prior conservation plans. • Ponds within critical habitat for California red-legged frog and/or California tiger salamander (Figure 5-5).	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored Blackbird • Numerous co-benefitted species
		PLR-A3: Collaborate with livestock owners to install wildlife-friendly fencing, maintain open water habitat or appropriate vegetation structure, and implement other	As described for PLR-A1 and 2.	• Working lands • Increased fine sediment • Exotic plants	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	restored, enhanced and/or occupied by rare species, or recovery goals and objectives met.	measures to protect pond habitat while providing water for livestock.		• Exotic animals • Climate change	• San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored Blackbird • Numerous co-benefitted species
		PLR-A4: Remove exotic wildlife such as American bullfrog, red-eared slider, mosquitofish, crayfish, and exotic fish and manage for native multi-species co-occupation including California newt (Biosearch Environmental Consulting 2018) and Canada geese.	As described for PLR-A1 and 2.	• Exotic animals • Incompatible recreation	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
		PLR-A5: Coordinate with mosquito abatement to safely manage aquatic habitat, avoid the introduction of mosquitofish (*Gambusia* spp.), and reduce/limit the use of pesticides, herbicides, fertilizers, petroleum products and other chemicals near aquatic habitats.	As described for PLR-A1 and 2.	• Working lands • Exotic animals	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
		PLR-A6: Install large wood, floating vegetation islands, or other features to provide basking habitat and cover for native animal use (Stebbins 1972).	As described for PLR-A3 and aquatic habitat known to support Southwestern pond turtle.	• Development • Working lands • Mining/quarrying • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
		PLR-A7: Manage current and future recreation, including off-road vehicles, biking, equestrian use, foot traffic, and unleashed pets to reduce impacts on and disturbance. Ensure that authorized recreation is compatible with current and future potentially suitable habitat and adjacent areas, and areas of known occurrences (USFWS 2002a).	As described for PLR-A1.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants • Exotic animals • Incompatible recreation	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
				• Climate change	• Numerous co-benefited species
	PLR-O3: Create ponds to replace habitat lost by conversion elsewhere. Measure progress toward achieving this objective by the number of acres of habitat created and/or occupied by rare species.	**PLR A8:** Construct ponds on parcels with adequate protection, such as acquisition or easement, and that feature suitable upland and dispersal habitat, through manipulation of one or more attributes (topography, vegetation, hydrology, etc.) where doing so will not negatively impact other aquatic systems (e.g., streams)	As described for PLR-A1 and PLR-A2.	• Development • Working lands • Mining/quarrying • Water use • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
PLR-G2: Maintain and enhance connectivity of pond habitat to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**PLR-O4:** Protect upland habitat surrounding ponds, lakes and reservoirs, and dispersal habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward achieving this objective by the number of acres of habitat and adjacent/ associated acres protected.	**PLR-A9:** Use fee title acquisition or conservation easements to protect existing upland and dispersal habitat or properties that could support upland or dispersal habitat from conversion and other degradative land uses.	As described for PLR-A1.	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	PLR-O5: Restore and enhance upland habitat surrounding ponds, lakes and reservoirs and dispersal habitat to promote landscape connectivity through the manipulation of physical, chemical, or biological characteristics to return or improve natural/historic functions. Measure progress toward achieving this objective by the acres of habitat restored and/or occupied, and/or by the number of improved	**PLR-A10:** Restore and enhance upland and dispersal habitat through the reduction of invasive plant species, fuel load management, and revegetation with appropriate native plants to promote use of habitat by rare species moving between core habitat areas and to protect aquatic habitat from fire-related impacts.	As described for PLR-A1 and in locations where non-native plant species are surrounding ponds, lakes, and reservoirs, and/or are negatively affecting water availability, oxygen levels, pH, temperature, and macroinvertebrate production.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
		PLR-A11: Reduce use of rodenticides and encourage use of owl boxes, raptor perches,	As described for PLR-A2.	• Development • Working lands	• Southwestern pond turtle

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	connectivity corridors used by rare species.	and other methods to reduce incidental poisoning of native animals.		• Mining/quarrying • Exotic animals • Climate change	• Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
		PLR-A12: Restore and enhance dispersal habitat by modifying and installing road drainage infrastructure including culverts and road crossings to reduce roadkill and related morality, promote animal movement, and improve genetic exchange between populations (USFWS 2017a).	As described for PLR-A2 with priority habitat areas for wildlife connectivity, and specifically: • Focus on areas with high numbers of vehicle-related mortality, areas with high Area of Conservation Emphasis Terrestrial Connectivity rankings and include areas to create corridor redundancy. • Enhance habitat on either side of crossing structures, including protecting adjacent areas and restricting human activity nearby. • Work with transportation districts or others to collect and analyze roadkill data, to identify hotspots where mortality occurs and inform the design of wildlife crossing infrastructure improvements (Yap and Rose 2019). • Projects to address hotspots, such as Highway 1, San Andreas Road and Larkin Valley Road in Watsonville.	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Numerous co-benefited species
PLR-G3: Promote the recovery and long-term persistence of both rare and common native species, including focal and non-focal species, that rely on ponds, lakes, and reservoirs.	**PLR-O6**: Protect habitat occupied by, or suitable for, rare species in ponds, lakes, and reservoirs and surrounding upland habitat.	**PLR-A13:** All actions from PLR-A1.	As described for PLR-A1 to and specifically: • Within known populations of the southwestern pond turtle (San Lorenzo Lagoon, Loch Lomond Reservoir, Pinto Lake, Antonelli Pond, and Glenwood Preserve). • Between Highway 1 and San Andreas Road near Watsonville, for the only population of California tiger salamander within the RCIS Area and to facilitate connectivity for Santa Cruz long-toed salamander and California red-legged frog. • Between Highway 1 and Larkin Valley to facilitate connectivity for Santa Cruz long-toed salamander, in preparation for the installation of a Highway 1 wildlife undercrossing. • Within known occurrences of tri-colored blackbird (Antonelli Pond).	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Within known populations of California red-legged frog, particularly: ○ North Coast: Ponds managed by State Parks and the Bureau of Land Management (BLM) ○ City of Santa Cruz: Antonelli Pond and in the ditches adjacent to the Union Pacific Railroad ○ Pajaro: Ponds in the Watsonville Slough system, particularly those managed by the Land Trust of Santa Cruz County (Watsonville Slough Farms and Bryant Habert properties), USFWS (Ellicott Unit of the Ellicott Slough National Wildlife Refuge), and within the southern portion of Larkin Valley.		
	PLR-O7: Maintain or increase rare species populations to promote species persistence. Measure progress toward achieving this objective by the number of acres of habitat occupied by rare species.	**PLR-A14:** Conduct species-specific actions where needed to supplement habitat protection, restoration, enhancement, and creation efforts to ensure the persistence of species. Examples include surveys, including eDNA, captive breeding/rearing programs, and other species-specific actions.	• Locations that support or potentially support the focal, non-focal, and other co-benefit species that rely on this aquatic ecosystem. • Populations that are declining despite efforts to promote them using habitat protection, restoration, management, and enhancement methods. • Will likely be extirpated if the population-specific actions are not implemented.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Incompatible recreation • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
		PLR-A15: Conduct studies to fill gaps in basic life history information, such as distribution, resource utilization, reproduction, and survival to inform conservation and management and eDNA sampling, where feasible to identify presence/absence of key focal and non-focal species.	As described for PLR-A14.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Incompatible recreation • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		PLR-A16: Reduce disease transmission and pathogen-related mortality by sterilizing all equipment entering known or suitable habitat to prevent introduction of disease and monitor for the presence of pathogens.	As described for PLR-A14.	• Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Numerous co-benefited species
		PLR-A17: Reintroduce rare species into protected areas featuring suitable but unoccupied habitat, and habitat that can be made suitable through restoration and enhancement, and/or creation.	As described for PLR-A14.	• Development • Working lands • Mining/quarrying • Climate change • Loss of Genetic Diversity	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Numerous co-benefited species
PLR-G4: Promote water quality of aquatic ecosystems to support function, and species survival.	P**LR –O8**: Protect habitat or habitat degraded by prior land uses to ensure high quality surface and groundwater. Measure progress toward achieving this objective by the number of acres protected.	**PLR-A18:** Use fee title acquisition or conservation easements to protect habitat or habitat degraded by prior land uses from conversion and other degradative land uses.	As described for PLR-A1.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	PLR-O9: Restore and enhance or habitat degraded by prior land uses to ensure high quality surface and groundwater. Measure progress toward achieving this objective by the improvement of aquatic conditions (inundation duration, water depth, water chemical composition, and/or stream characterization, habitat	**PLR-A19**: Restore and enhance habitat degraded by prior land uses (e.g., development, agriculture, mining, forestry, livestock ranching) and other anthropogenic impacts including altered disturbance regimes, incompatible recreation, and exotic plants.	As described for PLR-A2.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Incompatible recreation • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	structure, native species diversity, percent cover), water quality, and connectivity of water resources.				
	PLR-O10: Improve water quality by reducing nutrient, pathogen, and pesticide runoff. Measure progress toward achieving this objective by the number of acres treated through implementation.	**PLR-A20:** Use filter strips, sediment basins, vegetated treatment systems, grassed waterways, buffers, hedgerows, cover crops or other water treatment techniques to replace the vegetation where it has been removed to treat surface runoff before it enters surface and groundwaters through outreach, education, and incentive-based programs.	As described for PLR-A1 and PLR-A2.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	PLR-O11: Treat water quality within ponds, lakes, and reservoirs when source of impairment cannot be adequately addressed.	**PLR-A21**: Treat cyanobacterial blooms to address pathogen-laden sediment from impairing water quality and ecosystem health (RCD 2013).	As described for PLR-A1 and PLR-A2 and specifically Pinto Lake.	• Water use	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
	PLR-O12: Address food safety, cultural and other barriers and incentivize the installation of water quality treatment systems. Measure progress toward achieving this objective by the number of acres treated through implementation.	**PLR-A22:** Conduct education and outreach, explore new technology, install demonstration projects, and engage across industry to encourage the adoption of water quality treatment systems/practices to improve surface runoff before it enters surface and groundwaters.	As described for PLR-A1 and PLR-A2.	• Working lands	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
PLR-G5: Promote water quantity of aquatic ecosystems to support function and species survival.	**PLR-O13:** Protect intact habitat or habitat degraded by prior land uses to reduce water use, to increase rates of infiltration, to raise groundwater levels, and to improve groundwater hydrology that supports ponds, lakes, and reservoirs.	**PLR-A23:** Use fee title acquisition or conservation easements to protect intact habitat or habitat degraded by prior land uses from conversion to land uses with higher rates of water consumption, that limit the rate of infiltration or increase the rate of runoff.	As described for PLR-A1 and PLR-A2 and specifically that support groundwater dependent ecosystems (GDEs). These include: • Santa Margarita Basin, particularly along Lompico Creek, Zayante Creek near Quail Hollow Ranch County Park, Bean Creek, Lockhardt Gulch, Ruins Creek between Olympia and Hanson quarries; and Mackenzie Creek, Bean Creek, West Branch Carbonera Creek, and Carbonera Creek near Scotts	• Development • Working lands • Mining/quarrying • Water use • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	Measure progress toward achieving this objective by the number of acres protected.		Valley High School (Santa Margarita Groundwater Agency 2021); • Pajaro Valley Basin, particularly in the mountainous regions where the streams are underlain by the Purisima Formation and in the lowlands by the Aromas Red Sands soil or younger alluvial material (PVWMA 2021); and • Mid-County Basin, particularly Soquel Creek and Rodeo Gulch (Ryan 2021).		• Numerous co-benefited species
	PLR-O14: Restore and enhance habitat degraded by prior land uses to reduce water use, to increase rates of infiltration, to raise groundwater levels, and to improve groundwater hydrology that supports ponds, lakes, and reservoirs. Measure progress toward achieving this objective by the number of acres restored and enhanced and/or by the improvement of hydrological indicators such as water depth, duration, water temperature and chemistry.	**PLR-A24:** Restore and enhance habitat degraded by prior land uses (e.g., development, agriculture, mining, forestry, livestock ranching) and other anthropogenic impacts including altered disturbance regimes, incompatible recreation, and exotic plants.	As described for PLR-A1, PLR-A2, and PLR-A25.	• Development • Working lands • Mining/quarrying • Water use • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	PLR-O15: Create, expand, and maintain groundwater recharge systems, recycling programs, and/or water storage systems to increase rates of infiltration, to raise groundwater levels, and to improve groundwater hydrology that supports ponds, lakes, and reservoirs. Measure progress toward achieving this objective by the number of acres created, expanded, or maintained and/or by the improvement of hydrological indicators such as	**PLR-A25:** Create, expand, and maintain groundwater recharge systems.	As described for PLR-A1, PLR-A2, and PLR-A25 and specifically, areas: ● With high infiltration capacities, connectivity to groundwater aquifers, and within coastal areas with high rates of seawater intrusion; ● within Key Riparian Corridors; ● Recommended within the three groundwater basin management plans for the RCIS Area (PVWMA 2021, Santa Cruz Mid-County Groundwater Agency 2019, Santa Margarita Groundwater Agency 2021); and ● Without the presence of an impermeable clay layer (PVWMA 2021).	• Development • Working lands • Mining/quarrying • Water use • Unauthorized activities • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	water depth, duration, water temperature and chemical composition.				
	PLR-O16: Conserve and recycle water to increase groundwater and surface water availability for ecosystems and species that are aquatic dependent. Measure progress towards this objective by the improvement of hydrologic indicators, as documented by GSAs.	**PLR-A26:** Support conservation and recycling programs to increase water supply for ecosystem function.	Areas included in the three (3) Groundwater Sustainability Plans that cover portions of the RCIS Area, as listed above.	• Water use	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species

5.3.5 Santa Cruz Long-Toed Salamander

Santa Cruz Long-Toed Salamander

State and Federal Status:

Federally Endangered

California Endangered, State Fully Protected

Global Rank: G5 **State Rank:** S1

Detailed Species Accounts

Ferguson 1961

Stebbins 2003

Reed 1981

Ruth 1994

USFWS 1977

Distribution and Range

- Endemic to an approximately 15 square mile area in southern Santa Cruz County and northern Monterey County (CDFW 2020a, USFWS 2019c; Figure 5-6).
- The population occupies a 16,731-acre region in Santa Cruz County (Figure 5-6).

Key Ecological Requirements

- Santa Cruz long-toed salamander (SCLTS) life cycle requires migratory movements between mesic upland habitats and breeding ponds.

- SCLTS spend a majority of life in upland habitat, particularly underground in small mammal burrows; during dispersal and migration they find temporary cover under leaf litter and organic debris, in root systems of plants in dense coastal scrub, maritime chaparral, and coast live oak (*Quercus agrifolia*), and in patches of riparian vegetation, such as arroyo willows (*Salix lasiolepis*; CDFW 2020a, USFWS 1999, 2004b, 2009). These upland and riparian habitat features protect SCLTS from heat and the drying rays of the sun (Reed 1981).
- With the onset of winter rains in mid-to-late November or December, adults migrate at night to breed in shallow, usually ephemeral, freshwater ponds with clumps of vegetation or debris (CDFW 2020a; USFWS 1999, 2004b). Peak breeding occurs during January and February because earlier rains are usually insufficient to fill the breeding ponds (Anderson 1967). After breeding, adult SCLTS leave the aquatic habitat and return to terrestrial habitat.
- Eggs are generally laid singly on submerged stalks of spikerush (*Eleocharis* spp.) or other aquatic vegetation, although unattached and clustered eggs have been observed. Eggs hatch 15 to 30 days after egg laying (Reed 1979).
- Larval SCLTS remain in the pond environment for 90 to 145 days until they reach about 1.3 inches snout to vent length (Anderson 1960), but the timeline for metamorphosis is influenced by increased water temperatures and drying of the aquatic habitat.
- SCLTS appear to become reproductive after 3 years (Kasteen et al. 2020).
- After breeding, adult SCLTS disperse away from the ponds into upland habitat, up to 0.7 – 1 miles from breeding site (USFWS 1999, Biosearch 2021)
- Adults forage for invertebrates on the soil surface. Prey consist of isopods, but also includes beetles, slugs, and earthworms (Anderson 1968).

Pressures and Stressors

Table 4-1 highlights the pressures and stressors affecting Santa Cruz long-toed salamander in the RCIS Area, which include the following most critical ones:

- Habitat loss and fragmentation due to infrastructure (e.g., Highway 1), development and agriculture; conversion of oak woodland by clearing native understory to eradicate poison oak, create horse pastures, open up habitat for human uses, and reduce fire risk.
- Habitat degradation in upland and riparian habitat due to exotic plants, including eucalyptus, Monterey pine, and pampas grass, which outcompete native plants including for water and create fire hazard; use water. In particular, eucalyptus trees surrounding wetlands take up greater amounts of freshwater than native oaks and thus cause dry down of wetlands earlier in the season, preventing native amphibians from achieving metamorphosis. Eucalyptus also produce allelopathic chemicals that prevent reducing native understory diversity and potentially degrading water quality.

- Erosion due to incompatible recreation and other disturbances that remove vegetation; fire exclusion, and climate change.
- Degraded water quality through chemical contamination (e.g., pesticides, herbicides, petroleum products) and sedimentation via runoff, which reduces the growth or survival of salamander larvae (USFWS 2009).
- Predation from introduced predators such as mosquitofish (*Gambusia* spp.), bluegill, bass, Louisiana red-swamp crayfish, American bullfrogs, as well as native predators including rough-skinned newts, California tiger salamanders, predacious aquatic insects, birds, mammals, and snakes (USFWS 2009);
- Genetic isolation leading to a decline in ability to endure stochastic events and increased vulnerability to extirpation. Allentoft and O'Brien (2010) conducted a thorough review of 34 studies (17 amphibian species) in which clear genetic-fitness-correlations are documented. They identified four factors, small effective population sizes and whole clutch mortality, population declines, habitat fragmentation, and low dispersal rates, that render amphibians especially prone to severe loss of genetic diversity in recent times. Each of these factors can undoubtedly be ascribed to the SCLTS.
- Susceptibility to fungal diseases, such as chytrid (*Batrachochtrium dendrobatidis* [BD]), which has been confirmed in SCLTS in both Santa Cruz and Monterey counties (USFWS 2009).
- Broad mosquito abatement treatment of most freshwater habitats within the range of SCLTS, which can have unintended consequences on non-target animals, with particularly negative effects on native amphibians (USFWS 2019c). Mosquito larvicides include compounds that disrupt larval development, such as Methoprene and diflubenzuron; microbial agents such as *Bacillus thuringiensis* var. *israelensis* (Bti) and *Lysinibacillus sphaericus* that are toxic to mosquito larvae when ingested; and surface oils such as Golden Bear that interfere with the SCLTS larva's ability to breathe (Camara et al. 2018).
- Road mortality when adults migrate at night during rain events and experience high levels of road kill and are flushed out through culverts due to the lack of appropriate wildlife crossings and infrastructure.
- Climate change, which is expected to greatly influence habitat availability and quality for all endemic animals. Larger but fewer storm events could result in declining aquifer levels and thus the loss of freshwater wetlands and ponds supported by groundwater and could reduce creek levels and flow at the coast and other watersheds in Santa Cruz County.

Climate Change Vulnerability Assessment

Santa Cruz long-toed salamander have "High" vulnerability to climate change (EcoAdapt 2021) due to:

- Exposure to projected temperature increases and highly variable precipitation including drought, which together can affect water temperature, resulting in decreased plant growth, increased morality, and altered vegetation composition;
- High sensitivity to climate stressors and disturbances such as warmer air and water temperatures, changes in precipitation, increased drought, altered wildfire regimes, and disease, which directly impact the species by increasing physiological stress and mortality rates and indirectly by altering habitat availability and quality;
- Sensitivity to factors that result in the loss of cool, moist microclimates within terrestrial habitats as well as those that alter stream and pond hydroperiods;
- Their limited range and/or isolated populations make them particularly vulnerable to habitat fragmentation/loss and environmental changes that increase the risk of desiccation. Small, isolated populations also generally have lower genetic diversity than more widespread species.
- Moderate adaptive capacity: due to the following:
    - Likely low genetic variability, due to limited population size and geographic range; and
    - Habitat fragmentation and land conversion that negatively affects migration and dispersal.

The conservation strategies for Oak Woodlands and Forests, Riparian and Riverine communities, Maritime Chaparral and Knobcone Pine Forest, Freshwater Wetlands, and Ponds, Lakes, and Reservoirs provide additional relevant information for the assessment of SCLTS vulnerability to climate change.

The goals, objectives, actions, and priorities for Santa Cruz long-toed salamander (Table 5-8) will help address the impacts of climate change by:

1. Protecting existing and potential habitat within the narrow geographic range of the species;
2. Restoring and maintaining natural hydrologic regimes to support native vegetation and breeding for wildlife reliant on those ecosystems;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and incompatible recreation;
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat, to facilitate the movement of species and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency; and

5. Introducing rare species into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations or extinctions due to demographic and environmental stochasticity.

Other Actions that Benefit this Conservation Element

Santa Cruz long-toed salamander along with its associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Riparian and Riverine:** Actions conducted to protect and restore riparian and riverine habitat that supports (or could support) SCLTS part of RR-A1 through RR-A3;
- **Ponds, Lakes, and Reservoirs:** Actions to protect, restore, create, and manage ponds and lakes and adjacent upland habitat that supports (or could support) SCLTS part of PLR-A1 through PLR-A10;
- **Freshwater Wetlands:** Actions to protect, restore, and manage freshwater wetlands and adjacent upland habitat that supports (or could support) SCLTS part of FW-A1 through FW-A16;
- **Connectivity:** Actions to protect and enhance habitat connectivity through protection, restoration, and enhancement of habitat as part of CONNECT-A1 through CONNECT-A4;
- **Oak Woodlands and Forests:** Actions to protect, restore, and manage oak woodlands and forests that support (or could support) SCLTS part of OAK-A1 through OAK-A5; and
- **Maritime Chaparral and Knobcone Pine Forest:** Actions to protect, restore, and manage maritime chaparral communities that support (or could support) SCLTS part of CHAP-A1 through CHAP-A5.
- Santa Cruz long-toed salamander will also benefit from the conservation strategy in the Monterey County RCIS, which includes actions to protect known occurrences, enhance occupied and suitable habitat, and reduce vehicle and pathogen-related morality.

Focal and Non-Focal Species Associated with Santa Cruz Long-Toed Salamander

- Santa Cruz long-toed salamander *(Ambystoma macrodactylum croceum)* [F]
- California tiger salamander *(Ambystoma californiense)* [NF]
- California red-legged frog *(Rana draytonii)* [NF]
- San Francisco garter snake *(Thamnophis sirtalis tetrataenia)* [NF]
- Southwestern pond turtle *(Actinemys pallida)* [F]
- Tricolored blackbird (*Agelaius tricolor)* [NF]
- Bald eagle *(Haliaeetus leucocephalus)* [NF]

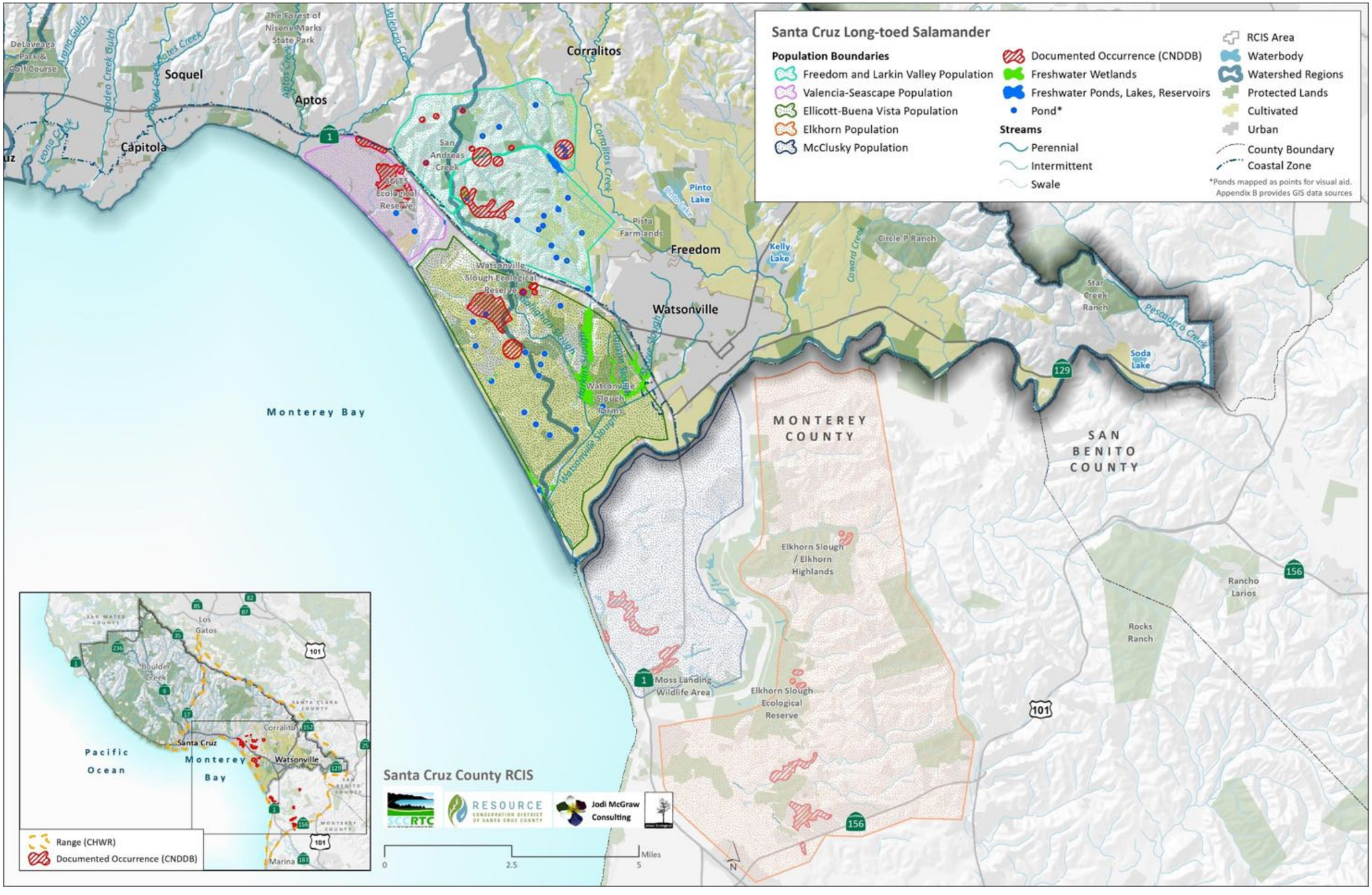

Figure 5-6:Santa Cruz Long-Toed Salamander Conservation Element

Table 5-8: Conservation Strategy for Santa Cruz Long-Toed Salamander

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
SCLTS-G1: Promote the recovery and long-term persistence of Santa Cruz long-toed salamander.	**SCLTS-O1**: Protect at least 10,402 additional acres of undeveloped habitat and 28 additional ponds within the SCLTS population area to achieve the 90% target for conservation of these communities (Table 5-3). Measure progress toward achieving this objective by the number of acres of habitat and adjacent/ associated acres protected or by meeting recovery goals and objectives.	**SCLTS-A1:** Use fee title acquisition or conservation easements to permanently protect habitat from conversation and other degradative land uses. Identify corridors between breeding complexes; map upland by habitat type; identify intact upland habitat and modified or degraded habitat that could be restored.	Properties that: • Are within and in proximity to the four (4) population boundaries (Figure 5-6); • Can expand or connect existing protected lands supporting the species; and • Can be used to establish a new SCLTS population, including by protecting suitable but unoccupied habitat, and habitat that can be rendered suitable. Other priorities: • Establish an incentive program for private landowners to protect occurrences and manage habitat. This includes fee title acquisition of properties with limited development potential.	• Development • Working lands • Climate change	• Southwestern pond turtle • California red-legged frog • Santa Cruz long-toed salamander • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	SCLTS-O2: Restore and enhance habitat to promote SCLTS populations. Measure progress toward achieving this objective by the number of acres of habitat restored, enhanced and/or occupied by the rare species.	**SCLTS-A2:** Restore habitat that has been degraded by prior land use and/or altered disturbance regimes, by addressing altered ponds, wetlands and upland and dispersal habitats; controlling exotic plants and animals; promoting diverse native plant assemblages; and otherwise increasing suitability of habitat for SCLTS.	• Habitat that, if restored, can support SCLTS, to expand their distribution and abundance, and that can connect or buffer existing protected habitat. • Areas that are permanently protected, can buffer and expand existing habitat occupied by SCLTS, and where the restoration area can be maintained.	• Development • Working lands • Water use • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • California red-legged frog • Santa Cruz long-toed salamander • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
	SCLTS-O3: Restore and enhance habitat connectivity for SCLTS. Measure progress toward achieving this objective by the number of acres of habitat restored, enhanced and/or occupied by the rare species.	**SWPT-A3:** Restore and enhance dispersal habitat by modifying and installing road infrastructure including culverts and road crossings to reduce roadkill and related mortality, promote wildlife movement, and improve genetic exchange between populations.	Properties as outlined in SCLTS-A2 within priority areas for habitat connectivity, and: • Focus on areas with high vehicle-related mortality; • Enhance habitat on either side of crossing structures, including by protecting adjacent areas and restricting human activity nearby; and • Work with transportation agencies and others to collect and analyze roadkill data, to identify hotspots where mortality occurs and inform the design of wildlife crossing infrastructure improvements. • Within key dispersal corridors between the Ellicott/Buena Vista and Larkin Valley metapopulations and between the Larkin Valley and Seascape populations.	• Development • Working lands • Climate change • Loss of genetic diversity	• Southwestern pond turtle • California red-legged frog • Santa Cruz long-toed salamander • California tiger salamander

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	SCLTS-O4: Establish new SCLTS populations within their historic range to promote species persistence in the face of a changing climate and alleviate genetic isolation. Measure progress toward achieving this objective by the number of acres of habitat restored, enhanced and/or occupied by the rare species.	**SCLTS A-4**: Reintroduce SCLTS into protected areas featuring suitable but unoccupied habitat, or habitat that can be made suitable through restoration and enhancement.	Establish new populations within: • Protected lands including those managed by CDFW and USFWS; and • Other suitable habitat within, or in proximity to, the population boundaries (Figure 5-6).	• Development • Working lands • Climate change • Loss of genetic diversity	• Southwestern pond turtle • California red-legged frog • Santa Cruz long-toed salamander • California tiger salamander • Bald eagle • Tri-colored blackbird • Numerous co-benefited species
		SCLTS A5: Continue genetic admixture studies and captive breeding.	As designated by USFWS and CDFW.	• Loss of genetic diversity	
	SCLTS-O5 Evaluate population recovery and inform adaptive management through research and monitoring, including eDNA. Measure progress toward achieving this objective using the SCLTS recovery plan downlisting/ delisting criteria (USFWS 1999).	**SCLTS A-6:** Conduct annual aquatic sampling, eDNA, and night surveys to document species presence. Conduct surveys using eDNA and/or traditional survey methods in suitable or potentially suitable habitat, identify movement corridors between breeding sites, locate undocumented occurrences of focal species and other conservation elements and opportunities for habitat protection, enhancement, restoration, and creation.	• Protected lands including those managed by CDFW and USFWS; and • Other suitable habitat within, or in proximity to, the population boundaries (Figure 5-6).	• Development • Working lands • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California tiger salamander • California red-legged frog
		SCLTS A-6: Conduct population studies every 5-10 years to estimate population size to inform additional conservation and management.	• Protected lands including those managed by CDFW and USFWS; and • Other suitable habitat within, or in proximity to, the population boundaries (Figure 5-6).	• Climate change • Loss of genetic diversity	• Santa Cruz long-toed salamander • California tiger salamander • California red-legged frog

5.3.6 Freshwater Wetlands

Freshwater Wetlands

Status and Global and State Ranks

- Freshwater Wetlands include the following Sensitive Natural Communities:
  - Cattail marshes (52.050.00): G5, S5
  - Arroyo willow thicket (61.201.00): G4, S4
  - Spikerush marshes (45.230.00): G4, S4
- County of Santa Cruz Sensitive Habitat (Wetlands)
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone (Intermittent Wetlands, Wetland Conditions)

Detailed Descriptions

CNPS 2021

Corps of Engineers 1987

Distribution and Range

- 793 acres of mapped freshwater wetlands (0.3% of the RCIS Area)
  - 26 acres adjacent to Bar-Built Estuaries, plus an additional 767 acres away from these features (Figure 5-7); and
  - Additional smaller, unmapped wetlands are found in association with ponds (445 mapped in the RCIS Area); springs and seeps (107 mapped in the RCIS Area), and along streams (1,569 miles in the RCIS Area; Figure 5-7).
- Includes the Watsonville Sloughs, which are one of the largest remaining coastal wetland ecosystems in California, and critically important for migratory and wetland

birds, and special-status species such as the California red-legged frog and Southwestern pond turtle (Mackenzie et al. 2011).

Key Ecological Elements

- Freshwater wetlands occur where standing water covers the soil or an area where the ground is very wet. The RCIS Area also features abundant wetlands, including freshwater emergent wetlands associated with the streams, ponds, and reservoirs, as well as brackish and saltwater wetlands near the coast. (Mackenzie et al. 2011). Unlike estuaries, freshwater wetlands are not connected to the ocean.
- Wetlands are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of plants that are typically adapted for life in saturated soil conditions (Corps of Engineers 1987).
- Freshwater wetlands are transitional ecotones between aquatic and terrestrial communities and are dynamic ecosystems, and support plant species adapted to inundation and saturation, and habitat for a native invertebrates, fish, amphibians, reptiles, birds (foraging and nesting habitat) and mammals.
- Wetlands attenuate floodwaters and improve water quality, providing important ecosystem services (Schmidt et al. 2015).

Pressures and Stressors

- Freshwater wetlands have been lost due to historical draining, dredging, and levelling for agricultural operations, which reduced topographic variation, vegetative diversity, and species presence.
- Freshwater wetlands and their surrounding habitat have been lost due to development, including residential, commercial, and infrastructure development.
- Freshwater wetlands have been degraded by the introduction of exotic invasive species, and pollution from sediment, pesticides, and pathogens. Their surrounding habitat has been degraded by land uses, the introduction of exotic species, and anthropogenic habitat conversion (e.g., grasslands to coyote brush scrub).
- Freshwater wetlands have been lost or degraded by water diversions, decreasing groundwater levels, increased water temperatures and oxygen deficient conditions, and loss of macroinvertebrates.
- Freshwater wetlands and their surrounding habitat have been affected by climate change that has altered runoff frequency and intensity and modified plant community structure and species composition.

- Freshwater wetlands are typically low-energy environments; as such, they are highly vulnerable to sedimentation deposition that is unlikely to be remobilized. This can result in a habitat conversion.

Climate Change Vulnerability Assessment

Freshwater wetlands and ponds have "High" vulnerability to climate change due to the following (EcoAdapt 2021):

- High exposure to:
    - Projected temperature increases and highly variable precipitation including drought, which together can affect water temperature, resulting in decreased plant growth, increased mortality, and altered plant community composition and sediment regimes;
    - Altered hydrology due to drought, which will particularly affect wetlands supported by surface water (compared to groundwater supplied systems);
    - Storms and flooding, due to more frequent and extreme precipitation events;
    - Sea level rise, which is likely to increase salinity within tidal freshwater marshes directly and also impact salinity in groundwater-fed wetlands where saltwater intrudes coastal aquifers;
- High sensitivity to changes to stressors and disturbances that impact water levels, hydroperiods, and water quality, which alter habitat suitability for plants and animals and drive changes in wetland and pond structure and function.
- Moderate adaptive capacity due to the following:
    - Many freshwater wetlands have been eliminated or degraded by human stressors:
    - There is reduced resistance to climate change in fragmented and degraded systems.

The goals, objectives, actions, and priorities for the Freshwater Wetlands (Table 5-9) will help address the impacts of climate change by:

1. Protecting existing freshwater wetlands, restoring habitat to improve system function, and creating new wetlands on sites with appropriate soils and hydrology, where doing so will not impact other native communities;
2. Restoring and maintaining natural hydrologic regimes to support native plants and animals reliant on wetlands (e.g., wetland-breeding species);
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate (Heller and Zavaleta 2009),

including alterations to the natural fire regime, exotic plants, and incompatible recreation;

4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat, to facilitate the movement of species and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency; and
5. Introducing rare species into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations or extinctions due to demographic and environmental stochasticity.

Species Associated with the Freshwater Wetlands Element

- Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) [F]
- California tiger salamander (*Ambystoma californiense*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) [NF]
- Southwestern pond turtle (*Actinemys pallida*) [F]
- Tricolored blackbird (*Agelaius tricolor*) [NF]
- White-tailed kite (*Elanus (Elanus leucurus*) [NF]
- American peregrine falcon (*Falco peregrinus anatum*) [NF]
- Bald eagle (*Haliaeetus leucocephalus*) [NF]

Other Actions that Benefit this Conservation Element

Freshwater Wetlands, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following:

- **Connectivity**: Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of freshwater wetlands as part of CONNECT-A1 through CONNECT-A4;
- **Grasslands**: Actions to protect, restore, and enhance grasslands, which provide upland habitat, as part of GRASS-A1 through GRASS-A6;
- **Oak Woodlands and Forest**: Actions to protect, restore, and enhance oak woodlands, which provide upland habitat, as part of OAK-A1 through OAK-A5; and
- **Riparian and Riverine:** Actions to protect, restore/enhance and manage riparian and riverine habitat as part of RR-A1 through RR-A3 and RR-A7 through RR-A9.

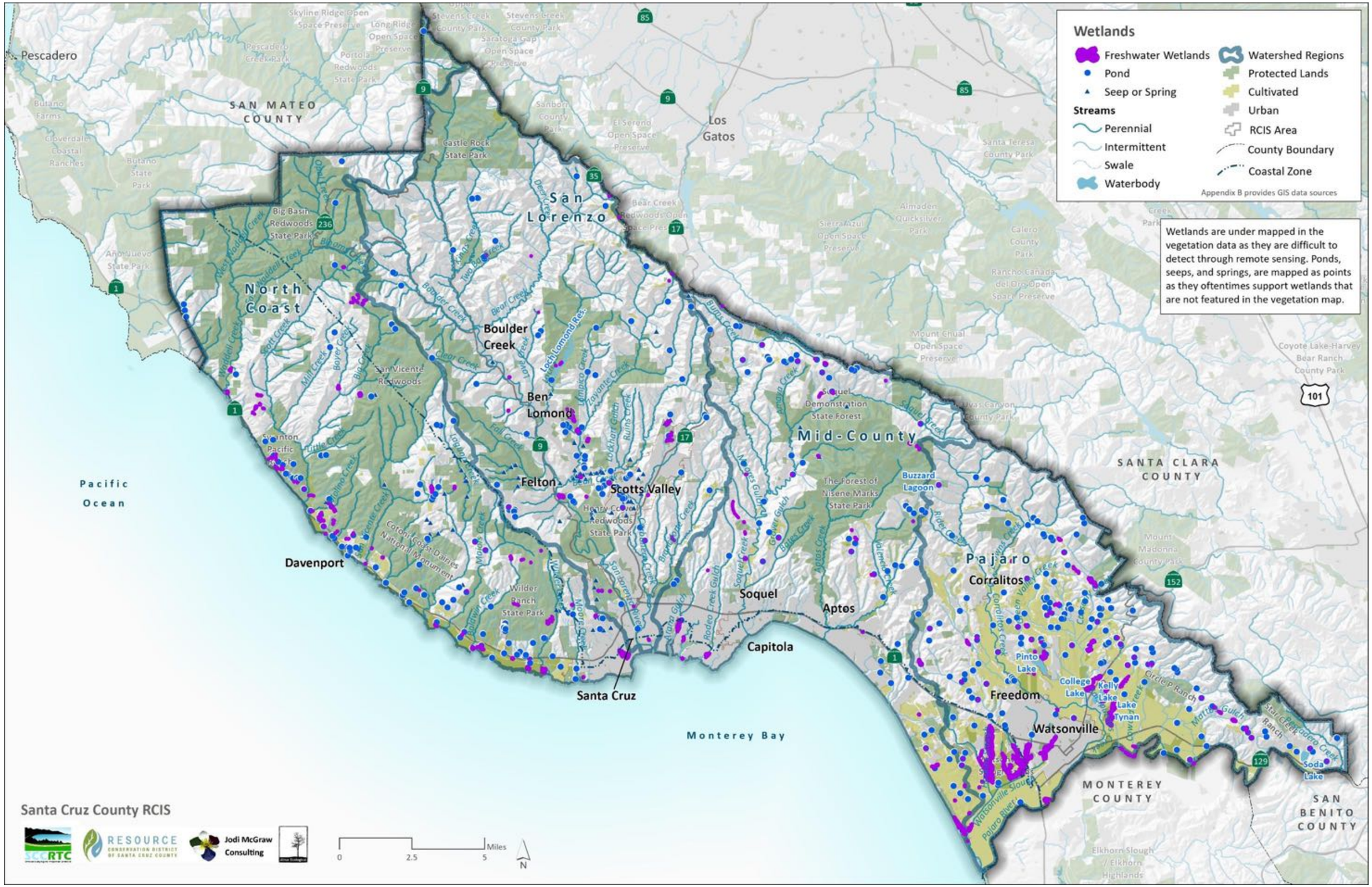

Figure 5-7: Freshwater Wetland Conservation Element

Table 5-9: Conservation Strategy for Freshwater Wetlands

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
FW-G1: Promote persistence and ecological integrity of freshwater wetlands, the rare species they support, and the ecological processes that sustain them.	**FW-O1:** Protect at least 200 additional acres of freshwater wetland habitat and an additional 50 seeps and springs to achieve the 90% protection targets for conservation of this community (Table 5-3). Measure progress toward achieving this objective by the number of acres of habitat protected.	**FW-A1:** Use fee title acquisition or conservation easements to protect existing freshwater wetlands or properties that could support wetlands from conversion and other degradative land uses.	Properties: • With freshwater wetlands that are intact or have the physical features (hydrology, topography, etc.) that can support wetlands now and the face of climate change. • With freshwater wetlands that were historically or currently drained and manipulated for farming activities but could be restored to provide ecosystem function. • With freshwater wetlands that support the focal, non-focal, and other co-benefited species that rely on wetlands. • That are within dispersal distance of focal, non-focal and other co-benefited species populations, to facilitate genetic exchange and promote persisting populations. • That are adjacent to other intact properties and/or protected properties that can: be effectively managed; achieve multiple benefits; and/or were identified in prior conservation plans, such as the Watsonville Slough Farm Plan (Land Trust of Santa Cruz County 2012) and the Watsonville Sloughs Watershed Conservation and Enhancement Plan (County of Santa Cruz 2003). • Properties that are within USFWS critical habitat designations for California red-legged frog and California tiger salamander (Figure 5-5).	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
	FW-O2: Restore and enhance freshwater wetlands habitat to support native plant species, promote early successional stages, provide suitable vegetation structure for wetland breeding birds, provide quality vegetation as food, shade, cover, reproductive medium, macroinvertebrate production, promote an appropriate hydrologic period, control predators, and promote other ecosystem functions where they have been degraded or	**FW-A2:** Restore and enhance habitat that has been degraded by prior land use, management, and natural system processes through the removal of vegetation to increase open water habitat (Meese and Beedy 2015) and sunlight exposure, plant emergent vegetation for egg-laying and cover, install infrastructure to drain ponds to control predators, pond lining or other measures to increase hydroperiod, repairing and/or rebuilding aged embankments, and prevent flooding of nests and	As described for FW-A1 and that feature freshwater wetlands that: • Are protected through acquisition or easements; and • If restored or enhanced, can support rare species, expand their distribution and abundance, provide flood attenuation, and provide connectivity to existing protected habitat.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	eliminated through prior land use, management, or time. Measure progress toward achieving this objective by number of acres of habitat restored, enhanced and/or occupied by rare species.	increase/decrease predator accessibility.			
		FW-A3: Remove exotic animals such as American bullfrog, mosquitofish, red-ear slider, crayfish, non-native fish and Canada geese.	As described for FW-A1 and FW-A2.	• Exotic animals • Incompatible recreation	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
		FW-A4: Coordinate with mosquito abatement to safely manage aquatic habitat, avoid the introduction of mosquitofish (*Gambusia* sp.), and reduce/limit the use of pesticides, herbicides, fertilizers, petroleum products and other chemicals near aquatic habitats.	As described for FW-A1 and FW-A2.	• Working lands • Exotic animals	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
		FW-A5: Install large wood as basking habitat and cover for native animal use (Stebbins 1972).	As described for FW-A1 and A2 and aquatic habitat known to support Southwestern pond turtle.	• Development • Working lands • Mining/quarrying • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
		FW-A6: Manage current and future recreation access, including off-road vehicles, biking, boating, kayaking, equestrian, foot traffic, and unleashed pets to reduce impacts on and disturbance to freshwater wetlands. Ensure that authorized recreation is compatible with current and future potentially suitable habitat and adjacent	As described for FW-A1 and FW-A2.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants • Exotic animals • Incompatible recreation • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		areas, and areas of known occurrences (USFWS 2002a)			• Numerous co-benefited species
	FW-O3: Create freshwater wetlands to replace habitat lost by conversion elsewhere. Measure progress toward achieving this objective by number of acres of habitat created and/or occupied by rare species.	**FW-A7:** Construct wetlands through manipulation of one or more attributes (topography, vegetation, hydrology, etc.) on parcels, with upland and dispersal habitat.	As described for FW-A1 and A2.	• Development • Working lands • Mining/quarrying • Water use • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
FW-G2: Maintain and enhance connectivity of freshwater wetland habitat to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**FW-O4:** Protect upland habitat surrounding freshwater wetlands and dispersal habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward achieving this objective by the number of acres of habitat protected.	**FW-A8:** Use fee title acquisition or conservation easements to protect existing upland and dispersal habitat or properties that could support upland or dispersal habitat from conversion and other degradative land uses.	As described for FW-A1 with priority given to areas that connect wetlands and adjacent upland habitat	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
	FW O5: Restore and enhance upland habitat surrounding freshwater wetlands and dispersal habitat to promote landscape connectivity including by rare species moving between core habitat areas. Measure progress toward achieving this objective by the acres of	**FW-A9:** Restore and enhance upland and dispersal habitat through the manipulation of physical, chemical, or biological characteristics to return or improve natural/historic functions including by reducing invasive plant species and revegetation with appropriate native plants.	Properties as described for FW-A2.	• Development • Working lands • Mining/quarrying • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	habitat restored, and/or occupied and/or the number of improved connectivity corridors.				• American peregrine falcon • Numerous co-benefited species
		FW-A10: Reduce use of rodenticides and encourage use of owl boxes, raptor perches, and other methods to increase burrows for native animals within upland and dispersal habitat (USFWS 2017a, b).	Properties as described for FW-A2.	• Development • Working lands • Mining/quarrying • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • San Francisco garter snake • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
		FW-A11: Restore and enhance dispersal habitat by removing roads, modifying and installing road drainage infrastructure including culverts, and road crossings to reduce roadkill and related mortality, promote wildlife movement, and improve genetic exchange between populations (USFWS 2017a).	As described for FW-A2 within priority habitat areas for wildlife connectivity, and specifically: • Focus on areas with high vehicle-related mortality, including known hotspots for rare amphibians in the Mid-County and Pajaro regions (Highway 1 and Bonita Drive in Aptos); • Enhance habitat on either side of crossing structures, including by protecting adjacent areas and restricting human activity nearby.	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Numerous co-benefited species
FWS-G3: Promote the recovery and long-term persistence of both rare and common native species, including focal non-focal species, and co-benefited species that rely on freshwater wetland communities.	**FW-O6:** Protect habitat occupied by, or suitable for, rare species in freshwater wetland and surrounding upland habitat.	**FW-A12:** All actions from FW-O1.	As described for FW-A1 and specifically as follows: • Within known habitat of Southwestern pond turtle (including Hanson Slough); • Near Ellicott Slough, San Andreas Road in the Pajaro Region, for the only population of California tiger salamander within the RCIS Area and to facilitate connectivity for the Santa Cruz long-toed salamander and California red-legged frog; • Within known occurrences of tri-colored blackbird (e.g., Neary Lagoon, Hanson Slough, and Struve Slough). • Within known habitat for the California red-legged frog, particularly: ○ North Coast: freshwater wetlands within State Parks;	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			○ Pajaro Region: Habitat in the Watsonville Slough system, particularly Watsonville Slough Farms and Bryant Habert Property, and the Ellicott Unit of the Ellicott Slough National Wildlife Refuge.		• Numerous co-benefited species
	FW-O7: Maintain or increase rare species populations to promote species persistence. Measure progress toward achieving this objective by number of acres of habitat occupied by rare species.	**FW-A13:** Conduct population-level actions where needed to supplement habitat protection, restoration, enhancement, and creation efforts to ensure the persistence of species. Examples include surveys (including eDNA), captive breeding/rearing programs, rare plant introductions, and other species-specific actions.	● Locations that support or could support the focal, non-focal, and other co-benefited species that rely on freshwater wetlands, including reintroductions of rare plants and animals into habitat from which they were extirpated or new locations, where suitable and appropriate; ● Populations that are declining despite efforts to promote them using habitat protection, restoration, management, and enhancement methods. ● Will likely be extirpated if the population-specific actions are not implemented.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Incompatible recreation • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged Frog • San Francisco garter snake • California tiger Salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
		FW-A14: Conduct studies on gaps in basic life history information, such as distribution, resource utilization, reproduction, and survival to inform conservation and management and eDNA sampling, where feasible, to identify presence/absence of key focal and non-focal species.	As described for FW-A13.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Incompatible recreation • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged Frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		FW-A15: Reduce disease transmission and pathogen-related mortality by sterilizing all equipment entering known or suitable habitat to prevent introduction of disease and monitor for the presence of pathogens.	As described for FW-A13.	• Exotic animals • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Numerous co-benefited species
		FW-16: Reintroduce rare species into protected areas featuring suitable but unoccupied habitat, and habitat that can be made suitable through restoration and enhancement, and/or creation	As described for FW-A13.	• Development • Working lands • Mining/quarrying • Climate change • Loss of genetic diversity	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Numerous co-benefited species
FW-G4: Promote water quality of aquatic ecosystems to support health, function, and species survival.	**FW-O8:** Protect intact habitat or habitat degraded by prior land uses to ensure high quality surface and groundwater. Measure progress toward achieving this objective by the number of acres treated through implementation.	**FW-A17:** Use fee title acquisition or conservation easements to protect habitat from conversion and other degradative land use.	As described for FW-A1.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
	FW-O9: Restore and enhance habitat degraded by prior land uses to ensure high quality surface and groundwater. Measure progress toward achieving this objective by the improvement of aquatic conditions (inundation	**FW-A18:** Restore and enhance habitat degraded by prior land uses (e.g., development, agriculture, mining, forestry, livestock ranching) and other anthropogenic impacts including altered disturbance	As described for FW-A2.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	duration, water depth, water chemical composition, and/or stream characterization, habitat structure, native species diversity, percent cover), water quality, and connectivity of water resources.	regimes, incompatible recreation, and exotic plants.			• American peregrine falcon • Numerous co-benefited species
	FW-O10: Improve water quality by reducing nutrient and pesticide runoff. Measure progress toward achieving this objective by the number of acres treated through implementation.	**FW A19:** Use filter strips, sediment basins, vegetated treatment systems, grassed waterways, buffers, hedgerows, cover crops or other water treatment techniques to replace the vegetation where it has been removed and treat surface runoff before it enters surface and groundwaters through outreach, education, and incentive-based programs.	As described for FW-A1 and FW-A2.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
	FW-O11: Promote use of water quality treatment systems. Measure progress toward achieving this objective by the number of acres treated through implementation.	**FW-A20:** Conduct education and outreach, explore new technology, install demonstration projects, engage across industry, and address food safety, cultural, and other barriers to encourage the adoption of water quality treatment systems and practices to improve surface runoff before it enters surface and groundwaters.	Properties as outlined in FW-A1 and A2, and specifically: • That can support water quality treatment projects to improve water quality adjacent to and/or downstream of wetlands and/or improve the quality of groundwater that supports wetland ecosystems. • Are within critical habitat designated by USFWS for the California red-legged frog and California tiger salamander (Figure 5-7).	• Working lands	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
FW-G5: Promote water quantity of aquatic ecosystems to support function	**FW-O12:** Protect intact habitat to reduce water use, increase rates of infiltration, raise groundwater levels, and improve groundwater	**FW-A21:** Use fee title acquisition or conservation easements to protect habitat from conversion to land uses that increase water	As described for FW-A1 and A2 and specifically support groundwater dependent ecosystems (GDEs). These include: • Santa Margarita Basin, particularly along Lompico Creek, Zayante Creek near Quail Hollow Ranch County Park, Bean Creek, Lockhardt Gulch and Ruins Creek between Olympia	• Development • Working lands • Mining/quarrying • Water use	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
and species survival.	hydrology that supports freshwater wetlands. Measure progress toward achieving this objective by the number of acres protected.	consumption, reduce infiltration, and/or increase runoff.	and Hanson quarries; and Mackenzie Creek, Bean Creek, West Branch Carbonera Creek, and Carbonera Creek near Scotts Valley High School (Santa Margarita Groundwater Agency 2021); • Pajaro Valley Basin, particularly in the mountainous regions where the streams are underlain by the Purisima Formation and in the lowlands by the Aromas Red Sands soil or younger alluvial material (PVWMA 2021); and • Mid-County Basin, particularly Soquel Creek and Rodeo Gulch (Ryan 2021).	• Climate change	• California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
	FW-O13: Restore and enhance habitat degraded by prior land uses to reduce water use, to increase rates of infiltration, to raise groundwater levels, and to improve groundwater hydrology that supports freshwater wetlands. Measure progress toward achieving this objective by the number of acres restored and enhanced and/or by the improvement of hydrological indicators such as water depth, duration, water temperature, and chemistry.	**FW-A22:** Restore and enhance habitat degraded by prior land uses (e.g., development, agriculture, mining, forestry, livestock ranching) and other anthropogenic impacts including altered disturbance regimes, incompatible recreation, and exotic plants.	As described for FW-A1 andFW-A2.	• Development • Working lands • Mining/quarrying • Water use • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species
	FW-O14: Increase rates of infiltration, to raise groundwater levels, and to improve groundwater hydrology that supports freshwater wetlands. Measure progress toward achieving this objective by the number of acres created, expanded, or maintained and/or by the improvement of hydrological indicators such as water depth, duration,	**FW-23:** Create, expand, and maintain groundwater recharge systems.	As described for FW-A1, FW-A2, and FW-A23, and specifically areas: • With high infiltration capacities, connectivity to groundwater aquifers, and within coastal areas with high rates of seawater intrusion; • within Key Riparian Corridors; • Recommended within the three groundwater basin management plans for the RCIS Area (PVWMA 2021, Santa Cruz Mid-County Groundwater Agency 2019, Santa Margarita Groundwater Agency 2021); and • Without the presence of an impermeable clay layer (PVWMA 2021).	• Development • Working lands • Mining/quarrying • Water use • Climate change	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • San Francisco garter snake • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	water temperature and chemistry.				• Numerous co-benefited species
	FW-O15: Conserve and recycle water to increase groundwater and surface water availability for ecosystems and species that are aquatic dependent. Measure progress towards this objective by the improvement of hydrologic indicators, as documented by GSAs.	**FW-A24:** Support conservation and recycling programs to increase water supply for ecosystem function.	Areas included in the three Groundwater Sustainability Plans that cover the RCIS Area (PVWMA 2021, Santa Cruz Mid-County Groundwater Agency 2019, Santa Margarita Groundwater Agency 2021).	• Water use	• Southwestern pond turtle • Santa Cruz long-toed salamander • California red-legged frog • California tiger salamander • Bald eagle • Tri-colored blackbird • White-tailed kite • American peregrine falcon • Numerous co-benefited species

5.3.7 Southwestern Pond Turtle

Southwestern Pond Turtle

(Photo courtesy of Matt Timmer, Land Trust of Santa Cruz County)

State and Federal Status: State Species of Concern

Global Rank: G3G4 **State Rank:** S3

Detailed Species Account

Jennings and Hayes 1994

Zeiner et al. 1988

Germano and Rathbun 2008

Distribution and Range

- The range of the Southwestern Pond turtle (*Actinemys pallida*; SWPT) is west of Sierra Nevada from San Francisco south to northwest Baja California.
- 18 documented occurrences in the RCIS (CDFW 2019d; Figure 5-8), with additional known occurrences in the following locations: Loch Lomond, lower San Lorenzo River, Laguna Creek, and Wilder Ranch State Park (Berry pers. comm. 2021); and near Glenwood Open Space Preserve and off Bean Creek Road (Scotts Valley), Roaring Camp (Felton) and Hanson Slough (Watsonville; Timmer pers. comm. 2021). Additionally, the Pajaro River population is more extensive than illustrated and extends ~8 miles upstream (City of Santa Cruz 2021).

Key Ecological Requirements

- Utilizes a broad range of lentic (still-water) and lotic (moving-water) aquatic habitats including sloughs, streams, large rivers, human-made ponds, lakes, reservoirs, and wetlands.

- Although they prefer freshwater, they tolerate slightly brackish water, such as coastal lagoons and bar-built estuaries (City of Santa Cruz 2021).
- Aquatic habitats that include basking sites, including exposed logs, rocks, and banks, enable SWPT to maintain a relatively constant body temperature for metabolic processes (Rosenberg et al. 2009).
- Utilizes terrestrial habitat for nesting, refuge during times of year when creeks dry or flood, and for basking usually between October and February. Individuals may refuge in upland habitats for long periods of time (up to 191 days; Rathbun et al. 2002).
- Overwintering sites typically include terrestrial refugia, burial in the substrate of aquatic habitats, or in undercut banks along streams (Rosenberg et al. 2009). In the Pajaro River, overwintering individuals were observed both instream in partially submerged woody debris piles and within leaf litter and rodent burrows in adjacent willow-cottonwood riparian habitat (City of Santa Cruz 2021).
- Nesting typically occurs within 650 feet of aquatic habitat in areas with sandy or compact soils, sparse vegetation, and good solar exposure (Rosenberg et al. 2009). Upland nesting was documented in the lower Pajaro River within grassland habitat 165 – 200 feet from aquatic habitat (City of Santa Cruz 2021).
- SWPT may also move overland considerable distances (up to 5 miles), which allows them to potentially move across permeable landscapes and through migration corridors to re-colonize nearby unoccupied habitat (Holland 1994). A single adult male dispersed from the Pajaro lagoon over 7.5 miles upstream between June 2009 and September 2010 (City of Santa Cruz 2021).
- It is believed that SWPT only feeds in water (Bury 1986). Food consists mostly of small to moderate-sized aquatic and terrestrial invertebrates (especially insects and crustaceans), but vegetation and carrion may also be consumed (Holland 1994).

Pressures and Stressors

Table 4-1 highlights the pressures and stressors affecting Southwestern pond turtle, which include the following most critical ones:

- Habitat loss, degradation, and fragmentation as land is converted for human use such as urbanization and agriculture.
- Drought, intense wildfire, and invasive vegetation continue threaten SWPT and their habitat.
- Habitat fragmentation due to roads, urbanized areas, and extensive agricultural lands prevent access to upland habitat and isolate populations.
- Predation of hatchlings by introduced American bullfrogs (*Rana catesbeiana*), smallmouth bass (*Micropterus dolomieui*), crayfish (e.g., *Procambarus clarkii*), and largemouth bass (*Micropterus salmoides*) is significant in some areas. Predation of nests

may be greater than historical levels in human-altered landscapes due to an increase in medium-sized predators, such as raccoons (*Procyon lotor*), that thrive in these environments.

- Disease, including upper respiratory disease and shell disease, in SWPT is not well-understood but is of great concern in Washington and could threaten the species locally or rangewide. Locally, a novel fungal pathogen, not previously detected in California, was documented at the Glenwood Preserve in Scotts Valley from 2019-2021 (Timmer pers comm. 2021).
- Along with the effects of nest habitat degradation, nest predation, and increasing temperatures on SWPT populations, road mortality is a threat, particularly in urban and recreational areas. As female turtles are more likely to cross roadways than males, road morality has led to skewed sex ratios toward males in many western pond turtle populations (Steen et al. 2006).
- Release of non-native pet turtles (e.g., red-eared slider [*Trachemys s. elegan*]) to the wild is a growing threat and may result in increased competition and disease transmission (WPTRCC 2020). The red-eared slider, in particular, can have a devastating impact on pond ecosystems, as they eat almost anything, including chicks of nesting birds.
- Incompatible recreational activities such as hiking, biking, fishing, boating, and off-highway vehicles, and the associated disturbance within or adjacent to aquatic and nest habitats are an important concern in some parts of the species' range. SWPT will rapidly flee from their basking sites into water when disturbed by the sight or sound of people and are sensitive to human disturbance even at relatively long distances (≥328 ft; Bury and Germano 2008).
- Habitat management/maintenance, including mechanical tule removal and mowing have been noted to result in inadvertent nest mortalities (City of Santa Cruz 2021).
- Climate change is expected to alter hydrology, increase temperatures, and promote non-native species. Climate change could also impact turtle sex ratios, resulting in skewed populations and ultimate population decline.
- Small population sizes can lead to inbreeding depression, Allee effects, and increased risk from stochastic events.

Climate Change Vulnerability Assessment

Southwestern pond turtle is likely to have moderately high vulnerability to climate change, as assessed for the Northwestern pond turtle (EcoAdapt 2021). This assessment reflects the following:

- Exposure to changes in precipitation amount and timing, increasing drought, altered streamflow, warmer air and water temperatures, heat waves, and sea level rise. While

this species can tolerate dry conditions periodically, high rates of mortality can occur during severe and/or multi-year drought.

- Wildfire combined with increased frequency and severity of drought may threaten the survival of small, isolated populations, especially those in ephemeral aquatic environments.
- Changes in hydrology and warmer air and water temperatures are likely to impact individual growth, recruitment, and survival in complex ways; for instance, warm, slow-flowing pools may provide additional habitat for juveniles, while more significant increases in air and water temperature could have detrimental effects on the food web, egg survival and sex ratios, and other factors.
- Sea level rise may pose an additional threat to pond turtles in coastal habitats affected by inundation and saltwater intrusion into freshwater areas.
- Severe flooding can reduce adult survival and increase nest failure, while both wildfire and flooding degrade turtle habitat and food resources.
- SWPT adaptive capacity is limited by its moderate dispersal ability, which is diminished by habitat fragmentation and can limited gene flow, and slow population growth rate during stressful conditions.

Additional information about climate change impacts on SWPT is provided in the climate change vulnerability analyses for their habitats, including riparian and riverine (Section 5.3.2), ponds, lakes, and reservoirs (Section 5.3.4), freshwater wetlands (Section 5.3.6), and grasslands (Section 5.3.12).

The goals, objectives, actions, and priorities for Southwestern pond turtle (Table 5-10) will help address the impacts of climate change by:

1. Protecting habitat that historically supported or could support SWPT;
2. Restoring and enhancing ponds and freshwater wetlands to maintain an adequate hydroperiod and native vegetation, to provide breeding and terrestrial habitat for overwintering and nesting.
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and incompatible recreation;
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat, to facilitate the movement of SWPT and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency; and
5. Introducing SWPT into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations due to demographic and environmental stochasticity.

Species Associated with Southwestern pond turtle

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-10 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Tidewater goby (*Eucyclogobius newberryi*) [NF]
- Coho salmon (*Oncorhynchus kisutch*) [F]
- Steelhead – Central California Coast and South-Central California Coast DPS (*Oncorhynchus mykiss irideus*) [NF]
- Foothill yellow-legged frog *(Rana boylii)* [NF]
- California tiger salamander *(Ambystoma californiense)* [NF]
- California red-legged frog *(Rana draytonii)* [NF]
- Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) [F]
- San Francisco garter snake *(Thamnophis sirtalis tetrataenia)* [NF]

Other Actions that Benefit this Species

Southwestern pond turtle will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Ponds, Lakes, and Reservoirs:** Actions to protect, restore, create, and manage ponds and lakes and adjacent upland habitat that supports (or could support) SWPT part of PLR-A1 through PLR-A10;
- **Riparian and Riverine:** Actions conducted to protect and restore riparian and riverine habitat that supports (or could support) SWPT part of RR-A1 through RR-A3, RR-A28, and RR-A31;
- **Freshwater Wetlands:** Actions to protect, restore, and manage freshwater wetlands and adjacent upland habitat that supports (or could support) SWPT part of FW-A1 through FW-A16;
- **Grasslands**: Actions to protect and restore/enhance upland habitat as part of GRASS-A1 through GRASS-A5; and
- **Connectivity:** Actions to protect and enhance habitat connectivity through protection, restoration, and enhancement of habitat as part of CONNECT A1 – A4.

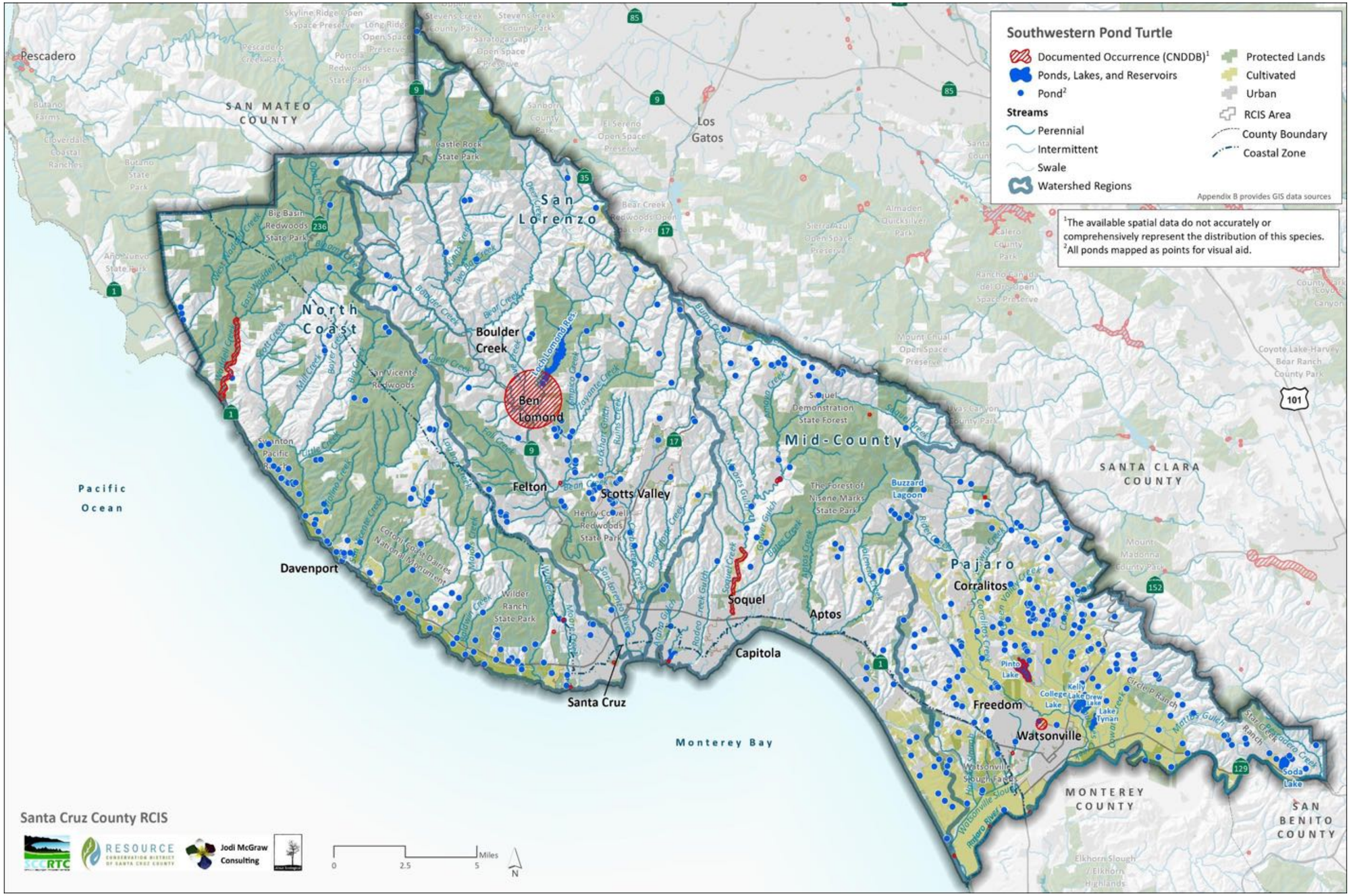

Figure 5-8:Southwestern pond turtle Conservation Element

Table 5-10: Conservation Strategy for Southwestern Pond Turtle

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited

SWPT-G1: Promote the long-term persistence of Southwestern pond turtle.	**SWPT-O1:** Protect at least 200 additional acres of freshwater wetland, 312 additional ponds, lakes, and reservoirs, and an additional 225 miles of streams to achieve the 90% protection target for these habitats important for SWPT (Table 5-3). Measure progress toward achieving this objective by the amount of habitat (acres, number of features, or miles of streams).	**SWPT-A1:** Habitat Protection: Use fee title acquisition or conservation easements to permanently protect SWPT habitat from conversation and other degradative land uses.	Prioritize areas that:
			• Support SWPT populations;
			• Feature suitable but unoccupied habitat near existing populations, that the species could naturally re-colonize, including areas with:
			  ○ Partially unshaded aquatic habitat with good escape cover (undercut banks, burrows in embankments and woody debris) and basking sites (easily climbed logs, branches, and rocks); and
			  ○ Adequate nesting habitat, including sparsely vegetated, sandy or compacted soil, and good solar exposure less than 1,500 ft from aquatic habitat.
			• That can expand or connect existing protected properties; and;
			• Feature current or future land uses that could threaten the persistence of existing SWPT populations.
				• Development
				• Working lands
				• Mining/ Quarrying
				• Climate change
				• Loss of genetic diversity
					• Southwestern pond turtle
					• California red-legged frog
					• California tiger salamander
					• Foothill yellow-legged frog
					• San Francisco garter snake
					• Tidewater goby
					• Coho salmon
					• Steelhead
					• Numerous co-benefited species

	SWPT-O2: Restore and enhance SWPT habitat. Measure progress toward achieving this objective by the number of acres of habitat restored, enhanced and/or occupied by rare species.	**SWPT-A2:** Restore habitat that has been degraded by prior land use and/or altered disturbance regimes and/or the introduction of fish and non-native turtles, by addressing degraded ponds, lakes, and reservoirs, grasslands, freshwater wetlands and riparian and riverine communities, and promoting diverse native plant assemblages, and increasing suitability of habitat for SWPT.	• Habitat that, if restored, can support SWPT, to expand their distribution and abundance, and that can connect or buffer existing protected habitat. Areas that are permanently protected, can buffer and expand existing habitat occupied by SWPT and where the restoration area can be maintained Including lands protected and managed by CDFW, USFWS, State Parks, County Parks, City of Santa Cruz, the Land Trust of Santa Cruz County, and other conservation agencies and organizations.	• Development • Working lands • Mining/quarrying • Water use • Increased fine sediment • Exotic plants • Exotic animals • Climate change	• Southwestern pond turtle • California red-legged frog • California tiger salamander • Foothill yellow-legged frog • San Francisco garter snake • Tidewater goby • Coho salmon • Steelhead • Numerous co-benefited species
		SWPT-A3: Install structures, such as floating rafts and logs, to provide cover and basking sites, particularly during periods when water level is low and hallow shoreline habitat is reduced.	As described for SWPT-A2 and specifically: • San Lorenzo Lagoon • Loch Lomond Reservoir • Glenwood Preserve • Pinto Lake	• Development • Working lands • Water use • Climate change	• Southwestern pond turtle • California red-legged frog • California tiger salamander • Foothill yellow-legged frog • Tidewater goby • Coho salmon • Steelhead • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		SWPT-A4: Implement measures to avoid artificially increasing populations of mesocarnivores, such as skunks and racoons, that can have a detrimental effect on turtle populations, Including by managing trash and compost.	As described for SWPT-A2 and specifically within or adjacent to residential, urban, agricultural, or recreational areas.	• Development • Working lands • Unauthorized activities • Incompatible recreation • Climate change	• Southwestern pond turtle • California red-legged frog • California tiger salamander • Foothill yellow-legged frog • San Francisco garter snake • Tidewater goby • Coho salmon • Steelhead • Numerous co-benefited species
	SWPT-O3: Restore and enhance habitat connectivity for SWPT. Measure progress toward achieving this objective by the number of acres of habitat restored, enhanced and/or occupied by rare species.	**SWPT-A5:** Restore and enhance dispersal habitat by identifying and modifying and installing road drainage infrastructure including culverts, and other road crossings infrastructure to reduce roadkill and related morality, promote wildlife movement, and improve genetic exchange between populations.	Prioritize properties as outlined in SWPT-A2 with priority habitat areas for wildlife connectivity, and specifically: ● Focus on areas with high vehicle-related mortality; ● Enhance habitat on either side of crossing structures, including protecting adjacent areas and restricting human activity nearby; and ● Work with transportation agencies or others to collect and analyze roadkill data, to identify hotspots where mortality occurs and inform the design of wildlife crossing infrastructure improvements.	• Development • Working lands • Mining/ Quarrying • Climate change • Loss of genetic diversity	• Southwestern pond turtle • California red-legged frog • California tiger salamander • Foothill yellow-legged frog • San Francisco garter snake • Numerous co-benefited species
	SWPT-O4: Establish new SWPT populations to promote species persistence in the face of a changing climate. Measure progress toward achieving this objective by number of acres of habitat restored, enhanced and/or occupied by rare species.	**SWPT-A6**: Reintroduce SWPT into protected areas featuring suitable but unoccupied habitat, and habitat that can be made suitable through restoration and enhancement, and/or creation.	As described for SWPT-A1 and SWPT-A2.	• Development • Working lands • Mining/ Quarrying • Climate change • Loss of genetic diversity	• Southwestern pond turtle

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	SWPT-O5: Develop and implement voluntary, cooperative stewardship programs to conservation and their habitat on public and private property (WPTRCC 2020)	**SWPT-A7:** Develop agreements with agencies, organizations, and landowners to implement high priority projects and/or long-term management for SWPT and conduct landowner outreach to limit non-native species release into the wild (WPTRCC 2020)	As described for SWPT-A1 and SWPT-A2.	• Development • Working lands • Mining/quarrying • Working lands • Climate change	• Southwestern pond turtle • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
	SWPT-O6: Evaluate population status and trends to inform conservation and management using research and monitoring. Measure progress toward achieving this objective by species occurrences.	**SWPT-A8:** Conduct presence/absence, distribution, and abundance surveys of known, historical, and potential habitat to determine priority areas for land conservation, habitat restoration/ enhancement, habitat creation, and landowner outreach (WPTRCC 2020).	As described for SWPT-A1 and SWPT-A2.	• Development • Working lands • Mining/quarrying • Climate change	• Southwestern pond turtle
		SWPT-A9: Conduct scientific investigations to evaluate the effects of invasive species and disease (e.g., shell disease) on SWPT populations.	As described for SWPT-A1 and SWPT-A2.	• Development • Working lands • Mining/ Quarrying • Climate change	• Southwestern pond turtle
		SWPT A-10: Evaluate genetic variation and diversity within populations to assess potential for inbreeding depression and the potential to increase diversity, including head-starting, captive rearing, translocation, and/or reintroduction, to enhance areas of decline or restore sites where the species have been extirpated (WPTRCC 2020).	As described for SWPT-A1 and SWPT-A2.	• Development • Working lands • Mining/ Quarrying • Climate change • Loss of genetic diversity	• Southwestern pond turtle

5.3.8 Beaches, Dunes, and Rocky Cliffs

Beaches, Dunes, and Rocky Cliffs

Status and Rarity

- Several sensitive plant communities:
  - Dune mat (*Abronia latifolia – Ambrosia chamissonis*; 21,100.00): G3, S3
  - Seaside woolly-sunflower – seaside daisy – buckwheat patches(21.310.00): G3, S3
  - Silver dune lupine-mock heather scrub (32.160.00): G3, S3
- County of Santa Cruz Sensitive Habitat
  - dune plant habitats
  - sandy beaches
  - shorebird roosting, resting, and nesting areas
  - cliff nesting areas
- Environmental Sensitive Habitat Areas (ESHAs) within the Coastal Zone
  - Marine mammal hauling grounds
  - Shorebird nesting areas
  - Sandy beaches
  - Dunes and coastal strand, including dunes perched on coastal bluffs
  - Cliff nesting areas
  - Coastal bluff scrub

Detailed Descriptions

Apert 2016

CNPS 2021

Distribution and Range

- 588 acres (0.2% of the RCIS Area), though this likely underestimates the actual area (as a result of mapping imprecision; Figure 5-9)[5]
- Occurs patchily among much of the 42.4-mile coast line, with the greatest area comprised of beaches and dunes in two areas:
    - North Coast (north of the City of Santa Cruz)
    - Beaches and dunes south of Rio Del Mar (in the Pajaro Valley region)
- Rocky cliffs line much of the remaining area

Key Ecological Elements

- Located along the immediate coast between the low tide line and marine terraces and other areas further inland that feature more developed soils that support denser vegetation (e.g., coastal prairie and coastal scrub) or have been urbanized or cultivated in many areas.
- The coastal region features the following geomorphological facets that are all included in the Beaches, Dunes, and Rocky Cliffs Conservation Element:
    - Beaches, which are areas of land constantly reshaped by ocean waves, and in the RCIS Area are generally sandy (as opposed to rocky);
    - Dunes that form where the wind blows sand inland above the high tide level;
    - Rock outcroppings (sea rocks) and rocky shores, where solid rock (rather than sand) adjoins the ocean;
    - Rocky cliffs, which are vertical (or near vertical) areas along the ocean; and
    - Coastal bluffs, which are a steep shoreline slopes formed in sediment (loose material such as clay, sand, and gravel).
- Plant communities vary greatly based on substrate and distance from the ocean, which influences salt exposure and soil development (and thus fertility) resulting in various plant communities that differ in structure and species composition and thus habitat conditions.
- Rare native plant species in the dunes include robust spineflower (*Chorizanthe robusta* var. *robusta*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), coast wallflower (*Erysimum ammophilum*), and Monterey coast paintbrush (*Castilleja latifolia*); Sand Hill Bluff clarkia (*Clarkia unguiculata* ssp. *nov*.) occurred in the namesake bluff, though may have been extirpated from the county (D. Neubauer, pers. comm. 2020).
- Rare animals in the dunes include globose dune beetle (*Coelus globosus*), sandy beach tiger beetle (*Cicindela hirticollis gravida*), Northern California legless lizard (*Anniella*

[5] This excludes areas of beach outside of the County of Santa Cruz boundary that was used to define the RCIS Area. In addition, some areas of coastal bluff scrub were classified as coastal scrub, which is not included in this number.

pulchra), and western snowy plover (*Charadrius nivosus nivosus*); California brown pelican (*Pelecanus occidentalis californicus*) roosts on rocky cliffs and American peregrine falcon (*Falco peregrinus anatum*) forage extensively in the beaches and other coastal strand areas of the North Coast.

- Rock outcroppings, rocky cliffs, and coastal bluffs between the City of Santa Cruz and the northern border of the RCIS Area provide important breeding habitat for Brandt's and pelagic cormorants (*Phalocorcorax penicillatus* and *P. pelagicus*), black swift (*Cypseloides niger*) and pigeon guillemots (*Cepphus columba*), while these areas and some beaches can provide important resting habitat (haul outs) for marine mammals including harbor seals and California sea lion (*Zalophus californianus*; Hapke et al. 2009).
- Exotic plants often dominate the rare plant communities, and include European beachgrass (*Ammophila arenaria*), ice plant (*Carpobrotus* spp.), sea rocket (*Cakile* spp.), and veldt grass (*Ehrharta calycina*).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting the Beach, Dunes, and Rocky Shore Conservation Element, which include the following most critical ones:

- Loss of remaining habitat in unprotected areas, due to development;
- Sea level rise, which can cause inundation, increase salinity of water and air in ways that render it unsuitable for some species, and cause cliff, bluff, dune, and beach erosion (Griggs et al. 2017);
- Habitat degradation due to exotic plants, such European beachgrass and iceplants, which can alter natural processes (e.g., dune formation), abiotic conditions, and plant community structure and species composition in ways that influence habitat for native animals, including nesting birds; and
- Incompatible recreation, which can trample native plants including rare plants, cause erosion/destabilization, and reduce habitat use, nesting success, and population performance of species sensitive to human activity, including nesting and foraging birds.

Climate Change Vulnerability Assessment

Beaches, Dunes, and Rocky Cliffs are moderately vulnerable to the effects of climate change (EcoAdapt 2021, Hutto et al. 2015). This rating reflects the following:

- **Moderate Exposure**: The coastal strand is exposed to the following effects of climate change:
    - **Sea-level rise**, which will cause 'coastal (beach) squeeze', whereby coastal habitats are inundated by the rising ocean but cannot migrate inland due to urbanization, coastal armoring (e.g., sea walls), or natural geomorphological features (e.g., cliffs).

  - **Storm flooding**, which is anticipated to accelerate dune erosion and inundation through wave action and flooding which will be exacerbated by sea level rise (Hutto et al. 2015).
  - **Climatic water deficit** due to increased temperature and more variable precipitation (including droughts), which can have acute effects on plants in sandy soils; plant water stress could be exacerbated if there is a reduction in summer fog (Johnstone and Dawson 2010), though the effects of climate change on fog in the region are currently difficult to predict (Langridge 2018)

- **Moderate sensitivity to changes**, which will be exacerbated by the following (EcoAdapt 2021)
  - invasive plants, including European beachgrass which is anticipated to expand in response to climate change;
  - incompatible recreational activities, which remove established native vegetation, exacerbate erosion, and can contribute to reduced shorebird nesting success due to direct disturbance and by promoting nest predators (e.g., corvids) attracted to garbage.
- **Low Adaptive Capacity**, due to the following:
  - Narrow habitat specificity of many of the species, which are uniquely adapted to the harsh environmental conditions;
  - Limited areal extent of communities, which generally limits their land facets (e.g., topographical and microclimatic diversity) and thus climate refugia;
  - Disruption of the natural geomorphic processes that allow dunes to erode and reform (Alpert 2016); and
  - land conversion including roads, which limit the ability of coastal habitats to migrate inland.

The goals, objectives, actions, and priorities for the Beach, Dune, and Rocky Cliff Conservation Element (Table 5-11) will help address the impacts of climate change by:

1. Protecting habitat, including that which currently supports the conservation element and adjacent habitat that can facilitate migration in response to sea level rise;
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity and resilience of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity that will be exacerbated by climate change;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate (Heller and Zavaleta 2009), including exotic plants and incompatible recreation;

4. Increasing habitat connectivity, by protecting habitat and restoring and managing adjacent habitat, to increase the ability of the species to establish in adjacent areas; and;
5. Introducing rare species into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations or extinctions due to demographic and environmental stochasticity; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-11 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Robust spineflower (*Chorizanthe robusta* var. *robusta*) [NF]
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) [NF]
- Western snowy plover (*Charadrius nivosus nivosus*) [NF]
- American peregrine falcon (*Falco peregrinus anatum*) [NF]
- California brown pelican (*Pelecanus occidentalis californicus*) [NF]

Other Actions that Benefit this Conservation Element

The Beaches, Dunes, and Rocky Cliffs, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Bar-Built Estuaries:** Actions to protect, restore, manage, and enhance estuaries and their adjacent wetlands as part of BBE A1-A33;
- **Grasslands:** Actions to protect, restore, manage, and enhance coastal prairie grasslands along the coast as part of GRASS-A1 through GRASS-A5; and
- **Connectivity**: Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of coastal strand areas as part of CONNECT-A1 through CONNECT-A4.

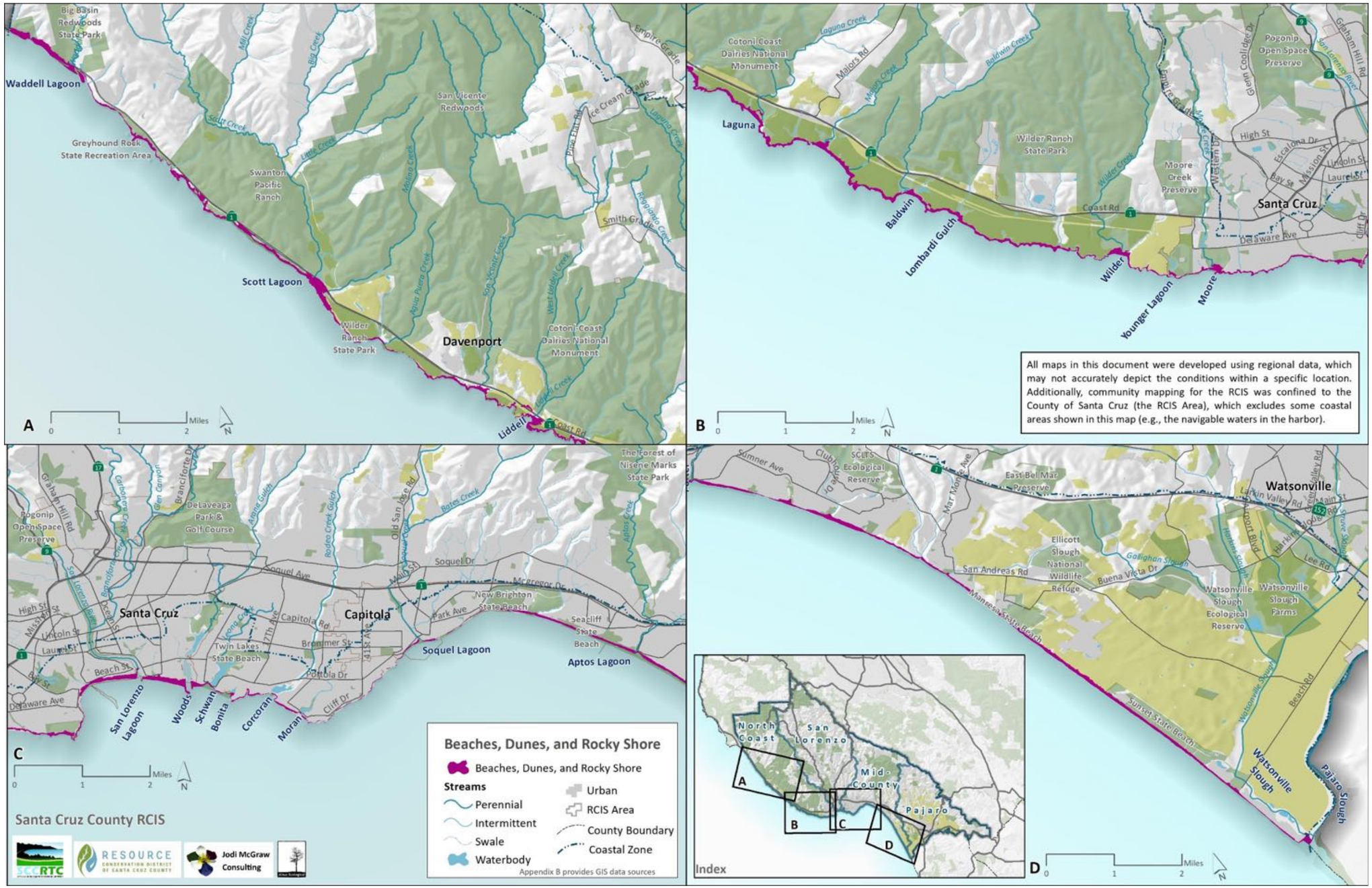

Figure 5-9: Beaches, Dunes, and Rocky Cliffs Conservation Element

Table 5-11: Conservation Strategy for Beaches, Dunes, and Rocky Cliffs

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
COAST-G1: Promote persistence and ecological integrity of the beaches, dunes, and rocky cliff habitats, the rare species they support, and the ecological processes that sustain them.	**COAST-O1:** Protect at least 202 additional acres beaches, dunes, and rocky cliffs (and associated coastal habitats) to achieve the 90% target for conservation of this element (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**COAST-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that can maximally promote conservation of this element, including those that: ● Feature highly intact habitat or habitat that can be restored to feature such habitat; ● Support rare and locally unique species including robust spineflower, Monterey spineflower, western snowy plover, American peregrine falcon, California brown pelican, and co-benefited species; ● Provide nesting habitat for seabirds, haul outs for marine mammals, or other important habitats; ● Can buffer and expand other habitat, particularly existing protected lands; and ● Feature habitat that is anticipated to persist despite sea level rise and associated other impacts of climate change.	● Development ● Working lands ● Incompatible recreation ● Climate change (incl. sea level rise)	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species
	COAST-O2: Restore or enhance beaches, dunes, and rocky cliffs to promote natural structure and native species composition and ecosystem functions where they have been degraded or eliminated. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**COAST-A2: Restore habitat** that has been degraded by land uses including cultivation, exotic plants, intensive incompatible recreation (e.g., trampling, trails and associated erosion), to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize the following areas for restoration: ● Areas that can buffer and expand intact habitat, particularly that which can facilitate inland migration of the natural systems during sea level rise; ● Areas currently degraded by invasive plants, including eucalyptus, European beach grass, ice plant, and pampas grass, where natural community structure and species composition can be restored; ● Areas that can increase populations of the rare species (focal, non-focal, and co-benefited species); ● Provide nesting habitat for seabirds, haul outs for marine mammals, or other important habitats; ● Can buffer and expand other habitat, particularly existing protected lands; and ● Areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained); and ● Areas that can help connect existing habitat to promote habitat connectivity	● Development ● Working lands ● Incompatible recreation ● Exotic plants ● Climate change (incl. sea level rise)	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species
		COAST-A3: Manage invasive plants and dense exotic plants that alter the structure and species composition of the coastal habitats, impact native species populations, have the potential to spread.	Prioritize actions that can maintain intact natural communities by abating threat, or restore already degraded by exotic plants, including by: ● Eradicating or controlling eucalyptus, European beach grass, veldt grass, ice plant, jubata grass, or other invasive plants that alter plant community structure and species composition, prevent	● Exotic Species ● Altered disturbance regimes	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			natural processes (e.g., dune formation), outcompete populations of rare plant species, alter native animal habitat; ● Preventing the invasion and spread of new invaders that can negatively impact the community and rare species populations, including by using Early Detection-Rapid Response.		● Numerous co-benefited species
		COAST-A4: Manage recreation that tramples plants, sensitive habitat features (e.g., dunes), causes erosion, deters habitat use by species wary of humans, to enhance the structure and function of habitat degraded by recreation.	Prioritize actions that: ● Manage recreation in public lands featuring important coastal habitats including: ○ the State Beaches in Mid-County and the Pajaro Valley (New Brighton, Seacliff, Rio Del Mar, Manresa, Manresa Uplands, and Sunset); ○ North Coast parks, including Wilder Ranch State Park, Greyhound Rock County Park, and Big Basin State Park, as well as protected lands in Swanton Pacific Ranch; ● Restore areas where incompatible use has removed habitat by denuding habitat and/or causing erosion; ● Areas where nesting seabird habitat can be restored through management of recreation.	● Incompatible recreation ● Unauthorized activities	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species
COAST-G2: Maintain and enhance connectivity of beaches, dunes, and rocky cliffs (and associated coastal habitats) to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**COAST-O3**: Protect habitat that can connect existing protected habitat, facilitate migration of coastal habitats, and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**COAST-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize land as outlined for Action 1 for Objective 1 (COAST-O1 COAST-A1) and that can connect and expand protected breaches, dunes, and rocky cliffs, as well as other intact plant communities that connect them where systems may be able to migrate in response to sea level rise.	● Development ● Working lands ● Altered disturbance regimes ● Climate change (incl. sea level rise)	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species
	COAST-O4: Restore degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**COAST-A2: Restore Habitat** that has been degraded by land uses including cultivation, exotic plants, intensive incompatible recreation (e.g., trampling, trails and associated erosion), to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize areas as outlined for Action 2 for Objective 2 (COAST-O2 COAST-A2) where restoration can connect habitat. This includes restoring beaches, dunes, and rocky cliffs in urban areas, including between Santa Cruz and Rio Del Mar, to connect intact habitat.	● Development ● Working lands ● Altered disturbance regimes ● Exotic species ● Incompatible recreation ● Unauthorized activities ● Climate change	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		COAST-A3: Manage invasive plants and dense exotic plants that alter the structure and species composition of the coastal habitats, impact native species populations, have the potential to spread.	Prioritize areas as outlined in Action 3 for Objective 2 (COAST-O2 COAST-A3) where invasive plant removal can re-create the natural community structure and species composition to promote habitat connectivity of beaches, dunes, and rocky cliffs. This includes iceplant covered areas near Santa Cruz (e.g., West Cliff and East Cliff).	• Exotic plants • Climate change	• Robust spineflower • Monterey spineflower • Western snowy plover • American peregrine falcon • California brown pelican • Numerous co-benefited species
		COAST-A4: Manage recreation that tramples plants, sensitive habitat features (e.g., dunes), causes erosion, deters habitat use by species wary of humans, to enhance the structure and function of habitat degraded by recreation.	Prioritize actions as outlined in Action 4 for Objective 2 (COAST-O2 COAST-A4) where recreation management can enhance the connectivity of beaches, dunes, and rocky cliffs. This includes habitat in urban areas between Santa Cruz and Rio Del Mar, where excessive trailing denudes habitat and contributes to fragmentation.	• Incompatible recreation • Unauthorized activities	• Robust spineflower • Monterey spineflower • Western snowy plover • American peregrine falcon • California brown pelican • Numerous co-benefited species
COAST-G3: Promote the recovery and long-term persistence of rare species.	**COAST-O5**: Protect habitat occupied by, or suitable for, rare species that rely on beaches, dunes, and rocky cliffs. Measure progress toward this objective based on the acres of habitat protected.	**COAST-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties as outlined in in Action 1 for Objective 1 (COAST-O1 COAST-A1) with an emphasis on areas that: • support, or provide suitable habitat for, robust spineflower, Monterey spineflower, western snowy plover, American peregrine falcon, California brown pelican, and co-benefited species such as Monterey coast paintbrush, globose dune beetle, sandy beach tiger beetle, and Northern California legless lizard; • can continue to support the rare species including in the face of climate change, including anticipated sea level rise; and • expand, buffer, and connect existing protected habitat.	• Development • Working lands • Incompatible recreation • Unauthorized activities • Climate change (incl. sea level rise)	• Robust spineflower • Monterey spineflower • Western snowy plover • American peregrine falcon • California brown pelican • Numerous co-benefited species
	COAST-O8: Restore habitat to enhance population size and persistence of rare species that rely on beaches, dunes, and rocky cliffs. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**COAST-A2: Restore Habitat** that has been degraded by land uses including cultivation, exotic plants, intensive incompatible recreation (e.g., trampling, trails and associated erosion), to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize restoration as outlined in in Action 2 for Objective 2 (COAST-O2 COAST-A2) with an emphasis on restoring areas that: • support, or provide suitable habitat for the non-focal species and co-benefited species of this element (listed in COAST-A5); • can be permanently protected or where restoration actions can otherwise be sustained.	• Development • Working lands • Exotic plants • Incompatible recreation • Unauthorized activities • Climate change (incl. sea level rise)	• Robust spineflower • Monterey spineflower • Western snowy plover • American peregrine falcon • California brown pelican • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		COAST-A3: Manage invasive plants and dense exotic plants that alter the structure and species composition of the coastal habitats, impact native species populations, have the potential to spread.	Prioritize invasive and exotic plant management as outlined in in Action 3 for Objective 2 (COAST-O2 COAST-A3), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on beaches, dunes, and rocky cliffs, including the non-focal species and co-benefited species (listed in COAST-A5). Specific management priorities should be determine based on a comprehensive assessment, but priority actions are likely to include: • Removal of European beachgrass in dunes of the Pajaro Valley area; • Removal of ice plants and jubata grass and grass on the rocky cliffs and bluffs; • Removal of exotic trees including Monterey cypress, planted Monterey pine, and eucalyptus near beaches, to eliminate perches used by native predators of western snowy plover, Rocky cliffs and bluffs and other erosive areas should be replanted with native species to provide erosion.	● Exotic plants Climate change (incl. sea level rise)	● Robust spineflower ● Monterey spineflower ● western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species
		COAST-A4: Manage recreation that tramples plants, sensitive habitat features (e.g., dunes), causes erosion, deters habitat use by species wary of humans, to enhance the structure and function of habitat degraded by recreation.	Prioritize recreation management as outlined in Action 4 for Objective 2 (COAST-O2 COAST-A4) with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of rare species that rely on beaches, dunes, and rocky cliffs, including the non-focal and co-benefited species (listed in COAST-A5). Specific management priorities should be determine based on a comprehensive assessment but may include: • Pajaro Valley area beaches, dunes, and bluffs particularly Sunset State Beach; • North Coast beaches and parks including Wilder Ranch; • Habitat in urban areas including the cliffs and beaches between Santa Cruz and Rio Del Mar, to enhance roosting and foraging habitat for rare birds.	● Incompatible recreation ● Unauthorized activities	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species
	COAST-O7: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**COAST-A5: Conduct species-specific actions** including surveys, captive breeding/rearing programs, seed banking and seed bulking, and other species-specific actions for rare species, to supplement habitat protection, restoration, and enhancement actions, to ensure the persistence of the species in	Prioritize actions based on a comprehensive assessment to identify species population enhancements needed to: ● Maintain or increase the areal extent, abundance, and persistence (as assessed based on population demography); and ● Prevent loss of populations. Priorities for Western snowy plover include: 1) manage nesting sites to address encroaching vegetation, predation, and human disturbance, and 2) conducting ongoing monitoring and analysis to assess populations and direct future management.	● Development ● Working lands ● Incompatible recreation ● Exotic plants ● Incompatible recreation ● Unauthorized activities ● Climate change (incl. sea level rise)	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		the beaches, dunes, and rocky cliffs.	Priorities for robust spineflower and Monterey spineflower include: 1) protecting additional occupied and suitable but unoccupied habitat; 2) managing habitat using controlled burning, exotic plant management, and recreation management to prevent soil compaction; 3) establishing populations in historical habitat within the range of the species; 4) conducting management-oriented research; and 5) establishing an *ex situ* seed bank comprised of seed collected from all available populations over multiple years, to capture the genetic diversity in the species.		
		COAST-A6: Conduct surveys and long-term monitoring of rare species, sensitive communities, and other sensitive habitats to inform conservation and management	Prioritize projects that: ● Increase understanding of the conservation and management needs of rare species and sensitive natural communities and habitats (e.g., sea bird roosting areas); ● monitor the effects of climate change, including sea level rise, to help identify climate change adaptation.	● Development ● Working lands ● Incompatible recreation ● Exotic plants ● Incompatible recreation ● Unauthorized activities ● Climate change (incl. sea level rise)	● Robust spineflower ● Monterey spineflower ● Western snowy plover ● American peregrine falcon ● California brown pelican ● Numerous co-benefited species

5.3.9 Karst Formations

Karst Formations

Status and State and Global Ranks

- County of Santa Cruz Sensitive Habitat: the caves provide habitat for rare and endangered species as defined in CEQA
- Caves are protected by the California Cave Protection Act
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

Ubick 2001

Nolan Associates 2016

Distribution and Range

- There are approximately 1,363 acres of marble outcrops, 31 karst springs, and six caves that have been mapped in the RCIS Area (Tinsley 1985, Nolan Associates 2016; Figure 5-10). The actual areal extent (acreage) of karst formations and number of caves is poorly understood, as the features are belowground.
- Known karst formations are located in the southeastern portion of Ben Lomond Mountain in the vicinity Bonny Doon, Felton, UC Santa Cruz, and Pogonip Park, in the North Coast Watersheds and western portion of the San Lorenzo Valley Watershed.

Key Ecological Elements

- Western Santa Cruz County features a karst landscape formed by the dissolution of soluble limestone and marble that underlays the marine terraces of sandy soil deposits. Dissolution of the limestone leads to the formation of sinkholes, caves, and underground drainages, that result in karst topography, which features sinkholes and lacks an integrated surface drainage system.

- The marine terrace that overlays the karst bedrock is believed to be approximately one million years old; the caves were formed after this date as the sea level dropped, and the area was subsequently populated by organisms (Tinsley 1985). The relative ages of the caves have been estimated by their elevations, with the highest caves being the oldest and the lower caves the youngest (Ubick 2001).
- The caves collectively support several rare cavernicolous (cave-dwelling) animals that feature adaptations to cave life such as depigmentation, elongation of appendages, and loss of eyes; some are aquatic and restricted to underground water sources (Ubick 2001). Caves in the Cave Gulch area contain over 70 invertebrate species, including the following endemic species:
    - Empire Cave pseudoscorpion *(Fissilicreagris imperialis*): G1, S1
    - Mackenzie's cave amphipod (*Stygobromus mackenziei*): G1, S1
    - Dolloff Cave spider (*Meta dolloff*): G1 S1
    - Empire Cave neochthonius (*Neochthonius imperialis*): G1 S1
    - Santa Cruz teleman spider (*Telema sp. nov*.)

  Empire Cave has 76 recorded cavernicoles (cave-dwelling animals), which is more than in any other Californian cave (Elliott et al. 2017).

  Though these naturally rare species are critically imperiled by anthropogenic pressures and stressors, none have been designated as special-status species.

  Many additional species have yet to be described (Ubick 2001).
- California giant salamander (*Dicamptodon ensatus*) occurs within and near the caves, where Dr. Barry Sinervo is investigating whether the strictly aquatic, paedomorphic form, is a distinct species from those found outside the caves.
- Additionally, caves are used by bats for roosting, including Townsend's big-eared bat (*Corynorhinus townsendii)* which is a special-status species and is sensitive to disturbance (Harris et al 2019), Western small-footed myotis *(Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), Yuma myotis (*M. yumanensis*).
- The karst formations, along with the associated granitic sand, are important for the public water supply and for sustaining stream flows in the North Coast and San Lorenzo River watersheds; specifically, Liddell, San Vicente, Majors, Laguna, and Fall creek subwatersheds. Cool, persistent groundwater flows into streams from the karst formations including during relatively hot, low-flows periods of the year and during droughts, helping maintain cool-water habitat for anadromous fish. Groundwater flow from karst may provide relief to anadromous fish during low-flow periods including those anticipated to increase as part of climate change (Berry 2010); as a result,

protection of karst terrain has recently been identified as crucial in federal coho salmon recovery (NMFS 2012).

- The distribution of karst formations is poorly understood. Surface expressions are easily identifiable and often have evidence of historic mining activity (e.g., Bonny Doon, Felton, and UCSC quarries). However, much of karst terrain is not visible on the surface, such as in remote areas of Laguna Creek Watershed, rendering it difficult to map the full extent of the formations (Berry 2010). Spring locations and well monitoring records have been used to help determine additional karst formations and flow volumes for the complex subterranean stream system (Nolan Associates 2016).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting karst caves, which include the following most critical ones:

- Habitat loss due to development and mining, which can open and expose caves, and seal caves and collapse karst features, altering flow paths;
- Habitat degradation due to altered hydrology resulting from water diversions, altered stormwater, and changes in surface drainage, which can alter the hydrology in caves (drying or flooding) relative to what the cavernicolous species are adapted, and affect hydrology in streams influenced by karst formations.
- Habitat degradation due to timber harvest, which has been found to alter soil and hydrological systems including by increasing sedimentation in karst landscapes and caves and contribute to sedimentation in streams in other karst regions (Harris 2020).
- Habitat degradation due to altered nutrient flow caused by barriers, including inappropriate gates installed to limit public access or by the introducing of organic matter such as litter (Ubick 2001).
- Habitat degradation due to chemical pollution, which readily reaches the groundwater in karst aquifers through fractures and sinkholes without filtering through any soil (as in most aquifers); as a result, chemicals can end up directly into underground water impacting both sensitive cave species and water supply (Nolan Associates 2016).
- Incompatible recreation, including spelunking and gatherings (i.e., cave parties; Ubick 2001).

Climate Change Vulnerability Assessment

- There have been no prior climate change vulnerability analyses for the local karst system, but studies from other karst areas suggest that the endemic biota may be highly vulnerable to climate change (Mahler et al. 2015) due to:
    - Exposure to projected temperature increases and highly variable precipitation including drought, which along with altered hydrology together can reduce humidity in caves;

  - Sensitivity to changes, as many invertebrates and amphibians are sensitive to changes in moisture and temperature; and
  - Low adaptive capacity, as most species (including the endemic species) are naturally restricted to the isolated cave formations, and have low dispersal ability, thus precluding migration to climate refugia.

- In addition, seeps and springs, including those that are associated with karst, have high vulnerability to climate stressors and disturbance regimes that alter groundwater recharge including changes in patterns of precipitation and runoff, increased drought, altered wildfire regimes, and more frequent and intense storms and flooding (EcoAdapt 2021).
- More information is needed. Inclusion of hydrologic factors that the species depend on is key to evaluating vulnerability of karst species to climate change.

The goals, objectives, actions, and priorities for the Karst Formations (Table 5-12) will help address the impacts of climate change by:

1. Protecting habitat underlain by karst formations (i.e., in karst terrain), to safeguard the aboveground and belowground features including caves and associated groundwater;
2. Reducing non-climate anthropogenic pressures and stressors such as groundwater withdrawals, surface water diversions, quarrying, exotic species, and incompatible recreation, to improve species resiliency to climate change (Heller and Zavaleta 2009).
3. Increasing understanding of the areal extent of karst formations, spring outflow and cave ecosystems, by conducting mapping, and monitoring the caves to evaluate climate changes.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-12 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- coho salmon (Oncorhynchus kisutch) [F]
- steelhead (Oncorhynchus mykiss irideus) CCC DPS [NF].

Other Actions that Benefit this Conservation Element

The Karst Formation, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Grasslands:** Actions to protect, restore, manage, and enhance coastal prairie grasslands, which overlay portions of the karst formation, as part of GRASS-A1 through GRASS-A5;

- **Oak Woodlands and Forest**: Actions to protect, restore, and enhance oak woodlands, which cover areas of the karst formation, as part of OAK-A1 through OAK-A5;
- **Redwood and Douglas-Fir Forest**: Actions to protect, restore, and enhance redwood and Douglas-fir forests, which cover large portions areas of the karst formation, as part of OAK-A1 through OAK-A5;
- **Connectivity**: Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of the Ben Lomond Mountain Habitat patch as part of CONNECT-A1 through CONNECT-A4; and
- **Working Lands**: Actions to protect and enhance the management of working forests and other working lands, which cover portions of the karst formation, as part of WORKING-A1 through Working-A8.

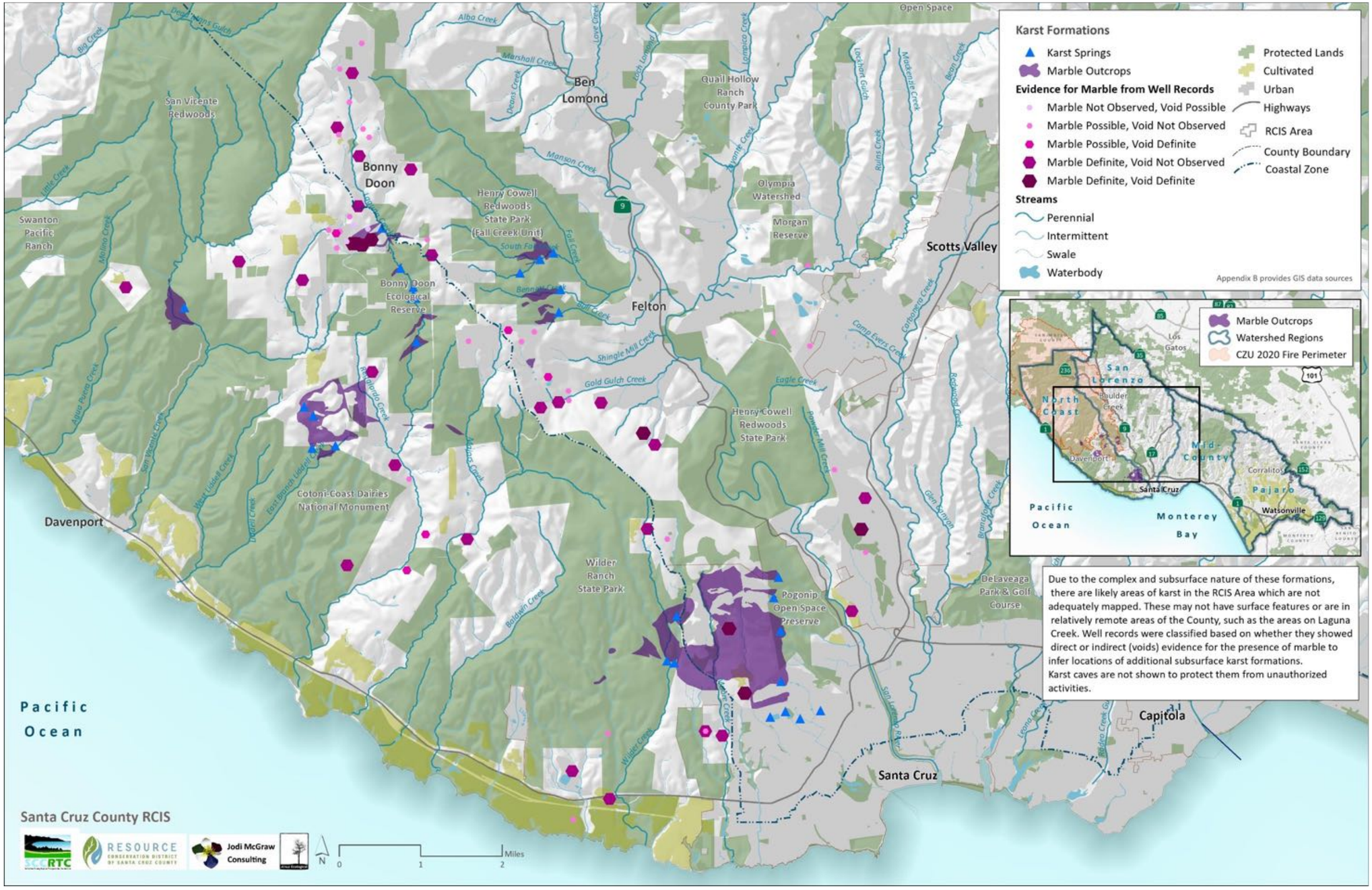

Figure 5-10: Karst Formations Conservation Element

Table 5-12: Conservation Strategy for Karst Formations

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited

KARST-G1: Promote persistence and ecological integrity of the karst landscape including caves, the rare species they support, karst hydrology, and other ecological processes that sustain them.	**KARST-O1**: Protect all of the karst caves, and at least 90% of the karst formation including at least 761 additional acres of marble outcroppings, which evidence the locations of the formation (Table 5-3). Measure progress toward this objective based on the acres of habitat protected in karst terrain and the number of caves protected.	**KARST-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that:
			• feature caves, with an emphasis on those that have the greatest diversity and abundance of rare cavernicolous species;
			• feature caves that provide roosting bat habitat, or other biodiversity conservation values;
			• feature seeps, springs, or streams or can contribute to the quality or quantity of water in these aquatic systems;
			• can protect karst terrain/landscapes, and buffer caves to reduce pollution and maintain vegetation including tree cover to reduce risk of subsidence and sinkhole flooding; and
			• can facilitate species adaptation to climate change, including:
			  ○ feature climate refugia (e.g., north-facing slopes, springs, drainage, etc.);
			  ○ a range of land facets due to variables topography and soils; and/or
			  ○ can help connect existing protected habitat to facilitate migration.
				• Development
				• Mining/quarrying
				• Working lands
				• Incompatible recreation
				• Unauthorized activities
				• Climate change
					• Coho salmon
					• Steelhead
					• Numerous co-benefited species

	KARST-O2: Restore or enhance habitat in karst caves, and in aquatic and terrestrial systems in karst terrain that have been degraded by prior land use and human activities. Measure progress toward this objective based on the acres (or stream miles) of habitat restored or enhanced.	**KARST-A2: Restore habitat** in karst caves that has been degraded by prior land use and human activities including recreation, to promote the unique and diverse cave assemblages including numerous endemic species.	Prioritize the following areas for restoration: • habitat that supports or, if restored, can support rare cavernicolous species, to expand their distribution and abundance, and enhance their persistence; • areas essential to the maintenance of rare species populations, especially the endemic cavernicolous biota, which have limited extent; and • areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained).	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
		KARST-A3: Restore habitat in karst terrain to enhance aquatic and terrestrial systems and water quality and quantity.	Prioritize the following areas for restoration: • areas that can contribute to habitat quality in caves, streams, springs, or other karst-dependent systems; • areas that feature aquatic habitat or can contribute to the quality and quantity of water in streams, springs, and seeps, and/or contribute to the region's water supply; and • areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained).	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
		KARST-A4: Manage recreation that degrades karst caves and impacts rare species, and	Prioritize projects that can maximally benefit the endemic cave species and their fragile environment, including by preventing incompatible recreational uses and other unauthorized activities in caves. The	• Incompatible recreation	• Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		enhance karst cave habitat that has been degraded by recreation.	prioritization should be based on an assessment of the caves biota and impacts of recreation. If caves need to barriers to limit public access, barriers should allow free movement to bats and other organisms and organic matter.		
KARST-G2: Maintain and enhance connectivity of habitat within karst terrain to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**KARST-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**KARST-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize protection of habitat as outlined in Action 1 for Objective 1 (KARST-O1 KARST-A1) that can help protect and enhance connectivity of habitat in the karst landscape.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
	KARST-O4: Restore degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**KARST-A2: Restore habitat** in karst caves that has been degraded by prior land use and human activities including recreation, to promote the unique and diverse cave assemblages including numerous endemic species.	Prioritize restoration of karst caves and landscapes as outlined in outlined in Action 2 for Objective 2 (KARST-O2 KARST-A2) that can help protect and enhance connectivity of habitat in the karst landscape.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Numerous co-benefited species
KARST-G3: Promote the recovery and long-term persistence of rare species.	**KARST-O5:** Protect habitat occupied by, or suitable for, rare species that utilize karst caves. Measure progress toward this objective based on the acres of habitat protected.	**KARST-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize habitat protection as outlined in Action 1 for Objective 1 (KARST-O1 KARST-A1) to promote persistence of populations and genetic diversity of rare cavernicolous species.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Numerous co-benefited species
	KARST-O6: Restore habitat to enhance population size and persistence of rare species that utilize karst caves. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**KARST-A2: Restore habitat** in karst caves that has been degraded by prior land use and human activities including recreation, to promote the unique and diverse cave assemblages including numerous endemic species.	Prioritize restoration of caves and associated karst terrain as outlined in Action 2 for Objective 2 (KARST-O2 KARST-A2) to promote persistence of populations and genetic diversity of rare cavernicolous species.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
	KARST-O7: Maintain or increase rare species	**KARST-A6: Conduct species-specific actions** including	Prioritize actions based on a comprehensive assessment to identify population management and enhancement needed to:	• Development	• Coho salmon

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	populations to promote species persistence.	surveys, captive breeding/rearing programs, and other species-specific actions for rare cavernicole species, to supplement habitat protection, restoration, and management and enhancement actions, to ensure the persistence of the species.	• Maintain or increase the areal extent, abundance, and persistence (as assessed based on population demography); and • Prevent loss of populations.	• Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Steelhead • Numerous co-benefited species
		KARST-A7: Conduct surveys and long-term monitoring of rare species, sensitive communities, and other sensitive habitats to inform conservation and management.	Prioritize projects that: • Increase understanding of the conservation and management needs of rare species and sensitive natural communities and habitats (e.g., karst caves); • monitor the effects of climate change including to help identify climate change adaptation strategies.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
KARST-G4: Promote the quantity and quality of water resources in the karst landscape.	**KARST-O8:** Protect water quality and quantity in karst landscape. Measure progress toward achieving this objective by the acres or linear feet of hydrologic features with improved of hydrological indicators such as water depth, flow rates, temperature, and/or chemistry.	**KARST-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize actions to protect karst caves and landscapes that will protect and enhance the quality and quantity of water for streams, springs, and seeps, and other karst-influenced aquatic systems, with additional consideration given to projects that can help safeguard and enhance the public water supply.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species
		KARST-A8: Develop land management programs to protect karst terrain and associated biological and water resources.	Prioritize programs that protect karst landscapes, caves, and karst-influenced aquatic features, including by (Berry 2010, 2011): • using a geologic hazard evaluation for areas near karst features to determine if development is on or near a fault or fissure; • Preventing the discharge of runoff into karst features; • Requiring on-site wastewater disposal systems be setback from karst formations; • Setting limits on the depth to groundwater for mining in karst terrain; • Limiting development of the water supply in karst terrain, which features subterranean streams; • Requiring maintenance of pre-development stormwater quality and quantity; and • Protecting water quality in wells, springs, and streams in karst terrain.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Coho salmon • Steelhead • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			Efforts to delineate karst protection zones will require rigorous hydrogeologic characterizations to identify the karst and non-karst areas that provide recharge (Berry 2010).		

5.3.10 Sandhills and Sand Parkland

Santa Cruz Sandhills

Status and Rarity

- Silverleaf manzanita chaparral Provisional Alliance (37.320.00): G1, S1
- County of Santa Cruz Sensitive Habitat
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone (i.e., in Bonny Doon)

Detailed Descriptions

Marangio and Morgan 1987

McGraw 2004

CNPS 2021

Distribution and Range

- Endemic ecosystem found only in the San Lorenzo Valley and Bonny Doon regions of central Santa Cruz County
- 5,885 acres (2% of the RCIS Area), which includes (Figure 5-11):
    - 255 ac. of sand parkland, a rare sandhills community type
    - 5,630 ac. of other Sandhills communities

Key Ecological Elements

- The sandhills are restricted to outcroppings of Zayante soils derived from the weathering of uplifted marine sediments of the Santa Margarita Sandstone Formation.
- The sandhills support endemic communities found nowhere else in the world, including silver leaf (Bonny Doon) manzanita chaparral, and sand parkland, which is very diverse and occurs on only 255 acres.

- The sandhills support six described endemic species, numerous undescribed species and ecotypes, and disjunct populations of species found primarily along the coastal strand (e.g., sea thrift, mock heather) or in higher-elevation montane regions (one-seeded pussy paws, ponderosa pine).
- The sandhills have the highest concentration (species per acre) of rare and unique species in the RCIS Area and are recognized as a biodiversity hot spot. As a result of high rates of endemism and diversity as well as their island-like distribution, the sandhills have been likened to the Galapagos Islands by renowned biologist Peter Raven.
- Sandhills communities are dominated by species that require fire to regenerate (e.g., silverleaf manzanita and knobcone pine) or require the open/earlier successional conditions fire creates and maintains (e.g., ponderosa pine).
- At a smaller-scale, soil disturbances including slides, trails, and animal diggings (i.e., pocket gopher mounds and badger burrows) create and maintain open habitat required by disturbance-adapted species (e.g., Ben Lomond wallflower and Ben Lomond spineflower) which are poor competitors for light.
- The Santa Margarita Formation, which underlies the Sandhills, is an important aquifer both for the public water supply and for sustaining stream flows in the San Lorenzo River Watershed. Because of their importance for biodiversity and water, the sandhills were identified as a Priority Muti-benefit area in the Conservation Blueprint for Santa Cruz County (Mackenzie et al. 2011).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting Sandhills/Sand Parkland, which include the following most critical ones:

- Sandhills habitat has been lost and fragmented by development, mining, and agriculture (primarily viticulture; McGraw 2004).
- Sandhills habitat is being degraded by alteration of the natural fire regimes, including fire exclusion, which increases the density of shrubs and trees in most habitat. This unnatural succession reduces the amount of earlier successional habitat available for many species that require (at least partially) open canopy conditions including Santa Cruz kangaroo rat, Zayante band-winged grasshopper, Ben Lomond wallflower, Ben Lomond spineflower, and Ben Lomond buckwheat. Conversely, too frequent fire may eliminate obligate seeding species, like silverleaf manzanita, which require fire-free periods to establish seed resources (McGraw 2004).
- Sandhills habitat is being degraded by exotic plants, including European plants that are pre-adapted to sandy soil and a Mediterranean climate and have become patchily abundant, particularly in the sand parkland community, where they outcompete rare plants, and degrade habitat for rare animals (McGraw 2004). Additionally, invasive species such as brooms (e.g., *Genista monspessulana* and *Cytisus striatus*) and acacias

(e.g., *Acacia dealbata* and *A.* melanoxylon). Reduce the amount of open canopy habitat, increase soil nitrogen, and can promote fire as well as further exotic plant invasions. New invaders such as stinkwort (*Dittrichia graveolens*) pose a serious threat to sandhills habitat.

- Sandhills habitat is being degraded by incompatible recreation (i.e., high intensity, frequency, and/or pervasive), and unauthorized uses, which can readily displace rare plant populations, degrade habitat for rare animals (e.g., Santa Cruz kangaroo rat), and cause erosion on slopes (McGraw 2004).

Climate Change Vulnerability Assessment

- There have been no prior climate change vulnerability analyses for the Sandhills communities or species.
- Sandhills communities and the species that inhabit them, particularly the endemic species, are highly vulnerable to climate change due to:
    - Exposure to projected temperature increases and highly variable precipitation including drought, which together can increase the climatic water deficit in ways that can reduce populations of the endemic plants and could potentially alter the structure and species composition of the sandhills communities in ways that degrade habitat for the native animals
    - Sensitivity to changes, as many plants and insects are sensitive to changes in soil moisture and temperature. Specifically:
        - The two multi-year droughts this century (2007-2009 and 2012-2015) likely contributed to the die-off of ponderosa pine and die-back of silverleaf manzanita, with the latter also experiencing declines due to a pathogen likely promoted by the well-above average rainfall in 2017 and 2019 (McGraw and Jordan 2020).
        - Populations of the three endemic herbaceous plants (Ben Lomond spineflower, Ben Lomond wallflower, and Ben Lomond buckwheat) generally track (i.e., are positively correlated with) annual rainfall which influences soil moisture availability. The rare plant populations declined following the two multi-year droughts this century (2007-2009 and 2012-2015; McGraw and Jordan 2021a).
        - Populations of the two endangered insects, Mount Hermon June beetle and Zayante band-winged grasshopper, are also influenced by temperature and rainfall and the abundance of both species declined in the wake of the two, multi-year droughts and nine consecutive years of above-average temperatures (McGraw et al. 2020, McGraw and Jordan 2021b).
    - Low adaptive capacity, as most species (including the endemic species) are naturally restricted to outcroppings of Zayante sand soil found only in central

Santa Cruz County that occur as disjunct habitat islands such that migration along elevational and latitudinal gradients is not possible. Most of the endemic species have low dispersal ability and the remaining habitat is highly fragmented, further constraining their dispersal to nearby climate refugia.

- Climate change may impact Sandhills including Sand Parkland indirectly by altering the fire regime to which the species are adapted. Too frequent fire could reduce populations by limiting seed available for regeneration post-fire.

The goals, objectives, actions, and priorities for the Sandhills and Sand Parkland (Table 5-13) will help address the impacts of climate change by:

1. Protecting additional habitat, including lands that contain climate refugia, such as cooler microclimates (e.g., north-facing slopes) that can help species stay with their 'climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and incompatible recreation;
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat to increase its suitability for species movement, to enable them to migrate to stay within their adapted climate envelope;
5. Introducing the rare species into habitat that is suitable but unoccupied to increase populations and reduce the potential for extirpations or extinctions; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-13 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*) [NF]
- Ben Lomond (Santa Cruz) wallflower (*Erysimum teretifolium*) [NF]
- Santa Cruz cypress (*Hesperocyparis abramsiana*) [NF]
- Zayante band-winged grasshopper (*Trimerotropis infantilis*) [F]

- Mount Hermon June beetle (*Polyphylla barbata*) [NF]

Other Actions that Benefit this Conservation Element

The sandhills and sand parkland communities, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Santa Cruz Cypress Forest:** Actions conducted as part of CYPRESS A1, A2, A3, A4, A5, and A7 within the portion of the Bonny Doon Santa Cruz Cypress Forest that occurs on Zayante sand soil; and
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of sandhills and sand parkland communities as part of CONNECT-A1 through CONNECT-A4.

In addition, the silverleaf manzanita chaparral community that dominates the sandhills is a type of maritime chaparral; sandhills (and sand parkland) were split out from maritime chaparral to plan for the unique needs of the sandhills community and species. The area of sandhills communities is *not* included in the area of Maritime Chaparral/Knobcone Pine Forest area. Nonetheless, actions in associate maritime chaparral and knobcone forest in and around the sandhills will benefit sandhills habitat and associated focal, non-focal, and co-benefited species.

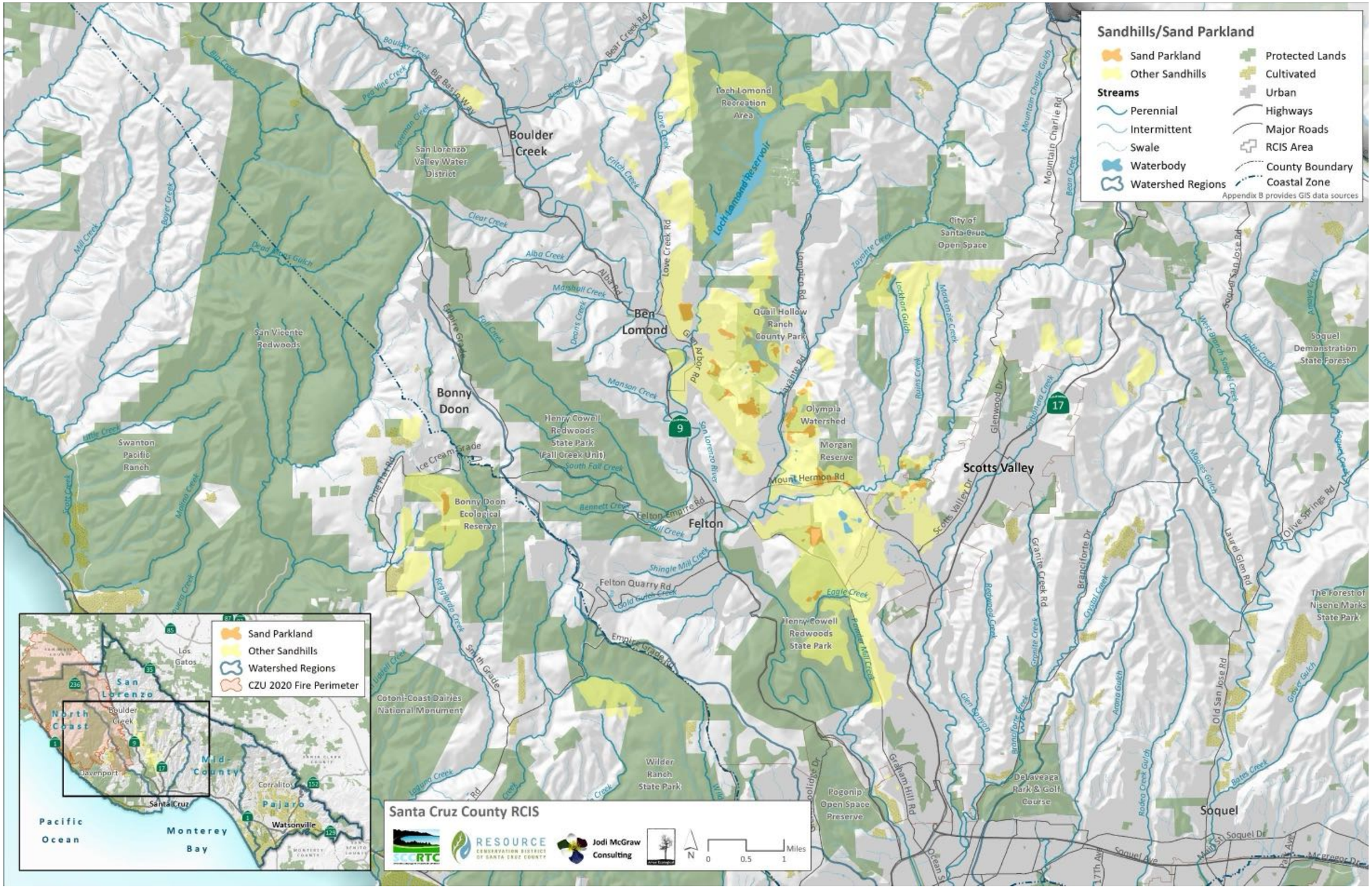

Figure 5-11: Sandhills and Sand Parkland Conservation Element

Table 5-13: Conservation Strategy for Sandhills and Sand Parkland

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited

SAND-G1: Promote persistence and ecological integrity of sandhills communities, the rare species they support, and the ecological processes that sustain them.	**SAND-O1:** Protect at least 2,270 additional acres of sandhills habitat and 81 additional acres of sand parkland habitat to achieve the 75%[6] and 90% target for conservation of these communities (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**SAND-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that:
			• feature sand parkland and Sandhills chaparral communities, which support the rare species and diverse assemblages of locally unique species;
			• are identified as priorities in prior plans including the *Sandhills Conservation Management Plan* (McGraw 2004), or sites that meet the criteria used to prioritize habitat;
			• former sand quarries that feature restoration potential: sandhills quarries are large, adjacent to protected lands, often support the endemic species, and therefore have high potential to expand and connect their populations and contribute to recovery;
			• can facilitate species adaptation to climate change, including:
			  ○ feature climate refugia (e.g., north-facing slopes);
			  ○ a range of land facets due to variable topography and soils; and/or
			  ○ can help connect existing protected habitat to facilitate species migration.
				• Development
				• Mining/quarrying
				• Working lands
				• Incompatible recreation
				• Unauthorized activities
				• Climate change
					• Ben Lomond spineflower
					• Ben Lomond wallflower
					• Mount Hermon June beetle
					• Zayante band-winged grasshopper
					• Numerous co-benefited species

	SAND-O2: Restore and or enhance sandhills habitat to promote natural structure and native species composition and ecosystem functions where they have been degraded or eliminated through prior land use (e.g., mining, development, or agriculture). Measure progress toward this objective based on the acres of habitat restored or enhanced.	**SAND-A2: Restore habitat** that has been degraded by prior land use including sand mining, by addressing altered soils, exotic plants, altered disturbance regimes, and incompatible recreation impacts including erosion, to recreate native plant sandhills community structure, promote diverse native plant assemblages, and increase suitability of habitat for rare species, with an emphasis on the native sand parkland and Sandhills chaparral assemblages that support the rare species and unique biodiversity.	Prioritize the following areas for restoration: • Habitat that, if restored, can support rare sandhills species, to expand their distribution and abundance; • Areas that can connect or buffer existing protected sandhills habitat; • mined sandhills habitat, as sandhills quarries are adjacent to existing protected lands, support (or can be restored to support) rare species populations, and are very large, and thus can greatly increase sandhills habitat and expand and connect rare species populations; • areas essential to the maintenance of rare species populations, especially the critically endangered Zayante band-winged grasshopper and Ben Lomond wallflower, which have experienced extirpations and have limited areal extent; • areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained);	• Development • Mining/quarrying • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Unauthorized activities • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

[6] The sandhills protection target is 75% rather than 90% recognizing that the mapped sandhills habitat includes areas of existing moderate to high residential development where protection of habitat via fee title or easement acquisition is infeasible. These areas should still be subject to policy protection to ensure the persistence of rare species.

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• areas that can buffer and expand existing sandhills habitat, including areas where sandhills communities have experienced encroachment at the ecotones and in transitional soils, but where disturbance can reset succession and restore plant community structure and species composition.		
		SAND A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects (i.e., fire surrogates) to manage Sandhills habitat within the range of variation of the natural fire regime to: 1) maintain habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3) maintain a range of microclimatic and other abiotic conditions that can facilitate adaptation to a changing climate.	Prioritize fire management in areas that are long-unburned, where succession and litter accumulation are causing the extirpation of species that require open canopy and bare mineral soil. • Use fire to reset succession in long-unburned areas that feature senescent vegetation (e.g., buckbrush chaparral, knobcone pine forest). • Use fire to prevent succession of sandhills woodland including coast live oak woodland, to dense forests as a result of establishment of Pacific Douglas-fir in long-unburned areas. • Use fire to expand the area of open sandhills habitat that is successional in transitional areas at the ecotone with non-Sandhills communities • Use surface fires to control dense exotic grasses in areas of litter accumulation in sand parkland to increase or maintain the area of open sandy habitat required by species adapted to open soil conditions including the Zayante band-winged grasshopper, Ben Lomond spineflower, Ben Lomond wallflower, Ben Lomond buckwheat, and other diminutive native herbaceous plants and associated species including pollinators. • Support indigenous community practices of cultural burns, where appropriate to achieve the biological goals and objectives.	• Altered disturbance regimes (Fire)	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
		SAND-A4: Manage invasive plants and dense exotic plants which alter sandhills community structure, and impact native species populations.	Prioritize actions that: • Eradicate or control invasive brooms, acacias, or other species that alter plant community structure and species composition and increase the risk of unnatural fire. • Use managed disturbance and other treatments to reduce the area of habitat degraded by dense exotic herbaceous plants, particularly in sand parkland. • Prevent the invasion and spread of new invaders that can alter sandhills (e.g., stinkwort), including by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes • Unauthorized activities	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
		SAND-A5: Manage recreation that denudes sandhills plant communities and exposes soil	Prioritize actions that: • Manage recreation in public lands with significant sandhills habitat, that has been impacted by incompatible public uses including:	• Incompatible recreation • Unauthorized activities	• Ben Lomond spineflower • Ben Lomond wallflower

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		to erosion that removes habitat for rare species, and enhance sandhills habitat that has been degraded by incompatible recreation and attendant erosion.	Henry Cowell Redwoods State Park, Quail Hollow Ranch County Park, and the Bonny Doon Ecological Reserve, to ensure it is compatible with protection of sensitive sandhills communities and rare species. • Prioritize recreation management in areas where incompatible use have removed habitat for rare species by denuding habitat and/or causing erosion. • Limit the extent and effects of incompatible recreational and unauthorized activities within Sandhills by regulating access (including symbolic fences), designated trails, patrols, and associated outreach to recreators.		• Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
SAND-G2: Maintain and enhance connectivity of sandhills habitat to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**SAND-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**SAND-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize land as outlined for Action 1 in Objective 1 (SAND-O1 SAND-A1) and that can connect and expand protected sandhills habitat, as well as other communities connecting it. Priority areas to connect include habitat: • in the San Lorenzo Valley between Henry Cowell State Park and northern Quail Hollow region; • between Weston Road region and East Zayante; and • within Scotts Valley, between Bean Creek and the Morgan Preserve.	• Development • Mining/quarrying • Working lands • Altered disturbance regimes • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
	SAND-O4: Restore sandhills quarries and other degraded sandhills habitat to promote habitat connectivity and dispersal between core habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**SAND-A2: Restore Habitat** that has been degraded by prior land use including sand mining, by addressing altered soils, exotic plants, altered disturbance regimes, and incompatible recreation impacts including erosion, to recreate native plant sandhills community structure, promote diverse native plant assemblages, and increase suitability of habitat for rare species, with an emphasis on the native sand parkland and Sandhills chaparral assemblages that support the rare species and unique biodiversity.	Prioritize areas where restoration can connect sandhills habitat as outlined for Action 2 in Objective 2 (SAND-O2 SAND A2). Most notably, prioritize restoration of former sand quarries (Olympia Quarry, Hanson Quarry, the Old Kaiser Quarry, and Quail Hollow Quarry) to enhance connectivity between adjacent protected sandhills habitat.	• Development • Mining/quarrying • Working lands • Altered disturbance regimes • Exotic species • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	SAND-O5: Enhance connectivity within sand parkland, sandhills chaparral, and sandhills habitat overall to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**SAND-A3: Manage fire and vegetation** using treatments that mimic fire's beneficial effects (i.e., fire surrogates) to manage Sandhills habitat within the range of variation of the natural fire regime to: 1) maintain habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3) maintain a range of microclimatic and other abiotic conditions that can facilitate adaptation to a changing climate.	Prioritize areas where fire and vegetation management can prevent unnatural succession that causes the following type conversions that reduce and fragment sandhills habitat: • open sand parkland to denser communities (sandhills chaparral or woodlands/forests), which degrade habitat for Zayante band-winged grasshopper, Ben Lomond wallflower, and other species that require open sandy areas; • sandhills chaparral to sandhills woodlands and forests, which reduce suitability for Santa Cruz kangaroo rat and Ben Lomond spineflower, and other species; and • sandhills habitat to non-Sandhills communities, which can occur on transitional soils (i.e., soils that have finer texture than typical Zayante soils).	• Altered disturbance regimes • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
SAND-G3: Promote the recovery and long-term persistence of rare species.	**SAND-O6:** Protect habitat occupied by, or suitable for, rare species in the sandhills. Measure progress toward this objective based on the acres of habitat protected.	**SAND-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties as outlined in Action 1 for the other objectives (SAND-A1's) with an emphasis on habitat that supports, or provides suitable habitat for, focal, non-focal, and co-benefited species and diverse assemblages of locally unique species, and can expand, buffer, and connect existing protected lands, where possible. The *Sandhills Conservation and Management Plan* (McGraw 2004) identifies priorities for conservation and rare species associated with each area.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
	SAND-O7: Restore habitat to enhance population size and persistence of rare species in the sandhills. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**SAND-A2: Restore Habitat** that has been degraded by prior land use including sand mining, by addressing altered soils, exotic plants, altered disturbance regimes, and incompatible recreation impacts including erosion, to recreate native plant sandhills community structure, promote diverse native plant assemblages, and increase	Prioritize restoration as outlined in Action 2 for the other objectives (SAND-A2's) with an emphasis on restoring areas to provide suitable habitat for, and where possible, support populations of, the focal, non-focal, and co-benefited species and diverse assemblages of locally unique species. Priorities include: • Olympia Quarry • Hanson Quarry • Quail Hollow Quarry • Olympia Watershed Property (mined areas) • Morgan Preserve (mined areas)	• Development • Mining/quarrying • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		suitability of habitat for rare species, with an emphasis on the native sand parkland and Sandhills chaparral assemblages that support the rare species and unique biodiversity.			
		SAND-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects (i.e., fire surrogates) to manage Sandhills habitat within the range of variation of the natural fire regime to: 1) maintain habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3) maintain a range of microclimatic and other abiotic conditions that can facilitate adaptation to a changing climate.	Prioritize fire and vegetation management as outlined in Action 3 for the other objectives (SAND-A3's), with an emphasis on areas where management can expand or enhance focal, non-focal, and co-benefited species habitat and increase the size and resilience/persistence of populations. Priorities include: • Henry Cowell Redwoods State Park • Bean Creek Preserve • Hihn Road Preserve • Olympia Watershed Property • Newell Creek Sandhills Preserve	• Altered disturbance regimes • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
		SAND-A4: Manage invasive plants and dense exotic plants which alter sandhills community structure, and impact native species populations.	Prioritize invasive and exotic plant management as outlined in Action 4 for the other objectives (SAND-A4's), with an emphasis on areas where management can expand or enhance focal, non-focal, and co-benefited species habitat and increase the size and resilience/persistence of populations. Priorities for exotic plant management include: • Olympia Watershed Property (brooms, acacia, and Pseudoacacia) • Morgan Preserve (acacias, pampas grass, and brooms) • Hihn Road Preserve (brooms) • Mount Hermon (brooms) • Newell Creek Sandhills Preserve (brooms)	• Exotic plants • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
		SAND-A5: Manage recreation that denudes sandhills plant communities and exposes soil	Prioritize recreation management as outlined in Action 5 for the other objectives (SAND-A5's), with an emphasis on areas where management can expand or enhance focal, non-focal, and co-benefited species	• Incompatible recreation	• Ben Lomond spineflower • Ben Lomond wallflower

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		to erosion that removes habitat for rare species, and enhance sandhills habitat that has been degraded by incompatible recreation and attendant erosion.	habitat and increase the size and resilience/persistence of populations. Priorities for recreation management include: • Henry Cowell Redwoods State Park • Newell Creek Sandhills Preserve • Quail Hollow Ranch County Park • Bonny Doon Ecological Reserve		• Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
	SAND-O8: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained	**SAND-A6: Conduct species-specific actions** including surveys, captive breeding/rearing programs, seed banking and seed bulking, and other actions, where needed to supplement habitat protection, restoration, and management and enhancement actions, to ensure the persistence of species.	Prioritize actions for populations of rare species that are: • Declining despite efforts to promote them using habitat protection, restoration, management, and enhancement methods; and • Will likely be extirpated if the population-specific actions are not implemented. Species that should be prioritized for targeted management include: • Santa Cruz kangaroo rat, which should be reintroduced, into areas large areas of suitable habitat, where feasible; • Ben Lomond wallflower, which should be subject to seed banking and additional reintroductions; and • Zayante band-winged grasshopper, which should be reintroduced to expand its population and increase resiliency (as describe in the Zayante band-winged grasshopper conservation strategy).	• Development • Mining/quarrying • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
		SAND-A7: Conduct surveys and long-term monitoring of rare species, sensitive communities, and other sensitive habitats to inform conservation and management	Prioritize projects that: • Increase understanding of the conservation and management needs of rare species and sensitive natural communities and habitats (e.g., sand parkland) • monitor the effects of climate change including to help identify climate change adaptation strategies.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

5.3.11 Zayante Band-Winged Grasshopper

Zayante Band-Winged Grasshopper

State and Federal Status: Federally Endangered

Global Rank: G1 **State Rank:** S1

Detailed Species Accounts

Arnold 2004

USFWS 2009

Distribution and Range

- Endemic to Zayante sand soils in central Santa Cruz County (Figure 5-12)

Key Ecological Requirements

- Zayante band-winged grasshopper (*Trimerotropis infantilis*) is endemic to the Santa Cruz Sandhills where it primarily occurs in open, sunlit areas that are sparsely vegetated within sand parkland communities; the species also occurs in large canopy gaps within sandhills chaparral communities and inhabits former sand mines where sufficient loose sand soil remains on the surface (Arnold 2004, McGraw 2013, McGraw et al. 2020).
- The species is known from only five areas where it is estimated to occupy less than 400 acres (McGraw 2019).
- The univoltine species has a one-year life cycle: nymphs mature through five instars during spring and early summer, the adult flight season is generally June to October, and eggs overwinter in the soil where they are laid in open sand (USFWS 2001).
- Zayante band-winged grasshopper feeds on silver bush lupine (*Lupinus albifrons* var. *albifrons*) and golden aster (*Heterotheca sessiliflora* ssp. *echioides*), as well as grasses (Poaceae); it may also feed on other herbaceous plants (Chu 2002).

- Most adult males are quite sedentary, with home ranges of no more than a few acres; dispersal distances averaged 91 and 123 feet and maximum dispersal distance was 930 feet (Arnold 2004).
- While open habitat can persist in some areas that are resistant to dense exotic plants and woody native plants, both of which reduce suitability of ZBWG habitat, many require disturbances including fire, which maintains open canopy conditions, and soil disturbances including slides, trails, and gopher mounds, which create and maintain loose sand soil preferentially used by the species (McGraw 2013, McGraw et al. 2019).
- Reduction in open sandy habitat due to disruption of natural disturbance regimes and the invasion and spread of exotic plants threaten persistence of the species.

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting ZBWG, which include the following most critical ones:

- Zayante band-winged grasshopper is threatened by all of the pressures and stressors that affect the sandhills/sand parkland element. Specifically:
    - Loss and fragmentation of sandhills (incl. sand parkland) due to development, mining, and agriculture (primarily viticulture);
    - Fire exclusion, which reduces the area of open, earlier successional habitat (e.g., eliminates canopy gaps) and allows leaf litter to accumulate on the soil surface;
    - Invasion and spread of dense exotic plants, including herbaceous species that create dense cover and thatch, as well as invasive shrubs and trees (e.g., French broom, Portuguese broom, and silver wattle) that exclude the species (McGraw 2013); and
    - Recreation that is frequent, intense, or occurs on steep slopes and thus can trample the species (which has low vagility) or its host plants and can cause excessive erosion that degrades habitat; seasonally timed, infrequent, and low-intensity recreation may help maintain loose sand soil required by the species.
- Habitat fragmentation has isolated remaining populations, which limits migration including in response to climate change, and necessitates active translocations to re-establish populations in areas where they have been extirpated.

Climate Change Vulnerability Assessment

There have been no prior climate change vulnerability analyses for ZBWG. However, the species is anticipated to have high exposure and sensitivity to anticipated temperature increases and highly variable precipitation (including drought) and have low adaptive capacity.

- Sensitivity: Projected climate changes are anticipated to impact ZBWG by stressing individuals directly and reducing the abundance of host plants.

  - Long-term population monitoring in the largest remaining population found that ZBWG abundance has tracked rainfall, with population estimates declining during the two multi-year droughts this century (McGraw et al. 2020).
  - Continued declines following the return of above-average rainfall suggest that the well-above average annual temperatures since 2012 may also be causing population declines (McGraw et al. 2020).
  - High rainfall promotes dense exotic plants in the sand parkland (McGraw 2004), which degrade ZBWG habitat at least temporarily.

- Adaptive Capacity: ZBWG are endemic to outcroppings of Zayante soil found only in central Santa Cruz County. Moreover, they have limited dispersal (Arnold 2004). As result, this species cannot migrate/disperse along landscape gradients in latitude and elevation to stay within its adapted climatic envelope.

The goals, objectives, actions, and priorities for the Zayante band-winged grasshopper (Table 5-14) will help address the impacts of climate change on this species by:

1. Protecting additional habitat, including lands that contain climate refugia for this species, such as cooler microclimates (e.g., north-facing slopes) where Zayante band-winged grasshopper can stay with their 'adapted climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of the ZBWG population, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and recreation;
4. Increasing habitat connectivity, by protecting habitat that can connect existing protected lands, and restoring and managing habitat to increase its suitability for species and thus its permeability for their movement, to enable ZBWG to migrate to stay within their adapted climate envelope;
5. Introducing the rare species into suitable but unoccupied habitat to increase populations and reduce the potential for extirpations or extinction; and
6. Conducting research and long-term monitoring to increase understanding of population trends and their drivers, including climate change impacts.

Species Associated with the Zayante Band-Winged Grasshopper

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-14 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*) [NF]

- Ben Lomond (Santa Cruz) wallflower (*Erysimum teretifolium*) [NF]
- Santa Cruz cypress (*Hesperocyparis abramsiana*) [NF]
- Mount Hermon June beetle (*Polyphylla barbata*) [NF]

Other Actions that Benefit this Species

Zayante band-winged grasshopper will benefit from actions to achieve the goals for the Sandhills/Sand Parkland Conservation Element, where they occur in sand parkland or other suitable habitat for this species; specifically, the species will benefit from actions SAND-A1 through SAND-A7.

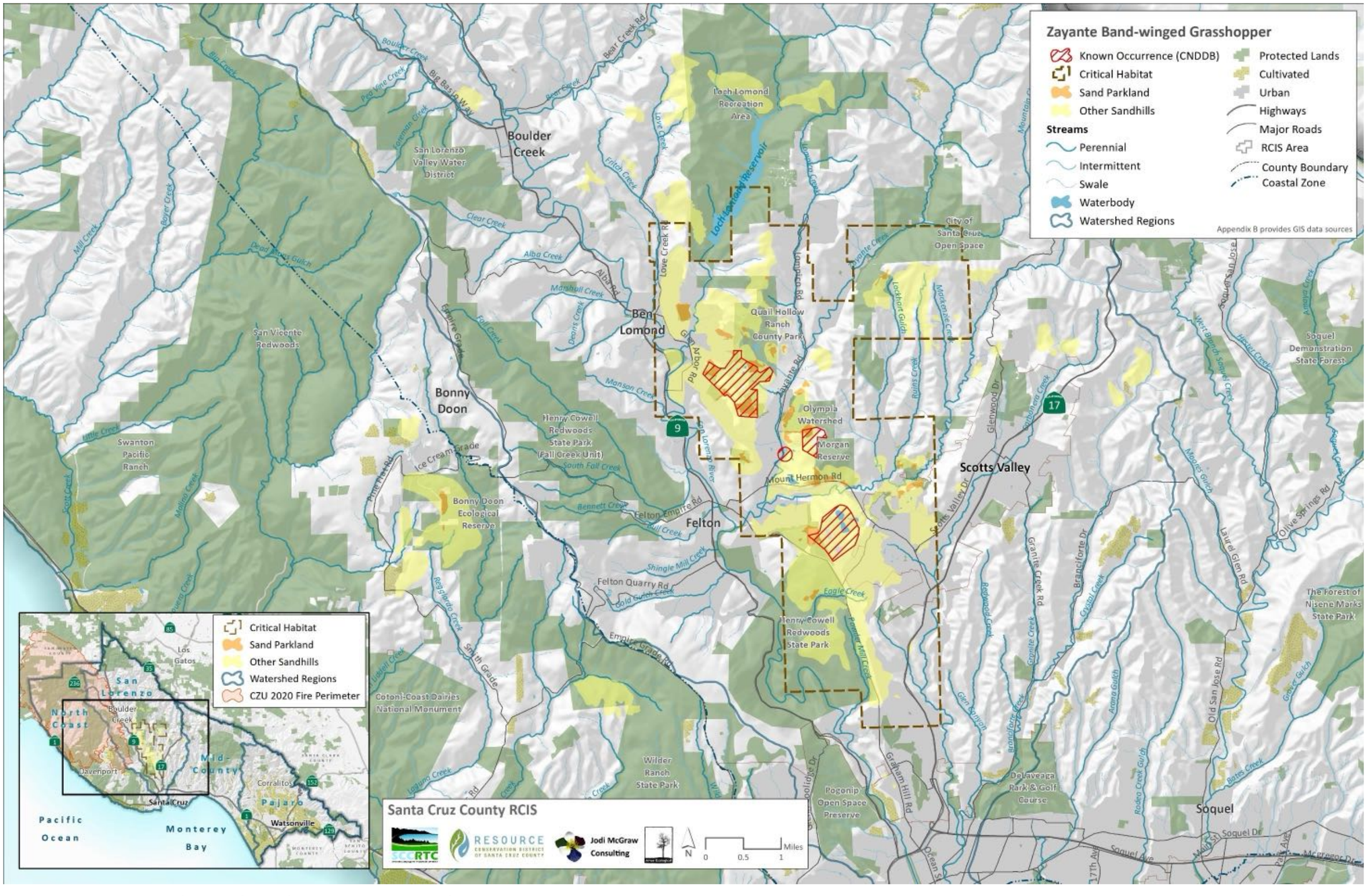

Figure 5-12: Zayante Band-Winged Grasshopper Conservation Element

Table 5-14: Conservation Strategy for Zayante Band-Winged Grasshopper

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
ZBWG-G1: Promote the recovery and long-term persistence of Zayante band-winged grasshopper (ZBWG).	**ZBWG-O1**: Protect at least 81 additional acres of sand parkland (to achieve the 90% protection target for this community; Table 5-3) and 90% of the additional habitat that is suitable for, or could be restored or enhanced to support ZBWG, including open habitat in former sand quarries. Measure progress toward this objective based on the acres of habitat protected.	**ZBWG-A1: Protect Habitat:** Use fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses and to enable active restoration and management of ZBWG and other rare species populations.	Prioritize habitat as outlined in Action 1 of the Sandhills conservation strategy (SAND-A1's) that: • Supports one of the five existing populations; • Can expand or connect existing protected lands supporting the species; and/or • Can be used to establish a new population, including by protecting suitable but unoccupied habitat, or protecting habitat that could be made suitable through restoration or enhancement.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Climate change	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

	ZBWG-O2: Restore and enhance habitat to promote ZBWG population distribution, abundance, and persistence. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**ZBWG-A2: Restore habitat** that has been degraded by prior land use (including sand mining).	Prioritize habitat as outlined in Action 2 of the Sandhills conservation strategy (SAND-A2's) that can expand ZBWG distribution and abundance, connect or buffer existing protected habitat for the species, and/or support large ZBWG populations. Specific priorities include:
			• Sandhills quarries, which are often adjacent to existing protected lands, naturally support (or can feasibly be restored to support) ZBWG, and are large, and thus can greatly increase and connect ZBWG populations. Specific priorities include:
			  ○ Olympia Quarry
			  ○ Hanson Quarry
			  ○ Quail Hollow Quarry
			  ○ Randall Morgan Preserve (mined areas)
			  ○ Olympia Watershed Property (mined areas)
			• Areas that are permanently protected or where restoration benefits can otherwise be maintained.
				• Development
				• Mining/quarrying
				• Working lands
				• Incompatible recreation
				• Exotic plants
				• Altered disturbance regimes
				• Climate change
					• Ben Lomond spineflower
					• Ben Lomond wallflower
					• Mount Hermon June beetle
					• Zayante band-winged grasshopper
					• Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		ZBWG-A3: Manage fire and vegetation to address the effects of altered disturbance regimes, and restore open canopy, bare mineral soil conditions suitable for ZBWG.	Prioritize areas in the following order: • Areas of sand parkland invaded by exotic plants, where removing leaf litter and dense exotics can promote use by ZBWG; and then • Areas of dense sand parkland where removing litter and native plants that are dense due to fire exclusion can promote ZBWG populations.	• Altered disturbance regimes	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

		ZBWG-A4: Manage invasive plants including shrubs and trees as well as dense occurrences of herbaceous exotic plants that degrade habitat for ZBWG.	Prioritize areas of sand parkland and other open habitat within or adjacent to existing occupied habitat that could support (larger) populations of ZBWG, including:
			• Areas of open habitat invaded by brooms and acacias including:
			  ○ Olympia Watershed Property
			  ○ Morgan Preserve
			  ○ Sandhills quarries
			• Areas of open habitat with dense cover of herbaceous exotics, including:
			  ○ Dowd Preserve
			  ○ Bean Creek Preserve
			  ○ Morgan Preserve
			  ○ Hihn Road Preserve
				• Exotic plants	• Ben Lomond spineflower
					• Ben Lomond wallflower
					• Mount Hermon June beetle
					• Zayante band-winged grasshopper
					• Numerous co-benefited species

		ZBWG-A5: Manage recreation to maintain or enhance the habitat suitability and promote persisting populations of ZBWG.	Prioritize areas where: • ZBWG habitat is being degraded by incompatible recreation, including uses that are too frequent and/or intense, denuded larger areas, and/or cause erosion. • Well-managed recreation can help maintain areas of open, loose sand soil by knocking back dense cover of exotic herbaceous plants, but where recreation impacts will not impede completion of the species life history (e.g., survival of eggs).	• Altered disturbance regimes • Incompatible recreation • Exotic plants	• Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
	ZBWG-O3: Establish new ZBWG populations throughout suitable habitat within the sandhills, in a range of microclimates to promote	**ZBWG-A6: Reintroduce ZBWG** into protected areas featuring suitable but unoccupied habitat, or habitat that can be made suitable through restoration and enhancement.	Establish new populations of ZBWG within: • the Bonny Doon Ecological Reserve; • any unoccupied former sand quarries within the San Lorenzo Valley; and • Other conserved sandhills habitat that feature suitable but unoccupied habitat, and where natural dispersal is	• Development • Mining/quarrying • Working lands • Incompatible recreation • Climate change	• Zayante band-winged grasshopper

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	species persistence in the face of a changing climate. Measure progress toward this objective based on the number of new populations.		precluded by barriers including development and non-habitat; • Areas that feature a range of microclimatic conditions including north, west, and east-facing slopes, that will be cooler and perhaps confer resiliency will in the anticipated hotter climate.		
	ZBWG-O4: Increase understanding of ZBWG populations to inform conservation and management.	**ZBWG-A7: Conduct research and long-term monitoring** to increase understanding of population trends and their drivers, including climate change impacts.	• Assess the effects of climate change, to identify climate change refugia and inform other climate adaptation strategies; • Increase understanding of microhabitat specificity including the roles of abiotic conditions, including microclimate and soils, and plant species composition, to inform efforts to reintroduce populations (ZBWG-A6).	• Development • Mining/quarrying • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Zayante band-winged grasshopper

5.3.12 Grasslands

Grasslands

Status and Rarity

- Sensitive Community: Coastal tufted hair grass – Meadow barley – California oatgrass wet meadow (41.221.00): GNR, S3
- County of Santa Cruz Sensitive Habitat
    - mapped native and mixed native grassland in the coastal zone
    - grasslands that support rare end locally unique species
- May be an Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

Stromberg et al. 2007

Eviner 2016

CNPS 2021

Distribution and Range

- 14,715 acres (5.2% of the RCIS Area; Figure 5-13)
- Grasslands occur patchily throughout the RCIS Area, but are concentrated in the following areas:
    - North Coast marine terraces
    - Hills surrounding the Pajaro Valley

Key Ecological Elements

- The RCIS Area includes native grasslands, including coastal prairies and wet meadows, which feature native perennial grasses such as California oatgrass (*Danthonia californica*) along the coast, and purple needle grass *(Stipa pulchra*) in the foothills.
    - These native grasslands oftentimes support diverse assemblages of native forbs and occur on soils that are seasonally saturated, including as a result of shallow bedrock (e.g., mudstone), clay pans or cemented soil horizons, such as Bonny Doon, Watsonville, Tierra, Elkhorn, Santa Inez, and Pinto soil series.
    - Native grasslands primarily occur on marine terraces on the North Coast, the foothills of the Santa Cruz Mountains and other uncultivated areas in the Pajaro Valley; in Scotts Valley's Glenwood region, where mudstone underlies shallow loam soils; and in scattered pocket meadows underlain by bedrock in the San Lorenzo Valley where grasslands occur within a matrix of forest.
- The RCIS Area also features Soda Lake, an alkali grassland and wetland area that supports a locally unique and diverse assemblage of species adapted to saline conditions including saltgrass (*Distichlis spicata* var. *nana*), alkali heath (*Frankenia salina*), alkali weed (*Cressa truxillensis*), and *s*aline clover (*Trifolium hydrophilum*).
- The RCIS Area also features exotic-dominated grasslands (e.g., California annual grassland), which feature native forbs but low (or no) cover of native grasses. These grasslands occur in previously cultivated areas as well as forest clearings. Grassland species composition occurs along a continuum from native to exotic dominated.
- The grasslands, particularly those that are naturally occurring due to the soils and climate (as opposed to grasslands created through clearing shrublands and forests) support incredibly diverse assemblages of native plants. These include:
    - Special-status species, such as San Francisco popcornflower (*Plagiobothrys diffusus*), Pacific Grove clover (*Trifolium polyodon*), Scotts Valley spineflower (*Chorizanthe robusta* var*. hartwegii*), Scotts Valley polygonum (*Polygonum hickmanii*), Santa Cruz tarplant (*Holocarpha macradenia*); and
    - Undescribed taxa including new species and ecotypes, such as Scotts Valley bouquet clover (*Trifolium grayi* ssp. *nov*. 1), San Lorenzo Valley bouquet clover (*Trifolium grayi* ssp. *nov*. 2), *Gilia longituba* (SLV form).
- The grasslands (native and exotic dominated) also support diverse and important assemblages of native animals including:
    - Rare insects, such as the Opler's longhorn moth (*Adela oplerella*), Obscure Bumble Bee (*Bombus caliginosus*), western bumble bee (*Bombus occidentalis*), and the endemic Ohlone tiger beetle (*Cicindela ohlone*)
    - Numerous birds, such as Golden eagle (*Aquila chrysaetos*), White-tailed kite (*Elanus leucurus*), and Northern harrier (*Circus cyaneus*);

  - Other special-status species such as American badger (*Taxidea taxus*) and Pallid bat (*Antrozous pallidus*).
  - Keystone species such as California ground squirrel (*Otospermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), and American badger, which create burrows and soil disturbances (i.e., diggings) that create opportunities for native plant establishment and provide habitat for native animals, including California tiger salamander (*Ambystoma californiense*) and western burrowing owl (*Athene cunicularia*).

- Though some grasslands, including the seasonally wet grasslands or pocket meadows underlain by shallow bedrock, are 'edaphically controlled' stable climax communities, many others transition to northern coastal scrub communities in the absence of grazing, fire, or other disturbance that prevent establishment of/remove shrubs such as coyote brush (*Baccharis pilularis*) and California sagebrush (*Artemisia californica*). Grasslands and northern coastal scrub often occur on similar soils and as a mosaic of successional types (Ford and Hayes 2007) as occur in the RCIS Area.
- Grasslands and the species they support evolved in response to complex regimes of disturbance that include fire and animal diggings that, along with grazing by large ungulates (e.g., tule elk), played an important role in maintaining the open, herb-dominated structure and the diversity of plants and animals in the communities (Jackson and Bartolome 2007).
- The RCIS Area's grasslands occur within reach of the coastal fog, which some native species utilize for moisture in the summer (Corbin et al. 2005).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting grasslands in the RCIS Area, which include the following most critical ones:

- Habitat loss, which has converted much of the remaining grassland to development, particularly in and around the cities of Santa Cruz, Capitola, Scotts Valley, and Watsonville, and cultivation, which converted much of the remaining grassland habitat in the Pajaro Valley and the more gently sloped marine terraces on the North Coast.
- Habitat degradation due to the invasion and spread of exotic plants, including widespread exotic annual grasses and forbs that outcompete native grasses and forbs and convert native grasslands to exotic-dominated grassland (e.g., California annual grassland), and invasive shrubs and trees including French broom and eucalyptus which alter structure and species composition, outcompete rare plants, degrade habitat for rare animals, and increase soil nitrogen, and can promote fire as well as further exotic plant invasions.
- Alteration of the natural fire regime, including primarily fire exclusion which has led to accumulation of dense thatch that suppresses native plants, particularly forbs, and also

colonization by woody species and thus succession of grasslands to northern coastal scrub, particularly in ungrazed areas.

- Elimination of grazing animals, including native ungulates and livestock, which, in the absence of fire, can promote diversity of native grassland plants, particularly forbs (Hayes and Holl 2003) by reducing competition and accumulation of dense thatch, and prevent or slow succession of grassland to shrublands. At the same time, incompatible grazing by livestock can displace native plants and degrade habitat for native animals in some circumstances (Fleischner 1994).
- Incompatible recreation, including extensive/growing networks of trails that trample native plants and animals, including populations of rare species such as Scotts Valley spineflower and Ohlone tiger beetle, can cause erosion, and can facilitate the invasion and spread of exotic plants.

Climate Change Vulnerability Assessment

Coastal prairies and wet meadows in the Santa Cruz Mountains are moderately vulnerable to the effects of climate change (EcoAdapt 2021). This rating reflects the following.

- Exposure to projected temperature increases and highly variable precipitation including drought, which together can increase the climatic water deficit. Potential reduction in the frequency and duration of coastal summer fog (Johnstone and Dawson 2010) could exacerbate these effects; however, the effects of climate change on coastal fog in the region are uncertain (Langridge 2018).
- Sensitivity to changes. Specifically:
    - Drier conditions (increased climatic water deficit) could affect plant species adapted to seasonally wet conditions, such as many of the rare plants including San Francisco popcornflower and Scotts Valley spineflower;
    - Reduced precipitation could limit establishment of coyote brush, which could alternatively be increased by increases in precipitation (EcoAdapt 2021), thus exacerbating the effects of altered disturbance regime and cessation of grazing;
    - Increased invasion and spread by exotic grasses, which could be promoted by reductions in the cover of native perennial bunchgrasses due to reduced fog water or increased climatic water deficit;
    - Increased carbon dioxide as well as nitrogen (through N-deposition) are likely to influence plant species composition in grasslands (Hobbs et al. 2007).
    - Under a hotter and drier model, grasslands in the San Francisco Bay Area are anticipated to transition to shrublands or woodlands (Ackerly et al. 2015).
- Adaptive Capacity: Grassland systems and species are anticipated to have overall low adaptive capacity due to the following:

- Limited Distribution: Grasslands are generally rare, due to natural restrictions and widespread habitat conversion. Reductions in areal extent of grassland habitat reduces species populations, which renders species more vulnerable to expirations, and limits the diversity of microhabitat conditions, including potential climate refugia.
- Habitat Fragmentation: Remaining grassland habitat is fragmented, with many patches surrounded by development and cultivation as well as non-grassland vegetation, through which many grassland species may experience reduced dispersal ability. Habitat fragmentation also reduces the ability to manage grasslands with fire and/or grazing, which can be essential to their persistence.

The goals, objectives, actions, and priorities for the Grassland Conservation Element (Table 5-15) will help address the impacts of climate change by:

1. Protecting additional habitat, including lands that contain climate refugia, such as cooler microclimates (e.g., north-facing slopes) that can help species stay with their 'climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, elimination of natural ungulate populations (i.e., using conservation grazing), exotic plants, and incompatible recreation;
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat to increase its suitability for species and permeability for their movement, to enable them to migrate to stay within their adapted climate envelope;
5. Introducing rare species into suitable but unoccupied habitat to increase populations and reduce the potential for extirpations or extinctions; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-15 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*) [NF]
- Santa Cruz tarplant (*Holocarpha macradenia*) [F]

- white-rayed pentachaeta (*Pentachaeta bellidiflora*) [NF]
- San Francisco popcornflower (*Plagiobothrys diffusus*) [NF]
- Scotts Valley polygonum (*Polygonum hickmanii*) [NF]
- Pacific Grove clover (*Trifolium polyodon*) [NF]
- western bumble bee (*Bombus occidentalis*) [NF]
- Ohlone tiger beetle (*Cicindela ohlone*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- California tiger salamander (*Ambystoma californiense*) [F]
- San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) [NF]
- Southwestern pond turtle (*Actinemys pallida*)
- Golden eagle (*Aquila chrysaetos*) [NF]
- Swainson's hawk (*Buteo swainsoni*) [NF]
- White-tailed kite (*Elanus leucurus*) [NF]
- American peregrine falcon (*Falco peregrinus anatum*) [NF]
- Tricolored blackbird (*Agelaius tricolor*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

The Grassland Community, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Ponds, Lakes, and Reservoirs:** Actions to protect, restore, and enhance upland habitat for landscape connectivity conducted as part of PLR-A14 through PLR-A18;
- **Freshwater Wetlands:** Actions to protect, restore, and enhance upland habitat for landscape connectivity conducted as part of FW-A14 through FW-A16; and
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of grassland communities as part of CONNECT-A1 through CONNECT-A4.

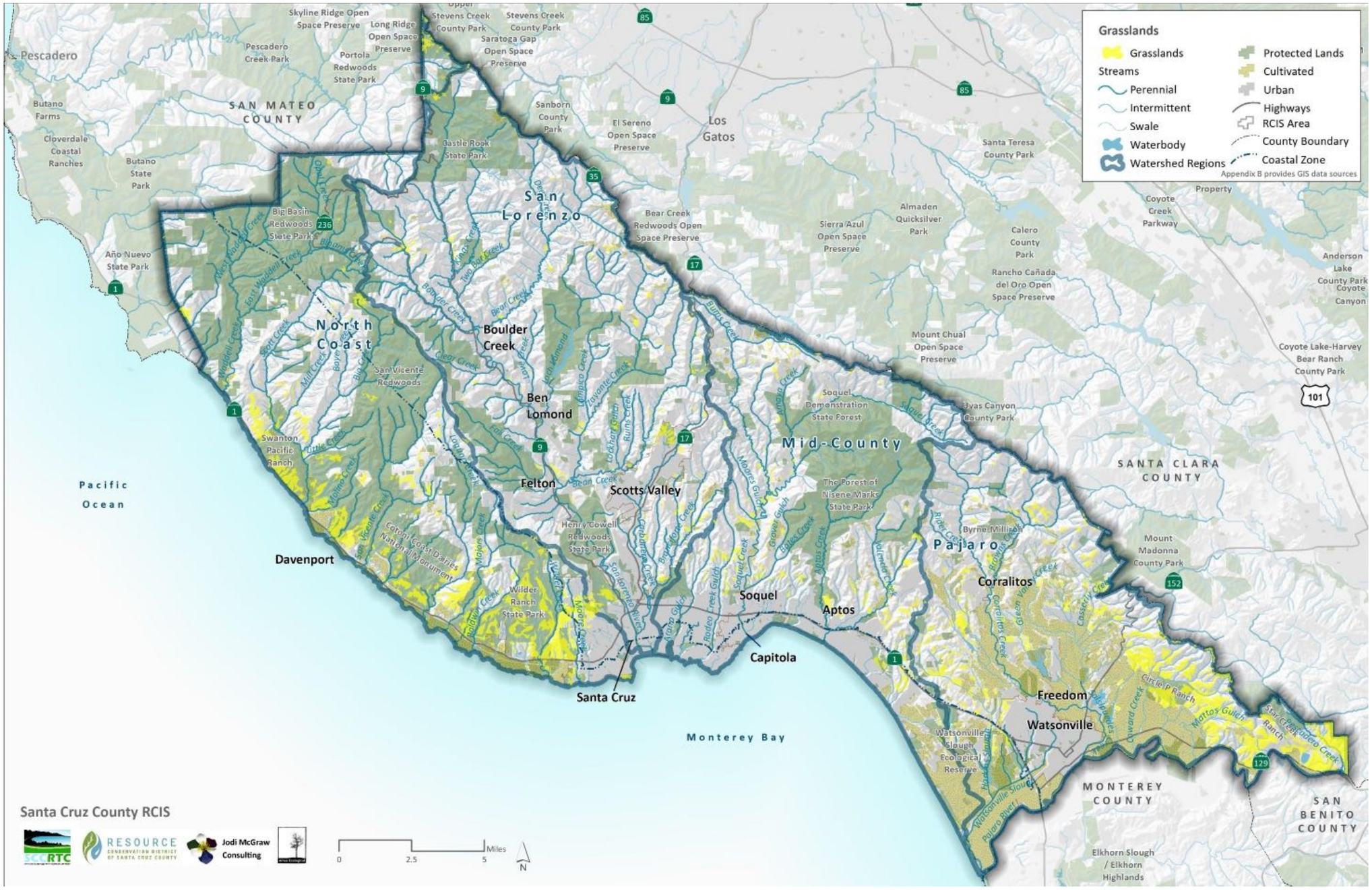

Figure 5-13: Grasslands Conservation Element

Table 5-15: Conservation Strategy for Grasslands

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
GRASS-G1: Promote persistence and ecological integrity of grasslands, the rare species they support, and the ecological processes that sustain them.	**GRASS-O1:** Protect at least 8,582 additional acres of grassland to achieve the 90% target for conservation of this community (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**GRASS-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that: • Support rare species and diverse assemblages of locally unique species, as outlined in for Action 1 for Objective 6 (GRASS-O6 GRASS-A1); • Support native grasses and/or forbs at relatively high abundance; • are identified as priorities in prior plans including the numerous recovery plans for the listed species that rely upon or utilize grasslands, areas of designated critical habitat, and the Conservation Blueprint for Santa Cruz County (Mackenzie et al. 2021); • can buffer and expand existing protected grasslands or other natural communities, or can otherwise contribute to the conservation of large blocks of habitat that can be actively managed using grazing and fire; • can ensure grasslands are protected throughout the RCIS Area, by protecting habitat where little has been protected (e.g., the Pajaro Hills) • can facilitate species adaptation to climate change, including: • feature climate refugia (e.g., seeps, springs, and wetlands; north-facing slopes, etc.); • a range of land facets due to variable topography and soils; and/or • can help connect existing protected habitat to facilitate species migration.	• Development • Mining/quarrying • Working lands • Exotic plants • Incompatible recreation • Unauthorized activities • Climate change	• All focal and non-focal grassland species could benefit, depending on specific area addressed: • San Francisco popcorn flower • Santa Cruz tarplant • Scotts Valley spineflower • Scotts Valley polygonum • White-rayed pentachaeta • Pacific Grove clover • Western bumble bee • Ohlone tiger beetle • California red-legged frog • California tiger salamander • San Fracisco garter snake • Southwestern pond turtle • Golden eagle • Swainson’s hawk • White-tailed kite • American peregrine • Tricolored blackbird • Mountain lion • Numerous co-benefited species
	GRASS-O2: Restore and enhance grasslands to promote natural structure and native species composition and ecosystem functions where they have been degraded or eliminated through prior land use (e.g., cultivation and development). Measure	**GRASS-A2: Restore habitat** that has been degraded by prior land uses, by addressing altered soils, exotic plants, altered fire regimes, cessation of grazing, and/or recreation impacts including erosion, to recreate native grassland structure, promote diverse native plant assemblages, and increase suitability of habitat	Prioritize the following areas for restoration: • Habitat that, if restored, can support rare grassland species, to expand their distribution and abundance; • Areas that can connect or buffer existing protected grassland habitat; and • areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained). • Specific priorities include grassland habitat important for rare species in the following areas:	• Development • Mining/quarrying • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• As in GRASS-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	progress toward this objective based on the acres of habitat restored or enhanced.	for rare plant and animals species.	○ North Coast (e.g., Cotoni-Dairies National Monument, Wilder Ranch); ○ Coastal terraces including near Santa Cruz (e.g., UCSC, Moore Creek Preserve, Arana Gulch, Santa Cruz Gardens); ○ Scotts Valley/Glenwood region (Glenwood Preserve, etc.); ○ Soquel Hills (e.g., Anna Jean Cummings Park, etc.) ○ Watsonville Slough region (e.g., Struve Slough); and ○ Pajaro Hills.		
		GRASS A3: Manage vegetation using fire, including cultural burning where appropriate, and/or grazing as well as other treatments that mimic the beneficial effects of fire and grazing to: 1) maintain open habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) reduce populations of exotic plants including grasses; 3) create and maintain a mosaic of native plant assemblages of various habitat conditions to maximize gamma (landscape) diversity, and 4) maintain a range of microclimatic and other abiotic conditions that can facilitate adaptation to a changing climate.	Prioritize grassland management in the following areas: • Where succession is causing grasslands to transition to shrublands or woodlands, and causing extirpation of species that require herb-dominated communities open. Examples include: • Prevent succession of grassland to northern coastal scrub, or restore grassland from northern coastal scrub; • Control encroachment of trees including hardwoods and Pacific Douglas-fir into pocket meadows surrounded by forest; • Grasslands that feature dense cover of exotic herbaceous plants, where fire and/or grazing can reduce exotic cover and promote the cover and diversity of native forbs. • Where rare species have been extirpated or are near extirpation due, at least in part, to unnatural succession and/or dense thatch and exotic plants, in the absence of fire and grazing animals, but where grassland management and facilitate their re-establishment alone or as part of a reintroduction.	• Altered disturbance regimes (Fire)	• San Francisco popcorn flower • Santa Cruz tarplant • Scotts Valley spineflower • Scotts Valley polygonum • White-rayed pentachaeta • Western bumble bee • Ohlone tiger beetle • California tiger salamander • Southwestern pond turtle • Tricolored blackbird • Golden eagle • White-tailed kite • Numerous co-benefited species
		GRASS-A4: Manage invasive plants and dense exotic plants which alter grassland community structure, and impact native species populations.	Prioritize actions that: • Eradicate or control invasive brooms, acacias, eucalyptus, or other woody species, and herbaceous species like jubata grass that the structure and species composition of grasslands and increase their risk of unnatural fire; • 'tip the balance' of competition between native and exotic herbaceous plants, to increase the cover and diversity of native grasses and forbs; • Prevent the invasion and spread of new invaders that can alter grassland structure, species composition, or ecosystem processes, including by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes	• As in GRASS-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		GRASS-A5: Manage recreation that denudes grasslands and exposes soil to erosion which removes habitat for rare species, and enhance grasslands that have been degraded by attendant recreation and erosion.	Prioritize actions that: • Manage recreation in public lands with ecologically significant grassland communities, particularly those impacted by incompatible uses, including: Wilder Ranch State Park, University of California at Santa Cruz, and Cotoni-Coast Dairies National Monument, so that human activity is compatible with protection of sensitive grassland communities and the rare species they support. • Prioritize recreation management in areas where incompatible use have removed habitat for rare species by denuding habitat and/or causing erosion. • Limit the extent and effects of unauthorized recreational uses within grasslands that are degraded habitat or negatively impacting rare species populations by regulating access using signage, fences (including symbolic fences), designated trails, patrols, and associated outreach to recreators.	• Incompatible recreation • Unauthorized activities	• As in GRASS-A1
GRASS-G2: Maintain and enhance connectivity of grassland communities as well as their connectivity to adjacent habitat including ponds and wetlands to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**GRASS-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**GRASS-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize land as outlined for Action 1 for Objective 1 (GRASS-O1 GRASS-A1) and that can connect and expand protected grasslands, as well as intact other natural communities connecting them, and contribute to regional connectivity. Priority areas to connect include: • Grasslands within the identified connectivity areas, including the landscape linkages, large habitat areas, and areas to maintain permeability between the large habitat areas. These include the extensive grasslands in the Pajaro Hills, which are in the landscape linkage connecting the Santa Cruz Mountains to the adjacent Gabilan and Diablo ranges; • Grasslands between Pogonip and Wilder Ranch State Park, including unprotected grasslands within UCSC; • Grasslands between Wilder Ranch State Park and Cotoni-Coast Dairies National Monument. Also prioritize lands that can maintain connectivity between grasslands and adjacent ponds, streams, and wetlands, including the Watsonville Slough System, to maintain connectivity between grasslands and adjacent aquatic habitat, which is important for pond-breeding species.	• Development • Mining/quarrying • Working lands • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• As in GRASS-A1
	GRASS-O4: Restore degraded grasslands to promote habitat connectivity and dispersal between core habitat	**GRASS-A2: Restore Habitat** that has been degraded by prior land uses, by addressing altered soils, exotic plants, altered fire regimes, cessation	Prioritize areas where restoration can connect grasslands habitat as outlined for Action 2 for Objective 2 (GRASS-O1 GRASS-A2).	• Development • Mining/quarrying • Working lands	• As in GRASS-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	of grazing, and/or recreation impacts including erosion, to recreate native grassland structure, promote diverse native plant assemblages, and increase suitability of habitat for rare plant and animals species.		• Altered disturbance regimes • Exotic species • Incompatible recreation • Unauthorized activities • Climate change	
	GRASS-O5: Enhance connectivity grassland habitat overall to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**GRASS-A3: Manage vegetation** using fire and/or grazing as well as other treatments that mimic the beneficial effects of fire and grazing to: 1) maintain open habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) reduce populations of exotic plants including grasses; 3) create and maintain a mosaic of native plant assemblages of various habitat conditions to maximize gamma (landscape) diversity, and 4) maintain a range of microclimatic and other abiotic conditions that can facilitate adaptation to a changing climate.	Prioritize areas where fire, grazing, or other grassland management as outlined in Action 3 for Objectives 2 and 3 (GRASS-O2 GRASS-A3 and GRASS-O3 GRASS-A3) and that can prevent unnatural succession that causes the following type conversions that reduce and fragment grasslands, including succession from grassland to northern coastal scrub and forest.	• Altered disturbance regimes • Climate change	• San Francisco popcorn flower • Santa Cruz tarplant • Scotts Valley spineflower • Scotts Valley polygonum • White-rayed pentachaeta • Western bumble bee • Ohlone tiger beetle • California tiger salamander • Southwestern pond turtle • Golden eagle • Swainson's hawk • White-tailed kite • Tricolored blackbird • American peregrine • Numerous co-benefited species
GRASS-G3: Promote the recovery and long-term persistence of rare species.	**GRASS-O6:** Protect habitat occupied by, or suitable for, rare species in grasslands. Measure progress toward this objective based on the acres of habitat protected.	**GRASS-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties as outlined in Action 1 for Objectives 1 and 3 (GRASS-O1 GRASS-A1 and GRASS O3 GRASS A-1) with an emphasis on habitat that supports, or provides suitable habitat for, focal, non-focal, and co-benefited species and diverse assemblages of locally unique species, are within designated critical habitat, and can expand, buffer, and connect existing protected lands, where possible. Specific priorities include: • Remnant Scotts Valley grasslands, which are essential to the persistence of Scotts Valley polygon and Scotts Valley spineflower, can help recovery Ohlone tiger beetle, and can conserve other locally unique species including the undescribed Scotts Valley bouquet clover (*Trifolium grayi* ssp. *nov*. 1);	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• As in GRASS-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Remaining grassland habitat at UC Santa Cruz and that is outside of the natural reserve, that supports several special-status plants and Ohlone tiger beetle; • Pajaro Hills grasslands that support rare grassland plants and animals as well as important raptor assemblances, and occur within an essential landscape linkage; • Pocket meadows within the San Lorenzo Valley, several of which support rare species found nowhere else, including San Lorenzo Valley bouquet clover (*Trifolium grayi* ssp. nov. 2). • The rare alkali grassland and associated wetlands in the Soda Lake area.		
	GRASS-O7: Restore habitat to enhance population size and persistence of rare species in grasslands. Measure progress toward this objective based on the number of rare species populations increased or maintained or the acres of habitat restored.	**GRASS-A2: Restore Habitat** that has been degraded by prior land uses, by addressing altered soils, exotic plants, altered fire regimes, cessation of grazing, and/or recreation impacts including erosion, to recreate native grassland structure, promote diverse native plant assemblages, and increase suitability of habitat for rare plant and animals species.	Prioritize restoration as outlined in Action 2 for Objectives 2 and 3 (GRASS-O2 GRASS-A2 and GRASS-O3 GRASS-A2) with an emphasis on restoring areas to provide suitable habitat for, and where possible, support populations of, the focal, non-focal, and co-benefited species and diverse assemblages of locally unique species. Priority areas include previously cultivated areas that can be restored to grassland, particularly on the North Coast.	• Development • Mining/quarrying • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• As in GRASS-A1
		GRASS-A3: Manage vegetation using fire and/or grazing as well as other treatments that mimic the beneficial effects of fire and grazing to: 1) maintain open habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) reduce populations of exotic plants including grasses; 3) create and maintain a mosaic of native plant assemblages of various habitat conditions to maximize gamma (landscape) diversity, and 4) maintain a range of microclimatic and other abiotic conditions that	Prioritize management of fire, grazing, or grassland as outlined in Action 3 for Objectives 2 and 3 (GRASS-O2 GRASS-A3 and GRASS-O3 GRASS A3), with an emphasis on areas where management can expand or enhance focal, non-focal, and co-benefited species habitat and increase the size and resilience/persistence of populations. Priorities include: • Remnant patches of grassland in Scotts Valley, where managed grazing or other disturbance is needed to recover Scotts Valley spineflower, Scotts Valley polygonum, and Ohlone tiger beetle, among other species; • Grassland near the City of Santa Cruz, including the Moore Creek Preserve region, Thurber Lane Area, and Graham Hill Road Showgrounds region, where cessation of grazing has led to declines and extirpations of rare plants including San Francisco popcorn flower and Santa Cruz tarplant, and Ohlone tiger beetle.	• Altered disturbance regimes • Climate change	• San Francisco popcorn flower • Santa Cruz tarplant • Scotts Valley spineflower • Scotts Valley polygonum • White-rayed pentachaeta • Western bumble bee • Ohlone tiger beetle • California tiger salamander • Southwestern pond turtle • Golden eagle • Swainson's hawk • White-tailed kite

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		can facilitate adaptation to a changing climate.			• Tricolored blackbird • Numerous co-benefited species
		GRASS-A4: Manage invasive plants and dense exotic plants which alter grassland community structure, and impact native species populations.	Prioritize invasive and exotic plant management as outlined in Action 4 for Objective 2 (GRASS-O2 GRASS-A4), with an emphasis on areas where management can expand or enhance focal, non-focal, and co-benefited species habitat and increase the size and resilience/persistence of populations. Priorities for exotic plant management include: • Control of French broom in UCSC and other North Coast Grasslands; and • Controlling dense cover of exotic grasses and invasive forbs that are causing rare plant extirpations in areas that are ungrazed and unburned, including portions of the grasslands in Scotts Valley, the Pajaro Hills and Pajaro Valley, and in and around the City of Santa Cruz, and the North Coast.	• Exotic plants • Climate change	• As in GRASS-A1
		GRASS-A5: Manage recreation that denudes grasslands and exposes soil to erosion which removes habitat for rare species, and enhance grasslands that have been degraded by attendant recreation and erosion.	Prioritize recreation management as outlined in Action 5 for Objective 2 (GRASS-O2 GRASS-A5), with an emphasis on areas where management can expand or enhance focal, non-focal, and co-benefited species habitat and increase the size and resilience/persistence of populations. Priorities for recreation management include: • Wilder Ranch State Park; • UCSC (Upper Campus); and • Arana Gulch.	• Incompatible recreation • Unauthorized activities	• As in GRASS-A1
	GRASS-O8: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**GRASS-A6: Conduct species-specific actions** including surveys, captive breeding/rearing programs, seed banking and seed bulking, and other actions, where needed to supplement habitat protection, restoration, and management and enhancement actions, to ensure the persistence of rare species that rely on the grasslands in the RCIS Area to persist.	Prioritize actions for populations of rare species that are: • Declining despite efforts to promote them using habitat protection, restoration, management, and enhancement methods; and • Will likely be extirpated if the population-specific actions are not implemented. • Grassland protection, restoration, and management/enhancement actions are anticipated to help recover many of the rare species populations and restore ecosystem functions. Exceptionally rare species that likely require species-specific actions include: • Glenwood area grassland species, including Scotts Valley spineflower and Scotts Valley polygonum, which is has an extremely limited areal extent and low abundance and is threatened with extinction and would benefit from an	• Development • Mining/quarrying • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• San Francisco popcorn flower • Santa Cruz tarplant • Scotts Valley spineflower • Scotts Valley polygonum • Ohlone tiger beetle • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			experimental reintroduction program to increase its distribution, abundance, and population persistence, as well as *ex situ* seed banking (if not already conducted); • Ohlone tiger beetle, Santa Cruz tarplant, San Francisco popcorn flower, and other species that have experienced extirpations that could lead to extinction, but will need to be reintroduced into habitat once conditions are restored (e.g., through fire, conservation grazing, exotic plant management, or other vegetation management); • Potentially endemic but undescribed taxa including Scotts Valley bouquet clover and San Lorenzo Valley bouquet clover, and Scotts Valley sandwort (*Sabulina californica*).		
		GRASS-A7: Conduct research and long-term monitoring to increase understanding of population trends and their drivers, including climate change impacts.	• Assess the effects of climate change, to identify climate change refugia and inform other climate adaptation strategies; • Increase understanding of microhabitat specificity to inform efforts to reintroduce populations (GRASS-A6).	• Development • Mining/quarrying • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• As in GRASS-A1

5.3.13 Santa Cruz Tarplant

Santa Cruz Tarplant

Status and Rarity

Federal Status: Threatened

State Status: Endangered

Global Rank: G1 **State Rank:** S1

Detailed Descriptions

USFWS 2014

Satterthwaite et al. 2007

Distribution and Range

- 99 acres (0.03% of the RCIS Area; Figure 5-14; USFWS 2014)
- 2,604 acres of designated critical habitat (Figure 5-14; USFWS 2002b)
- 14 natural populations in Santa Cruz and Monterey counties and four introduced populations in Contra Costa County (USFWS 2014)

Key Ecological Requirements

- Late-season annual plant found only in grasslands on coastal terraces below 330 feet, usually in sandy and fine-sandy loams (Watsonville, Tierra, Elkhorn, Santa Inez, and

Pinto soil series) on gentle slopes; these soils feature higher clay content and hold moisture longer than surrounding sandy soils, and are seasonally saturated (USWFS 2002b).

- Associated with native grasses such as needlegrass (*Stipa* spp.) and California oatgrass (*Danthonia californica*), and rare native species such as San Francisco popcorn flower (*Plagiobothrys diffusus*), Pacific Grove clover (*Trifolium polyodon*), and Ohlone tiger beetle (*Cicindela ohlone*), as well as non-native grasses such as wild oat (*Avena* spp.), barley (*Hordeum* spp.), rattlesnake grass (*Briza maxima*), bromes (*Bromus* spp.) and fescues (*Festuca* spp.).
- Preferentially occurs in short-statured, open grasslands with limited aboveground competition and thatch; such open conditions facilitate seedling establishment in spring (USFWS 2014).
- Populations feature a persistent seed bank (i.e., population of dormant seed in the soil) that is essential to the annual species' persistence and also acts as a 'genetic bank'; plants have germinated in the appropriate disturbance or environmental conditions 15 years after the seed was deposited (USFWS 2014).
- Experiments at Arana Gulch found that scraping, mowing, and prescribed burning all decreased thatch cover and exotic plant height, but scraping was most effective at promoting recruitment from the soil seed bank; mowing also promoted recruitment while burning did not (Bainbridge 2003).
- Appropriately timed mowing, clipping, grazing, or treatments must be conducted to promote performance (survivorship and reproduction) of plants that establish to avoid depleting the seed bank (Satterthwaite et al. 2007).
- Plants are self-incompatible and rely on gene flow for population growth and persistence (USFWS 2014).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting Santa Cruz tarplant, which include the following most critical ones:

- Santa Cruz tarplant is threatened by all of the pressures and stressors that affect the Grassland Element. Specifically:
    - Loss and fragmentation of grasslands due to development and cultivation;
    - The invasion and spread of exotic plants, including dense exotic grasses which create dense thatch that inhibits seedling establishment and otherwise compete with the rare plant;

  - Fire exclusion, which reduces the areal extent of grasslands by allowing succession to northern coastal scrub and oak woodland, and also facilitates accumulation of thatch;
  - Cessation of grazing, first by native ungulates and then by livestock, which helps reduce the height of the co-occurring species and maintain open ground that promotes seedling establishment;
  - Recreation that tramples the rare plants, creates compacted soil (e.g., along trails) that inhibits establishment, and fragments habitat;
- Habitat fragmentation, which has isolated remaining populations and limits gene flow in ways that could cause declines in reproduction as a result of self-incompatibility, inhibits migration including in response to climate change, and necessitates active reintroductions to re-establish populations in areas where they have been extirpated.
- Habitat and population management treatments that over-stimulate establishment from the seedbank without increasing survivorship and reproduction can deplete the seedbank, thus reducing the genetic diversity and population resilience (Satterthwaite et al. 2007).
- Non-native grey garden slug (*Deroceras reticulatum*) significantly reduced survivorship of seedlings (Maze 2009), and could thwart population introduction and enhancement efforts.

Climate Change Vulnerability Assessment

There have been no known climate change vulnerability analyses for Santa Cruz tarplant. However, the species is anticipated to have moderate exposure and sensitivity to anticipated temperature increases and highly variable precipitation (including drought) and have low adaptive capacity.

- Exposure: Projected temperature increases and highly variable precipitation including drought, could increase the climatic water deficit. Potential reduction in the frequency and duration of coastal summer fog (Johnstone and Dawson 2010) could exacerbate these effects; however, the effects of climate change on coastal fog in the region are uncertain (Langridge 2018).
- Sensitivity:
  - Drier conditions (increased climatic water deficit) could reduce survivorship and reproduction by reducing soil resource availability (i.e., soil moisture and nutrients conveyed to plants in soil water);
  - Reduced precipitation could limit establishment of coyote brush, which could be increased if precipitation increases (EcoAdapt 2021), thus exacerbating the effects of altered disturbance regime and cessation of grazing;

- Adaptive Capacity: Santa Cruz tarplant is anticipated to have low adaptive capacity due to the following:
    - Limited Distribution: The populations are small, which renders them more vulnerable to expirations, though this risk is reduced by a viable seed bank; the small areal extent of the current occurrences and remaining habitat limits the diversity of microhabitat conditions, including potential climate refugia.
    - Habitat Fragmentation: Remaining habitat is fragmented, with many patches sounded by development and cultivation as well as non-grassland vegetation, through which dispersal is likely very limited. Habitat fragmentation also reduces the ability to manage grasslands with fire and/or grazing, which can be essential to persistence.

The goals, objectives, actions, and priorities for Santa Cruz tarplant (Table 5-16) will help address the impacts of climate change by:

1. Protecting additional habitat, including lands that contain climate refugia, such as cooler microclimates (e.g., north-facing slopes) that can help species stay with their 'climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, elimination of natural ungulate populations (i.e., using conservation grazing), exotic plants, and incompatible recreation; and
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat to increase its suitability for species and permeability for their movement, to enable them to migrate to stay within their adapted climate envelope;
5. Increasing the size of populations, both aboveground and in the seed bank, to enhance their resiliency; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-16 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- white-rayed pentachaeta (*Pentachaeta bellidiflora*) [NF]
- San Francisco popcornflower (*Plagiobothrys diffusus*) [NF]
- Pacific Grove clover (*Trifolium polyodon*) [NF]
- Ohlone tiger beetle (*Cicindela ohlone*) [NF]
- western bumble bee (*Bombus occidentalis*) [NF]
- California tiger salamander (*Ambystoma californiense*) [F]
- San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) [NF]
- Southwestern pond turtle (*Actinemys pallida*) [F]
- Golden eagle (*Aquila chrysaetos*) [NF]
- Swainson's hawk (*Buteo swainsoni*) [NF]
- White-tailed kite (*Elanus leucurus*) [NF]
- American peregrine falcon (*Falco peregrinus anatum*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Species

Santa Cruz tarplant along with the associated focal and non-focal species will benefit from actions to achieve the goals and for the following additional conservation elements:

- **Grassland Element:** Actions to protection, restore/enhance, manage, and enhance connectivity in grassland communities as part of actions GRASS-A1 through GRASS-A6;
- **Ponds, Lakes, and Reservoirs**: Actions to protect, restore, and enhance upland habitat for landscape connectivity conducted as part of PLR-A14 through PLR-A18;
- **Freshwater Wetlands:** Actions to protect, restore, and enhance upland habitat for landscape connectivity conducted as part of FW-A8 through FW-A11; and
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of grassland communities supporting the rare species as part of CONNECT-A1 through CONNECT-A4.

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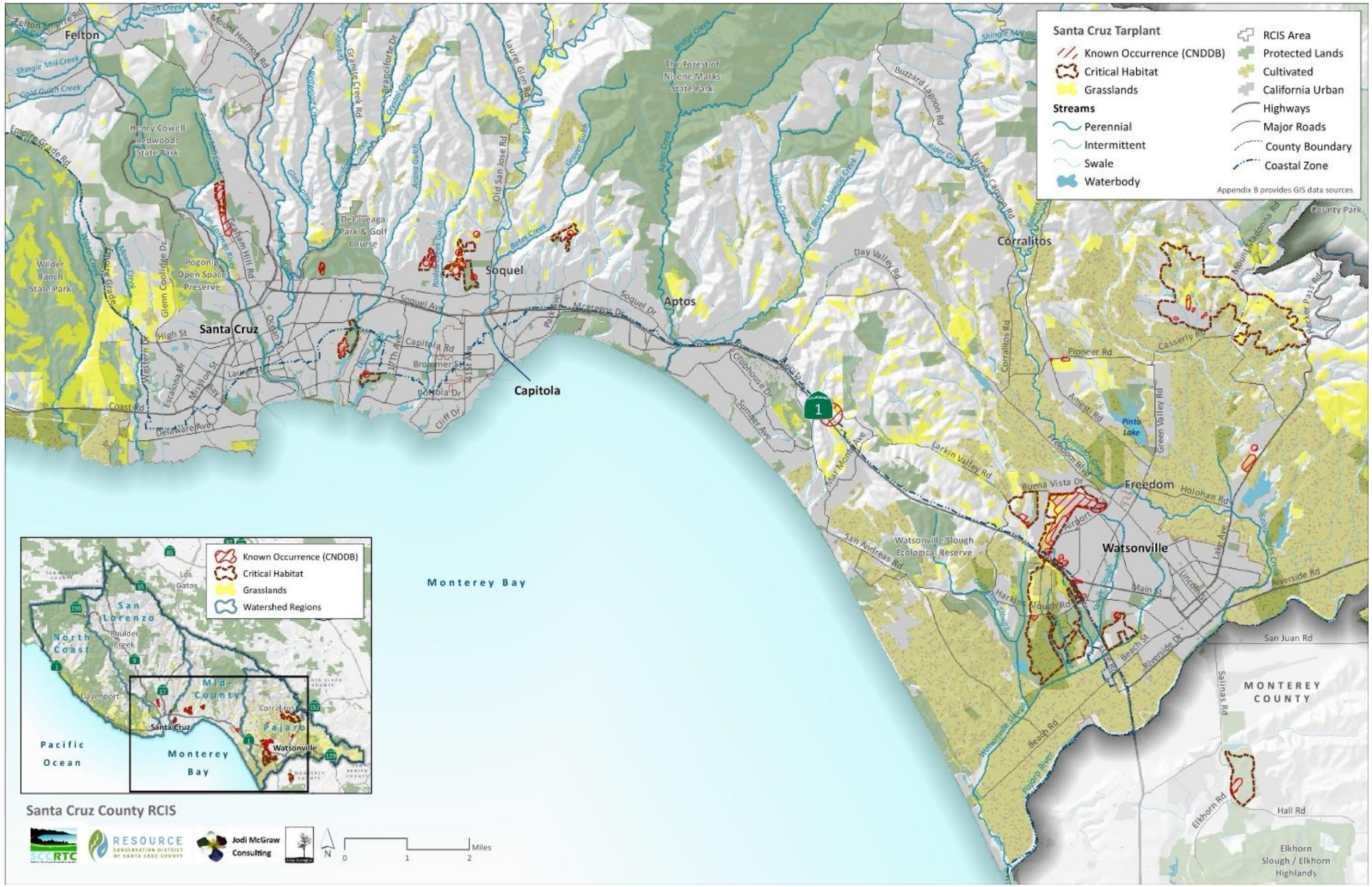

Figure 5-14: Santa Cruz Tarplant Conservation Element

Table 5-16: Conservation Strategy for Santa Cruz Tarplant

Goal	Objective	Action	Priorities	Pressures Addressed	Additional Species Potentially Benefited
TARPLANT-G1: Promote the recovery and long-term persistence of Santa Cruz tarplant.	**TARPLANT-O1:** Protect at least 564 additional acres of designated critical habitat for Santa Cruz tarplant to achieve the 90% protection target for this species (Table 5-3), or other habitat that is occupied by, suitable for, or could be restored or enhanced to support, Santa Cruz tarplant. Measure progress toward this objective based on the acres of habitat protected.	**TARPLANT-A1: Habitat Protection:** Use fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize grassland habitat for protection as outlined in the Action 1 for Objective 1 of the Grassland Conservation Strategy (GRASS-O1 GRASS-A1) that: • Contains an unprotected natural population of Santa Cruz tarplant with aboveground individuals or, secondarily, contain no aboveground individuals but feature a viable seed bank; • Can be used to establish a new population of Santa Cruz tarplant, including by protecting suitable but unoccupied habitat, or protecting habitat that could be made suitable through restoration or enhancement; • Can expand or connect existing protected lands supporting the species; and • Can be effectively managed using disturbance (fire, cattle grazing, mowing, or other techniques) to maintain suitable habitat and promote population persistence. • Are within areas designated as critical habitat (USFWS 2002b; Figure 5-14). • Protection priorities include unprotected habitat around the City of Watsonville (USFWS 2014).	• Development • Working lands • Altered disturbance regimes • Exotic plants • Incompatible recreation • Climate change	• Santa Cruz tarplant • White-rayed pentachaeta • San Francisco popcorn flower • Western bumble bee • Ohlone tiger beetle • California tiger salamander • Southwestern pond turtle • Golden eagle • Swainson's hawk • White-tailed kite • American peregrine falcon • Mountain lion • Numerous co-benefited species
	TARPLANT-O2: Restore and enhance habitat to promote Santa Cruz tarplant distribution, abundance, and population persistence. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**TARPLANT-A2: Restore habitat** that has been degraded by prior land use.	Prioritize grassland habitat for restoration as outlined in the Action 2 for Objective 2 of the Grassland Conservation Strategy (GRASS-O2 GRASS-A2), that can expand Santa Cruz tarplant distribution and abundance, connect or buffer existing protected habitat for the species, and/or support large populations of the rare plant. Priority areas should be identified in recovery plans or management plans for the species, but include work on Tarplant Hill.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• As in TARPLANT-A1
		TARPLANT-A3: Manage vegetation using fire, grazing, or other treatments including mowing that create and maintain the short-statured open soil conditions that promote Santa Cruz tarplant demographic performance. Monitoring the effects of grazing, fire, and other vegetation management to evaluate their effectiveness.	Prioritize areas as outlined in the Action 3 for Objective 2 of the Grassland Conservation Strategy (GRASS-O2 GRASS-A3) that will benefit tarplant. Prioritize protected lands with populations that have been extirpated (or nearly so) aboveground due to competition from exotic plants and dense thatch that accumulates in the absence of grazing, including Graham Hill Road and Santa Cruz gardens.	• Altered disturbance regimes	• As in TARPLANT-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Additional Species Potentially Benefited
		TARPLANT-A4: Manage invasive plants and dense exotic plants which alter grassland community structure, and impact Santa Cruz tarplant populations.	Prioritize areas as outlined in Action 4 for Objective 2 of the Grassland Conservation Strategy (GRASS-O2 GRASS-A4)that will benefit Santa Cruz tarplant.	• Exotic plants	• As in TARPLANT-A1
		TARPLANT-A5: Manage recreation to maintain or enhance the habitat suitability and promote persisting populations of Santa Cruz tarplant.	Prioritize areas in Action 5 for Objective 2 of the Grassland Conservation Strategy (GRASS-O2 GRASS-A5) that can benefit Santa Cruz tarplant, including areas where habitat is being degraded by incompatible recreation (too frequent and/or intense), denuded larger areas, and/or cause soil compaction that inhibits establishment	• Altered disturbance regimes • Incompatible recreation • Unauthorized activities	• As in TARPLANT-A1
	TARPLANT-O3: Establish and maintain Santa Cruz tarplant populations throughout suitable grasslands, in a range of microclimates to promote species persistence in the face of a changing climate. Measure progress toward this objective based on the number of populations established or maintained.	**TARPLANT-A6: Introduce (or re-introduce) Santa Cruz tarplant** into protected grasslands that feature suitable but unoccupied habitat, or habitat that can be made suitable through restoration and enhancement.	Establish populations of Santa Cruz tarplant within areas where the species has been extirpated above and below ground or has experienced declines that threaten persistence. Outplanting and seeding should be prioritized where populations will be permanently protected and can be actively managed and maintained using grazing or other management techniques to address thatch and exotic plants. Priorities include Graham Hill Road, Santa Cruz Gardens, Struve Slough, and restored grassland areas within Watsonville Slough Farm.	• Development • Altered fire regimes • Exotic plants • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Santa Cruz tarplant
	TARPLANT-O4: Preserve the genetic diversity of Santa Cruz tarplant to aid long-term recovery and adaptation to climate change. Measure progress toward this objective based on the number of rare species populations in long-term seed storage.	**TARPLANT-A7: Establish an *ex-situ* seed bank** comprised of seed collected (and stored separately) from all populations.	Prioritize establishment of the *ex-situ* seed bank to ensure that it features seed that is collected from: • all of the protected and other populations where permission is granted. • Multiple years in each site, to increase genetic diversity.	• Development • Altered fire regimes • Exotic plants • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Santa Cruz tarplant

Goal	Objective	Action	Priorities	Pressures Addressed	Additional Species Potentially Benefited
	TARPLANT-O5: Increase understanding of the ecological factors influencing populations to inform their conservation and management.	**TARPLANT-A8: Conduct research and long-term monitoring** to increase understanding of population trends and their drivers, including climate change impacts	Prioritize research to address the most significant data gaps to informing conservation and management. Current priorities include: • Evaluate the effects of mowing, raking, grazing, and fire, to determine strategies for reducing thatch and exotic plants; and • Evaluate factors influencing suitability of habitat and effectiveness of seeding and planting to guide reintroductions.	• Development • Working lands • Altered fire regimes • Exotic plants • Incompatible recreation • Climate change	• Santa Cruz tarplant

5.3.14 Maritime Chaparral and Knobcone Pine Forest

Maritime Chaparral and Knobcone Pine Forest

Status and Rarity

- Sensitive plant communities:
    - Hoary manzanita chaparral (37.323.03): G3, S3
    - Brittle leaf manzanita chaparral (37.308.03): G3, S3
    - Glossy leaf manzanita chaparral (37.306.00): G2G3, S2S3
    - Hooker's manzanita chaparral (37.321.00): G2, S2
    - Silverleaf [Bonny Doon] manzanita chaparral (37.320.00): G1, S1 (treated as part of Sandhills/Sand Parkland Community Element)
    - Other alliances or associations featuring Schreiber's manzanita and Ohlone manzanita, which could be described in the future
- Many of the endemic manzanita species are very rare, though not state or federally listed:
    - Santa Cruz manzanita (*Arctostaphylos andersonii*): CRPR 1B.2; G2, S2
    - Schreiber's manzanita (*A. glutinosa*): CRPR 1B.2; G1, S1
    - Ohlone manzanita (*A. ohloneana*): CRPR 1B.1; G1, S1
    - Hooker's manzanita (*A. hookeri* subsp. *hookeri*): CRPR 1B.2; G3, S2
    - Silverleaf (Bonny Doon) manzanita (*A. silvicola*): CRPR 1B.2; G1, S1
- County of Santa Cruz Sensitive Habitat (Northern Maritime Chaparral)
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone, which includes the North Coast, Bonny Doon, and San Andreas areas. Includes all above listed sensitive

communities as well as the more widespread communities, which are especially valuable habitat:

- Wedgeleaf ceanothus chaparral (37.211.00): G4, S4
- Knobcone pine forest and woodland (87.100.10, 87.100.09): G4, S4

Detailed Descriptions

Griffin 1978

Keeley and Davis 2007

Vasey et al. 2014

Parker et al. 2016

CNPS 2021

Distribution and Range

- 14,715 acres (5.2% of the RCIS Area), which includes (Figure 5-15):
  - 8,033 acres (2.8% of the RCIS Area) of maritime chaparral
  - 6,463 acres (2.3% of the RCIS Area) of knobcone pine

  Totals do not include the additional 5,630 acres of Sandhills (Figure 5-15), much of which is dominated by silverleaf (Bonny Doon) manzanita chaparral—a type of maritime chaparral that is addressed in the Sandhills/Sand Parkland Community Element (Section 5.3.10).
- Scattered throughout the RCIS Area with concentrations in the North Coast, Bonny Doon, and Summit regions, with smaller (and largely unmapped) patches in Day Valley, Larkin Valley, and San Andreas areas, which support different communities.

Key Ecological Elements

- Maritime chaparral is a community found on nutrient-poor soils derived from sandstone, shale, or granite, in isolated, low-elevation bands within reach of the summer fog, where the climate consists of cool winters, warm summers, small daily and seasonal temperature ranges, and high relative humidity.
- Maritime chaparral is dominated by evergreen, sclerophyllous (leathery-leaved) shrubs and subshrubs and herbaceous plants found in the canopy gaps. Maritime chaparral can feature scattered trees, including knobcone pine (*Pinus attenuata*), ponderosa pine (*P. ponderosa* var. *benthamiana*), Santa Cruz cypress (*Hesperocyparis abramsiana* var. *abramsiana*), and Monterey pine (*Pinus radiata*); these communities are generally named for the visually dominant tree species but are also often dominated, in terms of cover, by the same maritime chaparral shrubs. [The latter three types are mapped separately and treated as part of three separate conservation elements: Sandhills/Sand Parkland, Santa Cruz Cypress Forest, and Monterey Pine Forest, respectively.]

- Maritime chaparral features high rates of native plant endemism due primarily to manzanita species (*Arctostaphylos* spp.) that are narrowly restricted to maritime chaparral including specific soils therein.
    - Schreiber's manzanita (*A. glutinosa*) is endemic to "the Chalks"—an area within the Scott and Big Creek subwatersheds featuring soils derived from siliceous shale.
    - Ohlone manzanita (*A. ohloneana*) is endemic to Santa Cruz County, where it is found only in the Chalks (salicaceous shale) in the Scott Creek Subwatershed.
    - Silverleaf (Bonny Doon) manzanita (*A. silvicola*) is endemic to Zayante soils that support the Santa Cruz Sandhills community, which is addressed in the Sandhills/Sand Parkland Community Element.
    - Hooker's manzanita (*A. hookeri* subsp. *hookeri*) is endemic to the Monterey Bay Area and occurs on Aromas Sands in the San Andreas/ Calabasas area northwest of Watsonville, where agricultural land conversion likely reduced the amount of maritime chaparral. The remaining maritime chaparral is not represented in the vegetation map used for the RCIS, which misclassifies much of the habitat as coastal scrub.
    - Santa Cruz (Anderson's) manzanita (*A. andersonii*) is endemic to the central and southern Santa Cruz Mountains where it occurs in maritime chaparral and open canopy areas (clearings, edges) in redwood forests.
    - Crinite manzanita (*A. crustacea* ssp. *crinita*) is endemic to the Santa Cruz Mountains and the Monterey Bay Area.
- Native herbaceous plants occurring in maritime chaparral include rare species such as robust spineflower (*Chorizanthe robusta* var. *robusta*) and Santa Cruz Mountain pussypaws (*Calyptridium parryi* var. *hesseae*).
- The combination of the often coarse (e.g., sandy) soil, shrub-dominated vegetation, and moist maritime climate allow maritime chaparral to support native animals not found in other communities. These include narrowly endemic species, such as Northern California legless lizard (*Anniella pulchra*) and Santa Cruz kangaroo rat (*Dipodomys venustus venustus*), which historically occurred throughout the maritime chaparral in western Santa Cruz Mountains but is known only from two locations (one of which is in Santa Cruz County). Maritime chaparral and knobcone pine forest support diverse assemblages of more widespread native animals including wren tit (*Chamaea fasciata*), California thrasher (*Toxostoma redivivum*), and western scrub-jay (*Aphelocoma californica*).
- Maritime chaparral and knobcone pine forest are both dominated by species that primarily establish following fire. Knobcone pine is a relatively short-lived (ca. 70 years) closed-cone tree that releases seed in response to fire, after which it establishes at high

density. The chaparral shrubs are also fire-adapted and include obligate-seeding species (e.g., *A. glutinosa, A. hookeri* var. *hookeri, A. ohloneana, A. sensitiva,* and *A. silvicola*) as well as those that sprout from lignotubers (basal burls) such as *A. crustacea* ssp. *crinita* and *A. c.* sp. *crustacea*. The community features a diverse assemblage of fire-following herbaceous plants (e.g., *Cryptantha* spp., *Campanula angustiflora* spp., etc.), which can be eliminated above ground but persist in a soil seed bank between fires.

- Maintenance of the natural fire regime may be important to the long-term persistence of these communities and the species they support.
    - Too-frequent fire may decrease populations by killing adults prior to accumulation of sufficient viable seed to replace them (Odion and Tyler 2002).
    - At the same time, fire exclusion may cause "senescence risk": as adult shrubs and trees senesce and die, seed production decreases such that, if fire is excluded too long, seed availability could be reduced to a level below which seedling establishment following an eventual fire is insufficient to replace the stand (Odion and Tyler 2002). In some communities, maritime chaparral can succeed to other types (e.g., oak woodland) in the absence of fire (Van Dyke et al. 2001).
    - Exclusion of fire can reduce or eliminate populations of herbaceous fire followers and degrade habitat for native animals, such as the Santa Cruz kangaroo rat (Bean 2004).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting Maritime Chaparral and Knobcone Pine Forest, which include the following most critical ones:

- Loss of remaining habitat in unprotected areas, due to development and infrastructure improvements.
- Fire outside of the natural regime of disturbance, including fire that is too infrequent, occurring after shrubs and trees and their seed have declined below critical replacement level; or fire too frequent, occurring prior to sufficient seed being produced to replace populations of individuals killed by the fire.
- Vegetation management to reduce the risk of fire near development, some of which can reduce populations of rare manzanitas, and has the potential to promote the invasion and spread of exotic plant species.
- Habitat degradation due to exotic plants such as French broom (*Genista monspessulana*), silver wattle (*Acacia dealbata*), and eucalyptus (*Eucalyptus* spp.) and other aggressive species that can be promoted by fire. These can outcompete native species for light and soil resources and alter the structure of plant communities, degrading habitat for animals.

- Habitat degradation due to incompatible recreation, unauthorized uses (e.g., illegal cannabis growing), and associated erosion, which can be significant due to the erosive soils in many communities.

Climate Change Vulnerability Assessment

- Climate change is likely to impact Maritime Chaparral and Knobcone Pine Forest as a result of the following:
    - Exposure to projected temperature increases and highly variable precipitation including drought, which together can increase the climatic water deficit that can create drought stress for native shrubs and trees in the often droughty, poorly developed soils.
    - Moderate to high sensitivity to changes including the following:
        - Rarity: Several of the manzanita species are narrow endemics that could experience population declines due to reduced recruitment and/or increased mortality due to fire, which could render them vulnerable to extinction.
        - Narrow Habitat Specificity: The community occurs in a relatively narrow range of habitat conditions that could reflect a lower capacity of species to tolerate new environments, including adjacent soil types.
        - Interactions with Fire: Increased temperature, drought, and associated climatic water deficit could create too-frequent fire that would kill established individuals prior to accumulation of sufficient seed to replace populations of the obligate-seeding species post-fire. Fire can also promote exotic plants, which can further reduce recruitment, as noted above.
    - Low adaptive capacity: Narrowly endemic species may have reduced ability to adapt to climate change due to:
        - Likely low genetic variability, due to limited population size and geographic range.
        - Habitat fragmentation, due to naturally patchy communities (reflecting patchy soils) and development and other land-use modifications.
        - Association with specific environmental conditions (i.e., specific nutrient-poor soils).
- For these and other reasons, maritime chaparral communities in the Santa Cruz Mountains were ranked as “moderately” vulnerable to the effects of climate change. Maritime chaparral is anticipated to undergo declines, particularly under hotter scenarios, whereas interior chaparral dominated by chamise (*Adenostoma fasiculatum* var. *fasciculatum*) is anticipated to expand in terms of areal extent (EcoAdapt 2021). These changes will likely affect associated knobcone pine forests.

The goals, objectives, actions, and priorities for the Maritime Chaparral and Knobcone Forest community element (Table 5-17) will help address the impacts of climate change by:

1. Protecting habitat, which will preserve genetic diversity in remaining populations, which is needed to adapt to climate change, and protect climate refugia, such as cooler microclimates (e.g., north-facing slopes) and areas adjacent to current occupied stands where the species can migrate over to stay with their 'climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, incompatible recreation, and manual clearing (e.g., for fuel breaks);
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat between Maritime Chaparral and Knobcone Pine Forest, to increase the ability of the species to establish in adjacent areas;
5. Introducing rare species into suitable but unoccupied habitat, to increase their populations and reduce the potential for extirpations or extinctions; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-17 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Robust spineflower (*Chorizanthe robusta* var. *robusta*) [NF]
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) [NF]
- Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) [F]
- ringed-tailed cat (*Bassariscus astutus*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

The maritime chaparral and knobcone forest communities, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Sandhills/Sand Parkland:** Most actions conducted as part of SAND-A1 through SAND-A5, since the majority of the sandhills habitat supports silverleaf (Bonny Doon) manzanita chaparral, which is a type of maritime chaparral;
- **Santa Cruz Cypress Forest:** Most actions conducted as part of CYPRESS-A1, -A2, -A3, -A4, -A5, and -A7, as most of the Santa Cruz cypress community type features an understory of chaparral shrubs characteristic of maritime chaparral, which often surrounds the Santa Cruz Cypress Forest;
- **Ponds, Lakes, and Reservoirs:** Actions to protect, restore, and enhance upland habitat for landscape connectivity conducted as part of PLR-A14 through PLR-A18, particularly in the San Andreas area where maritime chaparral occurs adjacent to ponds important for rare species; and
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of maritime chaparral or knobcone pine forest communities as part of CONNECT A1 through CONNECT-A4.

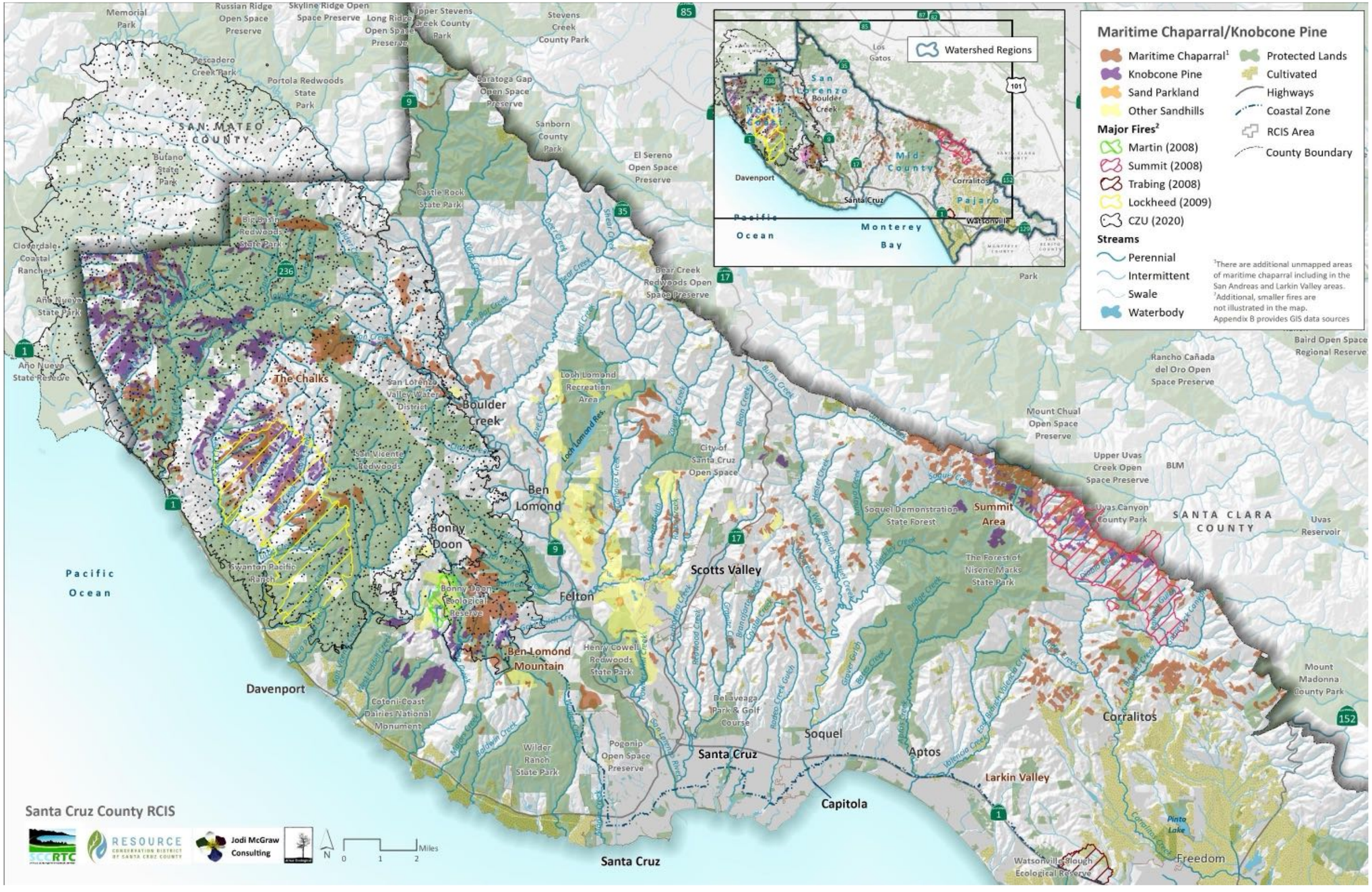

Figure 5-15: Maritime Chaparral and Knobcone Pine Forest Conservation Element

Table 5-17: Conservation Strategy for Maritime Chaparral and Knobcone Pine Forest

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
CHAP-G1: Promote persistence and ecological integrity of the Maritime Chaparral and Knobcone Pine Forests, the rare species they support, and the ecological processes that sustain them.	**CHAP-O1:** Protect at least 4,779 additional acres of Maritime Chaparral and 2,162 additional acres of Knobcone Pine Forest and to achieve the 90% targets for these communities within this element (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**CHAP-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that can collectively conserve large, manageable areas that protect the range of Maritime Chaparral and Knobcone Pine Forest in the RCIS Area. Specific priorities include: • Protect habitat supporting the manzanitas that are endemic to the RCIS Area, Ohlone manzanita, Schreiber's manzanita, and silverleaf manzanita (the latter is also addressed as part of the Sandhills/Sand Parkland community element, SAND-A1). • Protect habitat supporting additional rare and locally unique manzanitas, including Hooker's manzanita, Santa Cruz manzanita, and crinite manzanita. • Protect areas that feature other rare species, including Santa Cruz long-toed salamander, robust spineflower, Monterey spineflower, and the range of co-benefited species. • Protect habitat in the Summit Area (Loma Prieta Ridge), which is a known biodiversity hotspot for insects and birds (R. Morgan, pers. comm. 2009). • Protect habitat in the Summit Road Area, which features chaparral dominated by hoary manzanita, and Knobcone Pine Forest. • Protect areas that can be effectively managed using fire, including larger areas away from development. • Protect areas featuring a diverse mosaic of land facets (i.e., due to variable soils and/or topography) and that contain potential climate change refugia (e.g., cooler microclimates), to facilitate climate change adaptation and resilience.	• Development • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	CHAP-O2: Restore or enhance Maritime Chaparral and Knobcone Pine Forest to promote natural structure and native species composition and ecosystem functions where they have been degraded or eliminated.	**CHAP-A2: Restore and enhance habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, altered fire regimes, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize the following areas for restoration: • Areas degraded by prior land uses, including disused agricultural areas (e.g., old vineyards), and areas cleared to create roads or fuel breaks included where such activities reduced or eliminated stands of the narrowly endemic manzanitas; • Areas degraded by invasive plants, including eucalyptus, acacias, and brooms, where natural community structure and species composition can be restored; • Areas that can increase populations of the rare species (focal, non-focal, and co-benefited species); • Areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained), such as Big Basin, Cotoni-Coast Dairies; and	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Areas that can help connect existing habitat.		
		CHAP A3: Manage fire, including through cultural burning. and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) promote populations of the narrowly endemic manzanitas, including through population regeneration 2) maintain areas of open sand soil that support the two rare spineflowers and other fire-following herbaceous plants; 3) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity at the landscape scale, and 4) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.	Prioritize the following areas for fire management: • Long-unburned areas where the dominant chaparral species are senescent, and/or where oaks or other trees are encroaching and outcompeting native chaparral shrubs and the two rare spineflowers, which are at risk of losing their viable seed banks (senescence risk); • Areas at risk of too-frequent fire, which could reduce native obligate seeding species if insufficient seed is available to replace individuals killed by the fire (i.e., stands facing immaturity risk); in these areas, use vegetation management to reduce the risk of anthropogenic fire and/or facilitate restoration of affected native species. Implement fire management using experimental approaches to enhance habitat and populations while increasing understanding of the ecology of the system and informing future management. Specifically, • test the effectiveness of manual/mechanical thinning of the canopy and removal of litter on the soil surface at mimicking the beneficial effects of fire at promoting fire adapted species; and • use before/after monitoring and replicate treatments (where feasible) to evaluate changes in response to fire and other treatments over time	• Altered disturbance regimes (Fire)	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		CHAP-A4: Manage invasive plants and dense exotic plants that alter Maritime Chaparral and Knobcone Pine Forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or could	Prioritize actions that can maintain intact natural communities by abating threat, or restore already degraded by exotic plants, including by: • Eradicating or control invasive eucalyptus, acacias, brooms, or other woody species that alter plant community structure and species composition, outcompete populations of rare plant species, alter native animal habitat (e.g., for Santa Cruz kangaroo rat or Santa Cruz long-toed salamander), and/or increase the risk of unnatural fire; • Controlling and preventing the spread of exotic herbaceous plants (including grasses), that can degrade habitat and reduce rare species populations when abundant, and could increase fire frequency through addition of fine fuels; and	• Exotic Species • Altered disturbance regimes	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		promote increased fire frequency.	• Preventing the invasion and spread of new invaders that can negatively impact the community and rare species populations, including by using Early Detection-Rapid Response.		
		CHAP-A5: Manage recreation that tramples plants, sensitive habitat features (e.g., burrows), and/or exposes soil to erosion, and enhance habitat degraded by incompatible recreation and attendant erosion.	Prioritize actions that: • Manage recreation in public lands featuring Maritime Chaparral and Knobcone Pine Forest, including: Big Basin State Park, Wilder Ranch State Park, Ellicott Slough National Wildlife Refuge and the Bonny Doon Ecological Reserve, to ensure it is compatible with protection of the sensitive communities and rare species, by regulating access using signage, fences, trails, patrols, and associated outreach to recreators; and • Restore areas where incompatible use has removed habitat by denuding habitat and/or causing erosion.	• Incompatible recreation	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
CHAP-G2: Maintain and enhance connectivity of Maritime Chaparral and Knobcone Pine Forest to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**CHAP-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**CHAP-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize land as outlined for Action 1 for Objective 1 (CHAP-O1 CHAP-A1) and that can connect and expand protected Maritime Chaparral and Knobcone Pine Forest, as well as other intact plant communities connecting them, including Sandhills (silverleaf manzanita chaparral) and Santa Cruz Cypress Forest. Priority habitat areas to maintain connectivity include the following: • Remnant patches of chaparral including those on Aromas Sand soil in the Larkin Valley and San Andreas areas; • Core areas of Maritime Chaparral and Knobcone Pine Forest on siliceous soils ('the Chalks') in the North Coast; • Core areas of Maritime Chaparral and Knobcone Pine Forest in the Summit Area; and • Core areas of Maritime Chaparral and Knobcone Pine Forest on Ben Lomond Mountain.	• Development • Working lands • Altered disturbance regimes • Unauthorized activities • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	CHAP-O4: Restore and enhance degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CHAP-A2: Restore Habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, altered fire regimes, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize areas as outlined in CHAP-A2 where restoration can connect habitat.	• Development • Working lands • Altered disturbance regimes • Exotic species • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	CHAP-O5: Enhance connectivity within habitat to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CHAP-A3: Manage fire and vegetation** using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) promote populations of the narrowly endemic manzanitas, including through population regeneration 2) maintain areas of open sand soil that support the two rare spineflowers and other fire-following herbaceous plants; 3) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity at the landscape scale, and 4) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.	Prioritize areas where fire and vegetation management can prevent unnatural succession of Maritime Chaparral and Knobcone Pine Forest that causes type conversions and thus reduces the area of habitat.	• Altered disturbance regimes • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		CHAP-A4: Manage invasive plants and dense exotic plants that alter Maritime Chaparral and Knobcone Pine Forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or could promote increased fire frequency.	Prioritize areas where invasive plant removal can re-create the natural community structure and species composition of the Maritime Chaparral and Knobcone Pine Forest, to promote habitat connectivity. Known priorities include removal of eucalyptus forest in the Larkin Valley area, where the invasive plants have fragmented the maritime chaparral and coast live oak woodland.	• Exotic plants • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
CHAP-G3: Promote the recovery and	**CHAP-O6:** Protect habitat occupied by, or suitable for, rare species that rely	**CHAP-A1: Protect Habitat** through fee title acquisition or conservation easements	Prioritize properties as outlined in Action 1 for Objective 1 (CHAP-O1 CHAP-A1) with an emphasis on habitat that:	• Development • Working lands	• Robust spineflower • Monterey spineflower

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
long-term persistence of rare species.	on Maritime Chaparral and Knobcone Pine Forest. Measure progress toward this objective based on the acres of habitat protected.	to permanently protect habitat from conversion and other degradative land uses.	• supports, or provides suitable habitat for, the narrowly endemic manzanitas, listed spineflowers, and Santa Cruz long-toed salamander; • supports other focal, non-focal, and co-benefited species; • protects (or can contribute to the projection) of large habitat areas that can be effectively managed using fire; and • expands, buffers, or connects existing protected habitat.	• Incompatible recreation • Climate change	• Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	CHAP-O7: Restore and enhance habitat to enhance population size and persistence of rare species that rely on Maritime Chaparral and Knobcone Pine Forest. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CHAP-A2: Restore Habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, altered fire regimes, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize restoration as outlined in Action 2 for Objective 2 (CHAP-O2 CHAP-A2) with an emphasis on restoring areas that: • support, or provide suitable habitat for, the narrowly endemic manzanitas, listed spineflowers, and Santa Cruz long-toed salamander; • support other focal, non-focal, and co-benefited species; • can be permanently protected or where restoration actions can otherwise be sustained.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		CHAP-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) promote populations of the narrowly endemic manzanitas, including through population regeneration 2) maintain areas of open sand soil that support the two rare spineflowers and other fire-following herbaceous plants; 3) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity at the landscape scale, and 4) maintain a range of microclimatic and other abiotic conditions that can	Prioritize fire and vegetation management as outlined in Action 3 for Objective 2 (CHAP-O2 CHAP-A3), with an emphasis on: • areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on Maritime Chaparral and Knobcone Pine Forest, and other focal, non-focal, and co-benefited species. • Design and implement vegetation management actions to protect lives and property (e.g., fuel breaks) to enhance habitat and populations of rare species, where possible.	• Altered disturbance regimes • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		add resiliency in the face of climate change.			
		CHAP-A4: Manage invasive plants and dense exotic plants that alter Maritime Chaparral and Knobcone Pine Forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or could promote increased fire frequency.	Prioritize invasive and exotic plant management as outlined in Action 4 for Objective 2 (CHAP-O2 CHAP-A4), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on Maritime Chaparral and Knobcone Pine Forest, and other focal, non-focal, and co-benefited species. Specific management priorities should be determine based on a comprehensive assessment, that addresses effects of the recent fires, which can alter the distribution and abundance of exotic species, but priority actions are likely to include the following which occurred pre-fire: • Removal of eucalyptus in the Larkin Valley Area; and • Removal of silver wattle or other acacias where they occur in Maritime Chaparral and Knobcone Pine Forest, including on Ben Lomond Mountain.	• Exotic plants • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		CHAP-A5: Manage recreation that tramples plants, sensitive habitat features (e.g., burrows), and/or exposes soil to erosion, and enhance habitat degraded by incompatible recreation and attendant erosion.	Prioritize recreation management as outlined in in Action 5 for Objective 2 (CHAP-O2 CHAP-A5), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of rare species that rely on Maritime Chaparral and Knobcone Pine Forest and other focal, non-focal, and co-benefited species. Specific management priorities should be determine based on a comprehensive assessment but may include: • Big Basin Redwoods State Park (the Chalks area); and • Sierra Azul Open Space Preserve (Summit Road Area).	• Incompatible recreation	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	CHAP-O8: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**CHAP-A6: Conduct species-specific actions** including surveys, captive breeding/rearing programs, seed banking and seed bulking, and other species-specific actions for the rare plants and animals, to supplement habitat protection, restoration, and management and enhancement actions, to ensure the persistence of the species.	Prioritize actions for the rare plants based on a comprehensive assessment to identify population management and enhancement needed to: • Maintain or increase the areal extent, abundance, and persistence (as assessed based on population demography); and • Prevent loss of populations. Projects that are likely to emerge as priorities based on currently available information include: • (Re-)introduce the four rare plants that rely on this community element (Schreiber's manzanita, Ohlone manzanita, robust spineflower, and Monterey spineflower) into areas of suitable but unoccupied habitat. Suitable areas should be determined through a habitat characterization and introductions should be implemented through experimental trials designed to evaluate effectiveness of introduction methods and suitability of sites.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Establish *ex situ* seed banks for the four rare species (listed above), to ensure the maintenance of genetic diversity and support population recovery actions in the event of dramatic population declines that would cause bottlenecks and threaten persistence. • Conduct analysis of the population genetics of the four rare plants (listed above) to inform actions to preserve genetic diversity, inform introductions and reintroductions, prevent outbreeding depression by moving genetic material between populations that could break up locally adapted genetic complexes, and/or address potential loss of genetic diversity due to reproductive isolation of the small populations. • Conduct management-oriented research and long-term population monitoring to inform conservation and management. Priority actions for rare animals include those that increase the distribution and abundance of Santa Cruz kangaroo rat, including: • additional surveys to locate additional populations; and • reintroductions to expand the distribution and abundance of the species, which is known from only two populations (SAND-A6).		
		CHAP-A7: Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.	Prioritize projects that fill key data gaps in informing understanding of the conservation ecology and management of the system and rare species including: • Response to fire and vegetation management; • Response to climate change, to inform development of climate adaptation strategies.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Robust spineflower • Monterey spineflower • Santa Cruz long-toed salamander • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	CHAP-O9: Safeguard rock outcroppings to promote persistence of rare bryophytes and lichens as well as animals that use the important habitat features. Measure progress toward this objective based on the acres of habitat protected.	**CHAP-A8: Manage rock outcroppings** to prevent factors that degrade their habitat values.	Prioritize actions that protect the condition of rock outcroppings that provide native plant and animal habitat, such as Eagle Rock, which features a diverse assemblage of native bryophytes (*Grimmia torenii, Crossidium squamiferum, Syntrichia papillosissima,* and *Blindia acuta*) and China Grade (sandstone). Priority actions can include: • Manage incompatible recreation and unauthorized human activities to prevent removal of epiphytes including mosses, liverworts, and lichens, as well as epiphytes (e.g., ferns) that grow on rocks, and that disrupt natural behaviors of animals, including bat roosting; and • Manage fire to prevent severe fires from impacting rock outcrops, which naturally have lower fuels but can experience more intense and destructive fire if fuels accumulate due to fire exclusion.	• Incompatible recreation • Unauthorized activities • Altered disturbance regimes • Climate Change	• Ring-tailed cat • Numerous co-benefited species

5.3.15 Santa Cruz Cypress Forest

Santa Cruz Cypress Forest

Status and State and Global Ranks

- Santa Cruz cypress groves Special Stands (81.606.00): G1, S1
- Santa Cruz cypress is Federally Threatened and State Endangered and Ranked GI, S1
- County of Santa Cruz Sensitive Habitat
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone (i.e., in Bonny Doon and Majors Creek)

Detailed Descriptions

USFWS 1998e

Lyons 1988

McGraw 2007a

USFWS 2013

USFWS 2016

CNPS 2021

Distribution and Range

- 208 acres (0.1% of the RCIS Area; Figure 5-16)
- San Lorenzo Valley and Bonny Doon (North Coast) regions of central Santa Cruz County

Key Ecological Elements

- Santa Cruz cypress forest occurs in just five locations on the western slope of the Santa Cruz Mountains, on oligotrophic soils, including rock outcrops, xerorthents (dry, poorly developed mineral soils), and Zayante Soils. These soils limit establishment of more coast redwood, Douglas-fir, and associated hardwoods, which dominate the surrounding areas on loam soils; the xeric soils provide open habitat for Santa Cruz

cypress and associated chaparral shrub and tree species, which are poor light competitors but can tolerate the droughty and nutrient-poor soils. Associated rock outcroppings can support populations of rare and locally lichens and bryophytes including species round primarily in more inland regions (Kellman 2003).

- In this community, Santa Cruz cypress occurs within maritime chaparral shrubs including manzanitas (*Arctostaphylos sensitiva, A. crustacea* sp. *crinita,* and *A. silvicola*), other closed conifers including knobcone pine (*Pinus attenuata*), ponderosa pine (*Pinus ponderosa*), Pacific Douglas-fir (*Pseudotsuga menziesii*) and coast redwood (*Sequoia sempervirens*), and hardwoods such as tan oak (*Notholithocarpus densiflorus*) and coast live oak (*Quercus agrifolia*)
- Santa Cruz cypress forest is dominated by species that primarily establish following fire. Santa Cruz cypress (*Hesperocyparis abramsiana*) releases some seed as cones age and in response to mechanical disturbance (branch breaks) but the serotinous cones primarily release seeds in response to fire, which removes the established canopy (i.e., kills the adult trees) and creates bare mineral soil which are required for seedling establishment, growth, and survivorship. The associated chaparral shrubs are also fire-adapted and include obligate seeding species (e.g., *A. sensitiva* and *A. silvicola*) as well as those that sprout from basal burls (e.g., *A. crustacea* ssp. *crinita*).
- Previously, lack of fire which is necessary to promote recruitment and avoid senescence risk (*sensu* Ne'eman et al. 1999) was identified as a primary threat to the namesake species (McGraw 2007a, USFWS 2016). However the 2020 CZU Lightning Complex Fire burned four of the five locations and 34% of the acres occupied by the stands in Santa Cruz County (as well as the entire Butano stand in San Mateo County); the 2008 Martin Fire burned 27 acres in the fifth location (Bonny Doon).
- Research is needed to evaluate the severity of the fire and post-fire regeneration of Santa Cruz cypress and co-occurring species, which could promote seedling establishment and stand regeneration, as was documented initially following the 2008 Martin Fire (McGraw 2011); alternatively, Santa Cruz cypress and co-occurring species could be impacted by unnaturally intense fire, limited rainfall following the fire, which could limit seedling establishment and survivorship in the critical post-fire recruitment years, and the invasion and spread of exotic plants such as French broom (*Genista monspessulana*) or dense exotic herbaceous plants, which could outcompete seedlings for light and limited soil resources (water and nutrients).
- Recent taxonomic evaluations of Santa Cruz cypress led to identification of two varieties: Santa Cruz cypress (*Hesperocyparis abramsiana* var. *abramsiana*), occupies all four stands in (and is endemic to) Santa Cruz cypress, while Butano cypress (*H. abramsiana* var. *butanoensis*) is found in a single stand only in southern San Mateo County (Adams and Bartel 2009).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting Santa Cruz cypress forests, which include the following most critical ones:

- Loss of habitat in the unprotected areas, which include all of the Bracken Brae stand a portion of the Bonny Doon stand, and a portion of the Majors Creek Stand—the remainder is protected in State Parks (Wilder Ranch and Big Basin) and San Mateo County Parks (Pescadero Creek County Park).
- Fire outside of the natural regime of disturbance, including fire that is: 1) too intense and incinerates seed; 2) too infrequent, and thus occurs after adult trees and their seed have declined below critical replacement level; and/or 2) too frequent, and thus occurs prior to sufficient seeding being produced to replace the stand if killed. These effects of fire can be acute for the Santa Cruz cypress but can also affect other fire-adapted species including manzanitas.
- Habitat degradation due to exotic plants, such as French broom and other species that can be promoted by fire and could outcompete Santa Cruz cypress and other species for light and soil resources.
- Habitat degradation due to incompatible recreation (e.g., rock climbing/play, tree removal for creating trails and bike jumps), unauthorized activities, and associated erosion (USFWS 2013).

Climate Change Vulnerability Assessment

- There have been no prior comprehensive climate change vulnerability analyses for the Santa Cruz cypress forest community.
- Santa Cruz cypress ranked 23rd highest in climate change vulnerability in a recent trait-based evaluation of 339 native trees in the United States (Potter et al. 2017). This high vulnerability score likely reflects the following:
    - Exposure to projected temperature increases, and highly variable precipitation (including drought), which together can increase the climatic water deficit that can create drought stress for Santa Cruz cypress and the co-occurring native plant species including manzanitas.
    - Sensitivity to changes, which are predicted to be high for Santa Cruz cypress (Potter et al. 2017) and likely the broader community due to the following:
        - Rarity: Santa Cruz cypress has low population size and is thus susceptible to demographic as well as environmental stochasticity which can be exacerbated by climate change;
        - Narrow Habitat Specificity: the species and community are confined to a relatively narrow range of habitat conditions that likely reflect a lower capacity to tolerate new environments;
        - Interactions with Fire: Increased temperature, drought, and associated climatic water deficit could promote too-frequent fire that could limit the amount of seed available for Santa Cruz cypress and other obligate seeding species to establish post-fire.

  - Low adaptive capacity: Santa Cruz cypress may have low ability to adapt to climate change due to:
    - likely low genetic variability, due to limited population size and geographic range.; and
    - associate with specific environmental conditions (i.e., rock outcroppings and nutrient-poor soils).

- Closed-cone/pine forests mapped within the Ben Lomond Mountain region, which include the Bonny Doon and Majors Creek Santa Cruz Cypress Forest stands, were identified as having high exposure to climate change (Thorne et al. 2015).
- Climate change may impact Santa Cruz cypress forest indirectly by altering the fire regime to which the species are adapted. If the hotter climate and increased drought increase the frequency of fire, Santa Cruz cypress and co-occuring species could face immaturity risk—lack of establishment following fire due to insufficient seed development following the prior fire (Merriam and Rentz 2017).
- Santa Cruz cypress and associated maritime chaparral shrubs have some potential to expand their ranges as a result of climate change, if the hotter and drier conditions make more fertile soils no longer unsuitable for light-competitive trees (e.g., coast redwood, Pacific Douglas-fir, and associated hardwoods), which could also be eliminated by too-frequent fire; a reduction in competition for light could facilitate expansion of shade-intolerant shrubs and Santa Cruz cypress (McGraw 2011).

The goals, objectives, actions, and priorities for the Santa Cruz cypress community (Table 5-18) will help address the impacts of climate change by:

1. Protecting habitat, which will help preserve genetic diversity that will be essential to adapt to climate change, and protect climate refugia, such as cooler microclimates (e.g., north-facing slopes) and areas adjacent to current occupied stands where the species can migrate over to stay with their 'climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, recreation, and manual clearing (e.g., for fuel breaks);
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat, to facilitate the movement of species and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency;
5. Introducing rare species into suitable but unoccupied habitat, to increase their populations and reduce the potential for extirpations or extinctions;

6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-18 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Santa Cruz cypress (*Hesperocyparis abramsiana* var. *abramsiana*) [NF]
- white rayed pentachaeta (*Pentachaeta bellidiflora*) [NF]
- Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*) [NF]
- Ben Lomond (Santa Cruz) wallflower (*Erysimum teretifolium*) [NF]
- Zayante band-winged grasshopper (*Trimerotropis infantilis*) [F]
- Mount Hermon June beetle (*Polyphylla barbata*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

The Santa Cruz cypress forest, along with its associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Sandhills/Sand Parkland:** Actions conducted as part of SAND-A1 through SAND-A5 within habitat that supports (or could support) Santa Cruz cypress, including in Bonny Doon;
- **Maritime Chaparral/Knobcone Pine Forest:** Actions conducted as part of CHAP-A1 through CHAP-A5 within suitable habitat for Santa Cruz cypress (i.e., within the species' range and on suitable soils), by facilitating future population expansion (including as part of introductions); and
- **Connectivity:** Actions to maintain or enhance habitat connectivity that involve protection, restoration, and enhancement of Santa Cruz cypress forest, sandhills/sand parkland, or maritime chaparral or knobcone pine forests near Santa Cruz cypress as part of CONNECT-A1 through CONNECT-A4.

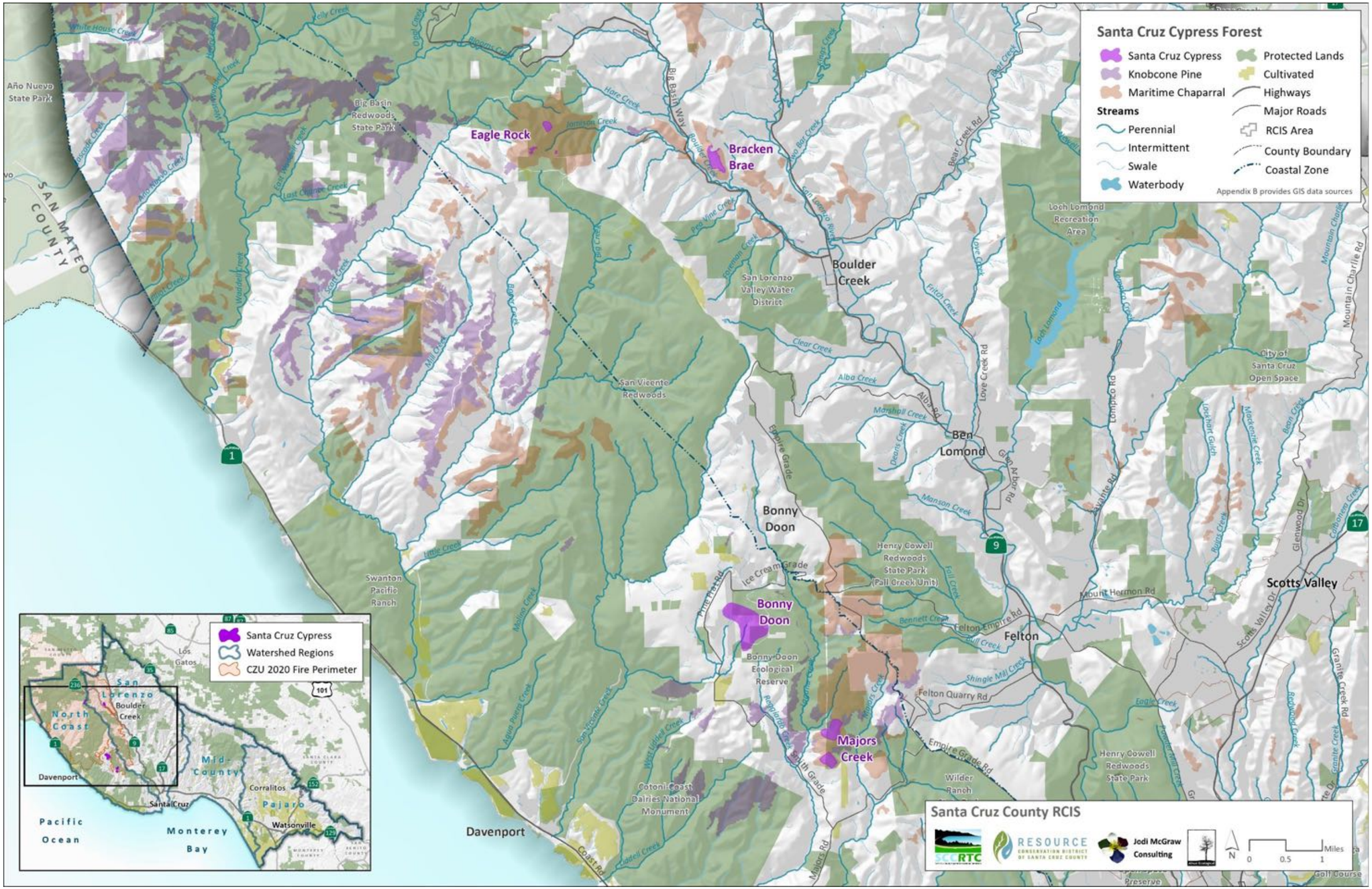

Figure 5-16: Santa Cruz Cypress Forest Conservation Element

Table 5-18: Conservation Strategy for Santa Cruz Cypress Forest

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
CYPRESS-G1: Promote persistence and ecological integrity of the Santa Cruz Cypress Forest, the rare species they support, and the ecological processes that sustain them.	**CYPRESS-O1:** Protect at least 82 additional acres of Santa Cruz Cypress Forest, including habitat within all four populations in the RCIS Area, to achieve the 90% target for conservation of this community (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**CYPRESS-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that: • Protect the Bracken Brae stand, which is entirely unprotected at this time; • Protect the Bonny Doon stand, where protection of habitat can facilitate goals for sandhills communities and species; • Protect the Majors Creek stand, the western portion of which is currently privately held; • Protect habitat that is suitable for, but not currently occupied by Santa Cruz cypress, including rock outcropping, xerorthents, and adjacent areas in the Boulder Creek Watershed near the Bracken Brae Santa Cruz cypress forest and suitable habitat along Empire Grade Road. These areas currently lack Santa Cruz cypress but feature many of the manzanita and other maritime chaparral species with which it co-occurs in the nearby Bracken Brae stand, and may be suitable for introduction of the species as part of CYPRESS-A6. • Protect habitat that can buffer Santa Cruz Cypress Forests and suitable habitat (described above), and provide opportunities for species migration and population expansion in response to climate change, which could render these areas more suitable. • Protect areas featuring a diverse mosaic of land facets (i.e., due to variable soils and/or topography) and that contain potential climate change refugia (e.g., cooler microclimates), to facilitate climate change adaptation and resilience.	• Development • Working lands • Incompatible Recreation • Unauthorized activities • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
	CYPRESS-O2: Restore and enhance Santa Cruz cypress habitat to promote natural structure and native species composition and ecosystem functions where they have been degraded or eliminated. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CYPRESS-A2: Restore habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, altered fire regimes, recreation impacts (e.g., clearing and trails), and erosion, to promote diverse native plant assemblages, and promote persistence of Santa Cruz cypress populations, based on an analysis of the highest priorities for restoration	Prioritize the following areas for restoration: • areas determined to be acutely negatively impacted by anthropogenic factors, through a future comparative analysis conducted following the 2020 CZU Lightning Complex Fire, which may have caused direct impacts to Santa Cruz cypress populations, as well as habitat degradation due to fire suppression, exotic plants, and post-fire erosion, among other factors which should be explored; • areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained); and • areas that can buffer and expand existing Santa Cruz Cypress Forest, including ecotones and transitional soils where Santa Cruz cypress and co-occurring chaparral shrubs could expand following fire, including the 2020 CZU Lightning Complex Fire, and in response to climate change, which could favor chaparral shrubs and Santa Cruz cypress.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Unauthorized activities • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		CYPRESS-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for Santa Cruz cypress and co-occurring fire-adapted species, to: 1) promote populations of Santa Cruz cypress, including population regeneration 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.	Prioritize the following areas for fire management: • Areas of the Bonny Doon population that are determined to be at risk of senescence due to fire exclusion, where fire or vegetation management that mimics its effects can be used to regenerate the Santa Cruz Cypress population and co-occurring fire-adapted species; • Areas at risk of too-frequent fire, which could reduce Santa Cruz cypress populations if insufficient seed is available to replace trees killed by the fire (i.e., stands facing immaturity risk); in these areas, use vegetation management to reduce the risk of anthropogenic fire. Use experimental approaches to management to enhance habitat and populations while increasing understanding of the ecology of the system and informing future management. Specifically, test the effectiveness of manual/mechanical thinning of the canopy and removal of litter on the soil surface at mimicking the beneficial effects of fire at promoting Santa Cruz cypress and co-occurring fire adapted species. Incorporate cultural practices where appropriate to achieve the biological goals and objectives.	• Altered disturbance regimes (Fire)	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
		CYPRESS-A4: Manage invasive plants and dense exotic plants that alter Santa Cruz Cypress Forest structure and species composition, and impact native species populations including Santa Cruz cypress, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or can promote increased fire frequency.	Prioritize actions that can maintain or increase populations of Santa Cruz cypress and co-occurring species, including by: • Eradicating or control invasive brooms, acacias, or other woody species that alter plant community structure and species composition, outcompete populations of rare species including Santa Cruz cypress, and increase the risk of unnatural fire; • Controlling and preventing the spread of exotic herbaceous plants, that can similarly degrade habitat and reduce rare species populations when abundant and can increase fire frequency; and • Preventing the invasion and spread of new invaders that can negatively impact the community and rare species populations, including by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Numerous co-benefited species
		CYPRESS-A5: Manage recreation that tramples or removes Santa Cruz cypress and associated species, and/or exposes soil to erosion, and enhance habitat degraded by recreation and attendant erosion.	Prioritize actions that: • Manage recreation in public lands featuring Santa Cruz Cypress forests, including: Big Basin State Park, Wilder Ranch State Park, and the Bonny Doon Ecological Reserve, to ensure it is compatible with protection of the sensitive community and rare species, by regulating access using signage, fences, trails, patrols, and associated outreach to recreators. And • Restore areas where incompatible use has removed habitat by denuding and/or causing erosion.	• Incompatible recreation	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
					• Numerous co-benefited species
CYPRESS-G2: Maintain and enhance connectivity of Santa Cruz Cypress Forest to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**CYPRESS-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**CYPRESS-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses..	Prioritize land as outlined for Action 1 in Objective 1 (CYPRESS-O1 CYPRESS-A1) and that can connect and expand protected Santa Cruz Cypress Forest, and maintaining intact plant communities connecting them, including maritime chaparral and knobcone forest, and sandhills/sand parkland. Priority habitat areas to connect include the following: • The Majors Creek stand, including the unprotected portion of Santa Cruz cypress forest, and maritime chaparral and knobcone pine forests along Empire Grade Road to connect the Majors Creek stand to the Eagle Rock stand; and • Maritime chaparral and knobcone pine forest within the Boulder Creek Watershed, to connect the Bracken Brae stand to the Eagle Rock stand.	• Development • Working lands • Altered disturbance regimes • Unauthorized activities • Climate change	• Santa Cruz cypress • White-rayed pentachaeta
	CYPRESS-O4: Restore and enhance degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CYPRESS-A2: Restore Habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, altered fire regimes, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize areas as outlined in Action 2 for Objective 2 (CYPRESS-O2 CYPRESS-A2) where restoration can connect habitat.	• Development • Working lands • Altered disturbance regimes • Exotic species • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion
	CYPRESS-O5: Enhance connectivity within habitat to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CYPRESS-A3: Manage fire and vegetation** using treatments that mimic fire's beneficial effects for Santa Cruz cypress and co-occurring fire-adapted species, to: 1) promote populations of Santa Cruz cypress, including population regeneration 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3) maintain a range of microclimatic and other abiotic	Prioritize areas where fire and vegetation management can maintain or expand Santa Cruz cypress forest.	• Altered disturbance regimes • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		conditions that can add resiliency in the face of climate change.			
CYPRESS-G3: Promote the recovery and long-term persistence of rare species.	**CYPRESS-O6:** Protect habitat occupied by, or suitable for, Santa Cruz cypress and other rare species. Measure progress toward this objective based on the acres of habitat protected.	**CYPRESS-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties as outlined in Action 2 for Objective 1 (CYPRESS O1 CYPRESS-A1) with an emphasis on habitat that supports, or provides suitable habitat for, Santa Cruz cypress, as well as any other focal, non-focal, and co-benefited species.	• Development • Working lands • Incompatible recreation • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
	CYPRESS-O7: Restore habitat to enhance population size and persistence of Santa Cruz cypress. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**CYPRESS-A2: Restore Habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, altered fire regimes, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize restoration as outlined in Action 2 for Objective 2 (CYPRESS O2 CYPRESS-A2) with an emphasis on restoring areas to provide suitable habitat for, and where possible, support populations of Santa Cruz cypress and other focal, non-focal, and co-benefited species and diverse assemblages of locally unique species.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Unauthorized activities • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
		CYPRESS-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for Santa Cruz cypress and co-occurring fire-adapted species, to: 1) promote populations of Santa Cruz cypress, including population regeneration 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3)	Prioritize fire and vegetation management: • As outlined in Action 3 for Objective 2 (CYPRESS O2 CYPRESS A3), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of Santa Cruz cypress and other focal, non-focal, and co-benefited species habitat; and • to enhance Santa Cruz cypress populations, while protecting lives and property (e.g., using shaded fuel breaks).	• Altered disturbance regimes • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.			
		CYPRESS-A4: Manage invasive plants and dense exotic plants that alter Santa Cruz Cypress Forest structure and species composition, and impact native species populations including Santa Cruz cypress, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or can promote increased fire frequency.	Prioritize invasive and exotic plant management as outlined in Action 4 of Objective 2 (CYPRESS-O2 CYPRESS-A4), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of Santa Cruz cypress and other focal, non-focal, and co-benefited species habitat. Specific management priorities should be determine based on a comprehensive assessment, as the recent fires may alter the distribution and abundance of exotic species, but priority actions are likely to include the following which occurred pre-fire: • Control of French broom and silver wattle (*Acacia dealbata*) in the Bonny Doon Ecological Reserve; • Control of silver wattle in the Majors Creek area;	• Exotic plants • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
		CYPRESS-A5: Manage recreation that tramples or removes Santa Cruz cypress and associated species, and/or exposes soil to erosion, and enhance habitat degraded by recreation and attendant erosion.	Prioritize recreation management as outlined in Action 5 of Objective 2 (CYPRESS-O2 CYPRESS-A5), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of Santa Cruz cypress and other focal, non-focal, and co-benefited species habitat. Specific management priorities should be determine based on a comprehensive assessment, as the recent fires may alter recreation use and resulting impacts, but are likely to include Wilder Ranch State Park where trail use occurred in and near the stands pre-CZU Lightning Complex fire.	• Incompatible recreation • Unauthorized activities	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
	CYPRESS-O8: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**CYPRESS-A6: Conduct species-specific actions** including surveys, seed banking and seed bulking, and introductions, applied research, and other species-specific actions for Santa Cruz cypress, white-rayed pentachaeta, and other rare species of the Santa Cruz cypress forest, to supplement habitat protection, restoration,	Prioritize actions for Santa Cruz cypress based on a comprehensive assessment of the species populations post-fire, to identify actions to: • maintain or increase the areal extent, abundance, and persistence (as assessed based on population demography); • safeguard genetic diversity for the species; and • Prevent loss of stands or entire populations. Projects that are likely to emerge as priorities based on currently available information include:	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Unauthorized activities • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited

		and management and enhancement actions, to ensure the persistence of the species.	• Conduct experimental (re-) introductions into areas of suitable but unoccupied habitat for Santa Cruz cypress, including:
			  ○ Open canopy areas adjacent to the populations, where Santa Cruz cypress is known to have occurred previously (e.g., the broader Eagle Rock area) and where it could have occurred pre-history;
			  ○ The rock outcroppings supporting maritime chaparral in the Boulder Creek Watershed near the Bracken Brae population;
			  ○ Suitable maritime chaparral communities along Empire Grade Road; and
			  ○ Areas within cooler microclimates, including north-facing slopes, which could provide climate change refugia.
			• Conduct introductions as experiments (i.e., with treatments and quantitative monitoring) to increase understanding of the rare species' ecology that is needed to inform conservation and management, as well as expand the areal extent, abundance, and thus population persistence.
			• Conduct analysis of the population genetics of Santa Cruz cypress, to inform actions to preserve genetic diversity, to inform introductions and reintroductions, prevent outbreeding depression by moving genetic material between populations that could break up locally adapted genetic complexes, and/or address potential loss of genetic diversity due to reproductive isolation of the small populations.
			• Evaluate the extent of disease including fungal pathogens and the potential implications for population persistence.
			• Establish *ex situ* seed banks for the four populations of Santa Cruz cypress in Santa Cruz County, as well as any outlying individuals and the Butano population (outside of the RCIS Area), to preserve genetic diversity and for use in future recovery actions (e.g., research and introductions). Seed has not yet been stored for the Eagle Rock and Butano populations (USFWS 2016).
			• Characterize the distribution, abundance, and population demographic of the Bonny Doon stand of Santa Cruz cypress, which has not been subject to detailed mapping or census.
			Conduct demographic analysis of the stands to assess population viability and identify demographic rates (e.g., seedling survivorship) that might be critical to population growth and persistence, to inform management actions (e.g., seedling protection).
					• Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			Prioritize actions for white-rayed pentachaeta to increase the distribution and abundance of the species to increase species persistence. Priority actions include: • Conduct surveys to identify populations in Santa Cruz County, including to evaluate re-emergence post fire (e.g., after the CZU Lightning Complex Fire); • Identify suitable but unoccupied habitat in Santa Cruz County and conduct (re-)introductions to expand the population; and • Conduct applied research to understand the species demography, seed biology (seed bank and germination requirements), reproduction, genetics, and response to vegetation management to inform conservation and management.		
		CYPRESS-A7: Conduct research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.	Prioritize projects that fill key data gaps in informing understanding of the conservation ecology and management of the system and rare species including: • Response to fire and vegetation management; • Effects of disease on populations including in response to climate change (i.e., drought); • Response to climate change, to inform development of climate adaptation strategies.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Unauthorized activities • Climate change	• Santa Cruz cypress • White-rayed pentachaeta • Ben Lomond spineflower • Ben Lomond wallflower • Mount Hermon June beetle • Zayante band-winged grasshopper • Mountain lion • Numerous co-benefited species
	CYPRESS-O9: Safeguard rock outcroppings to promote persistence of rare bryophytes and lichens as well as animals that use the important habitat features. Measure progress toward this objective based on the acres of habitat protected.	**CYPRESS-A8: Manage rock outcroppings** to prevent factors that degrade their habitat values.	Prioritize actions that protect the condition of rock outcroppings that provide native plant and animal habitat, such as Eagle Rock, which features a diverse assemblage of native bryophytes (*Grimmia torenii, Crossidium squamiferum, Syntrichia papillosissima,* and *Blindia acuta*). Priority actions can include: • Manage incompatible recreation and unauthorized activities to prevent human uses that remove epiphytes including mosses, liverworts, and lichens, as well as epiphytes (e.g., ferns) that grow on rocks, and that disrupt natural behaviors of animals, including bat roosting; and • Manage fire to prevent severe fires from impacting rock outcrops, which naturally have lower fuels but can experience more intense and destructive fire if fuels accumulate due to fire exclusion.	• Incompatible recreation • Altered disturbance regimes • Unauthorized activities • Climate Change	• Santa Cruz cypress • White-rayed pentachaeta • Numerous co-benefited species

5.3.16 Monterey Pine Forest

Monterey Pine Forest

Status and Rarity

- Sensitive Natural Community: Monterey Pine Forest and Woodland
    - Pinus radiata – Quercus agrifolia / Toxicodendron diversilobum (87.110.04): G3, S3
    - Pinus radiata / Toxicodendron diversilobum (87.110.02): G3, S2
- Monterey pine (*Pinus radiata*): CRPR 1B.1, G1, S1
- County of Santa Cruz Sensitive Habitat (indigenous Monterey Pine)
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

CNPS 2021

Distribution and Range

- 639 acres (0.2% of the RCIS Area) support Monterey Pine Forests that are naturally occurring, rather than planted forests or trees (Figure 5-17).
- Occurs on the North Coast in the Año Nuevo, Waddell Creek, Scott Creek, and Swanton Bluffs subwatersheds.

Key Ecological Elements

- Monterey Pine Forest is a natural community found well-drained soils on marine terraces and headlands that receive summer fog (marine layer) in four locations: Año Nuevo Area (Santa Cruz and San Mateo counties), Monterey Peninsula (Monterey County), Cambria (San Luis Obispo County), and Cedros and Guadalupe islands (Baja California).

- The namesake tree (*Pinus radiata*) has been widely planted as an ornamental species, windbreak, and for forest products; however, the natural community type is limited to just 20,000 acres (Rogers 2002).
- Monterey Pine Forest structure and species composition may vary among marine terraces of different elevations (and thus age), due to different habitat conditions (Cylinder 1995). Associated shrubs include poison oak (*Toxicodendron diversilobum*) and maritime chaparral species such as crinite manzanita (*A. crustacea* ssp. *crinita*) and (*Vaccinium ovatum*), with coast live oak (*Quercus agrifolia*) in some stands.
- Monterey Pine Forest occurs within the Swanton Floristic Area (*sensu* Mackenzie et al. 2011)—a 30-square mile area centered on the Scott Creek Watershed that features 10-12% of California's flora (West 2016), owing to its diverse geology, hydrology, disturbance history (including land use), and central location along the coast, where species with northern and southern affinities overlap in distribution.
- Several dominant plant species in the community are adapted to recurring fire, including Monterey pine; it features closed cones that open during fire, which creates bare mineral soil that promotes seedling establishment and increases seed production if the trees survive the fire, though canopy fires often kill trees (Vogl et al. 1977). Some cones open without fire such that periodic fire is not deemed essential to maintain Monterey pine stands (Davis and Borchert 2006). However, even-aged stands in some places suggest recruitment occurs primarily following fire.
- Most of the natural community in the RCIS Area burned in the 2020 CZU Lightning Complex Fire; in some areas (e.g., along roads), trees were subject to felling to reduce hazard. Many seedlings were observed at Rancho del Oso (Big Basin State Park) in the CZU burned area in May 2021 (D. Neubauer, pers. comm. 2021).
- Pine pitch canker (*Fusarium circinatum*), a fungus that cause swollen lesions that girdle branches, trunks, and exposed roots, and can cause tree mortality, could threaten populations, particularly those that are older.
- Native (naturally occurring) Monterey pine trees in Santa Cruz County feature several morphological features including a more branching habit, open gray-green needles, and often angled umbos, which suggest they may be hybrids between Monterey pine and knobcone pine (*P. attenuata*), which occur in close proximity in the Swanton Area (West 2016); genetic research is needed.
- Monterey pine forests provide overwintering habitat for western monarch butterfly, though senescence of Monterey pine, pitch canker, and associated tree pruning can reduce suitability of trees for roosts and clustering.

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting Monterey Pine Forest, which include the following most critical ones:

- Loss of remaining habitat in unprotected areas, due to development and infrastructure improvements.

- Vegetation management (e.g., to reduce fire risk) that is not compatible with maintaining the community.
- Fire outside of the natural regime of disturbance, including fire that is too frequent, and thus occurs prior to sufficient seeding being produced to replace populations of individuals killed by the fire.
- Habitat degradation due to exotic plants, such as French broom and other species that can be promoted by the 2020 CZU Lightning fire, and can outcompete native plants including Monterey pine for light and soil resources, alter the structure of the plant communities, increase fuels and thus risk of unnatural (too-frequent) fire, and degrade habitat for animals.
- Disruption of locally adapted genetic complexes and genetic erosion due to introduction of non-local genotypes (Rogers 2002).

Climate Change Vulnerability Assessment

Climate change is likely to impact Monterey Pine Forest as a result of the following:

- Monterey pine was rated as moderately vulnerable to climate change in a statewide assessment of vegetation (it received a score of 3.4 on a scale of 1 – 5 in which 1 is most vulnerable). This assessment reflects the following factors (Thorne et al. 2016):
    - **Sensitivity**: Neutral sensitivity to temperature and precipitation changes, low sensitivity to germination agents (as heat is a germination agent for this species), moderate sensitivity to dispersal agents (gravity and wind), but high sensitivity to fire, which kills individual trees.
    - **Adaptive Capacity**: The species was rated as having relatively high adaptive capacity due primarily to its adaptation to establishing post fire, and its seed longevity.
- Additional factors not considered in the statewide analysis that could increase the vulnerability of Monterey Pine Forest to climate change include:
    - **Rarity:** Monterey Pine Forest occupies a small area rendering it more vulnerable to environmental stochasticity (e.g., fire, disease outbreak). The small area also generally reduces the diversity of land facets (microtopography, geology, soils, etc.) that could provide refugia to climate change.
    - **Effects on Fog:** Monterey Pine Forest is restricted to areas along the coast in reach of the summer fog, and may require the moderated temperatures and/or increased humidity it creates such that it could be impacted if fog frequency is reduced. The impacts of climate change on fog incidence on the California Central Coast are uncertain, however (Langridge 2018).

The goals, objectives, actions, and priorities for the Monterey Pine Forest community element (Table 5-19) will help address the impacts of climate change by:

1. Protecting habitat, which will preserve genetic diversity in remaining populations, which is needed to adapt to climate change, and protect potential climate refugia, such as cooler microclimates (e.g., north-facing slopes) and areas adjacent to current occupied stands where the species can migrate over to stay with their 'climate envelope';
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of Monterey Pine populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and vegetation management (e.g., clearing for fuel breaks);
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat within and adjacent to disjunct stands of Monterey Pine Forest, to increase the ability of the species to establish in adjacent areas;
5. Introductions of Monterey pine into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations or extinctions due to demographic and environmental stochasticity; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-19 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Monarch butterfly (*Danaus plexippus*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

The Monterey Pine forest, along with its associated co-benefited species, will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Maritime Chaparral/Knobcone Pine Forest:** Actions conducted as part of CHAP A1 – A5 within suitable habitat for Monterey pine, including those maritime chaparral and knobcone pine forests that occur as a mosaic with the Monterey pine forest, by facilitating future population expansion (including as part of introductions); and
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of Monterey pine forest or as part of CONNECT-A1 through CONNECT-A4.

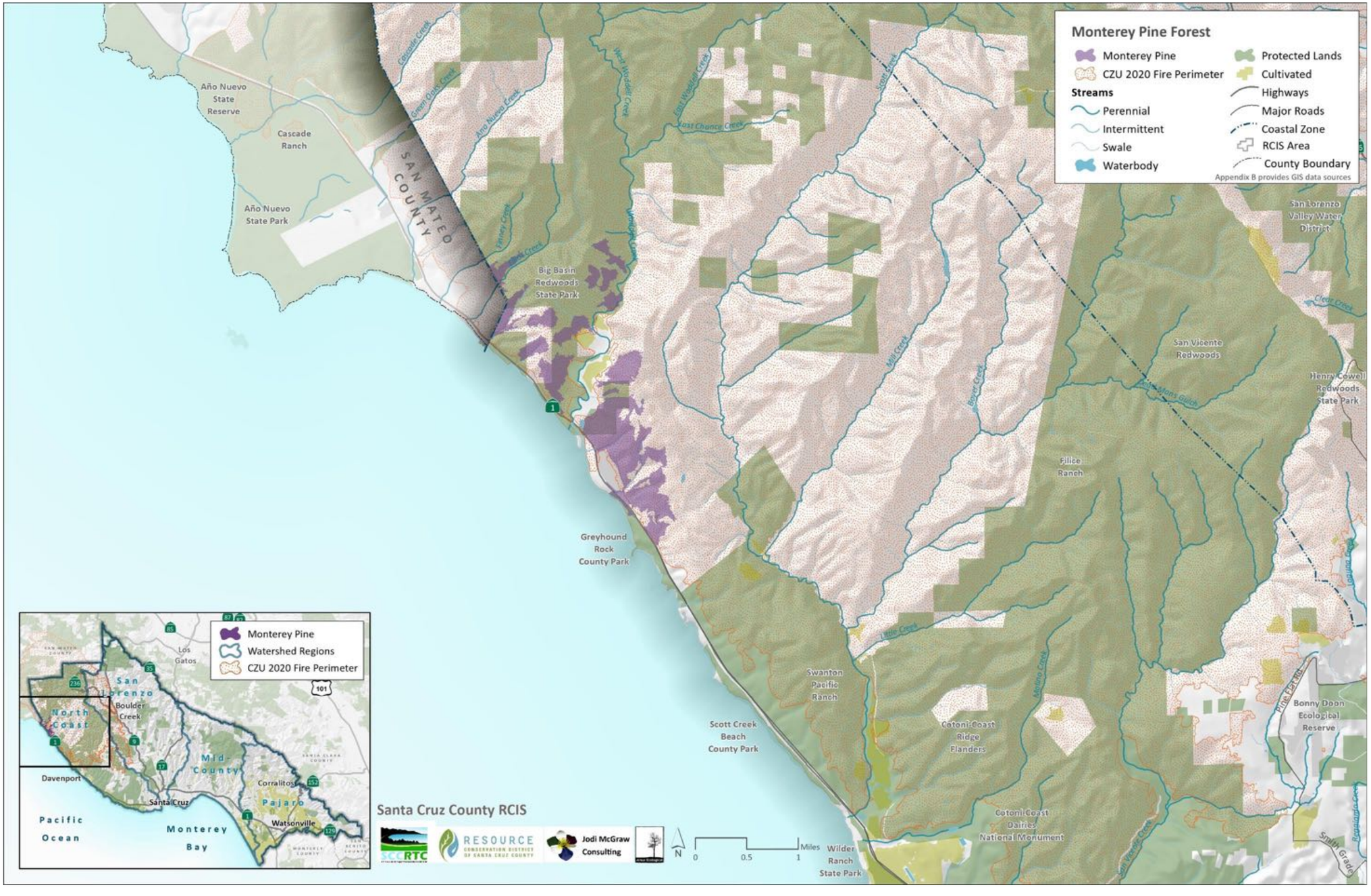

Figure 5-17: Monterey Pine Conservation Element

Table 5-19: Conservation Strategy for Monterey Pine Forest

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
PINE-G1: Promote persistence and ecological integrity of the Monterey Pine Forests, the rare species it supports, and the ecological processes that sustain it.	**PINE-O1:** Protect at least 314 additional acres of native Monterey Pine Forest to achieve the 90% target for conservation of this community element (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**PINE-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that can conserve relatively large, manageable portions of the remaining unprotected community in the RCIS Area. Specific priorities include: • Protect areas that can buffer and expand Big Basin State Park and Año Nuevo State Reserve. • Protect habitat that supports the diverse, representative assemblages of other native plants characteristic of the Swanton Floristic Province (West 2016). • Protect stands of Monterey pine and other trees that feature suitable overwintering habitat for monarch butterfly (Leong 1990, Xerces 2017); there is one overwintering site in the Swanton Bluffs Subwatershed, though others may exist (Xerces 2021). • Protect areas that can be effectively managed using fire, including larger areas away from development. • Protect areas featuring a diverse mosaic of land facets (i.e., due to variable soils and/or topography) and that contain potential climate change refugia (e.g., cooler microclimates), to facilitate climate change adaptation and resilience.	• Development • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• Monarch butterfly • Mountain lion • Numerous co-benefited species
	PINE-O2: Restore and enhance Monterey Pine Forest to promote natural structure and native species composition and ecosystem functions where they have been degraded or eliminated. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PINE-A2: Restore habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, the recent fire and associated suppression efforts, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize the following areas for restoration: • Areas degraded by prior land uses, including agriculture, roads, fuel breaks, or by the CZU Lightning Complex Fire and its associated suppression efforts, including tree felling, where Monterey pine and associated species in the community are reduced or eliminated; • Areas degraded by invasive plants, including brooms, pampas grass, and dense exotic herbaceous plants, where natural community structure and species composition can be restored; • Stands of Monterey pine and associated trees that can provide suitable overwintering habitat for Monarch butterfly; • Areas that can increase populations of the rare species (focal, non-focal, and co-benefited species); • Areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained); and • Areas that can help connect existing habitat.	• Development • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• Monarch butterfly • Mountain lion • Numerous co-benefited species
		PINE A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species,	Prioritize fire management in areas at risk of too-frequent fire, including where dense fuels are accumulating following the CZU Lightning Complex Fire where a fire in the next 50 years could potentially preclude population regeneration if there is insufficient seed available to replace	• Altered disturbance regimes (Fire)	• Monarch butterfly • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		to: 1) promote populations of Monterey pine including population regeneration; 2) create and maintain a mosaic of native plant associations of various successional stages and thus habitat conditions to promote diversity; and 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.	individuals killed by the fire (i.e., stands facing immaturity risk), in these areas, use vegetation management to reduce the risk of anthropogenic fire. Use experimental approaches to fire management to enhance habitat and populations while increasing understanding of the ecology of the system and informing future management. Specifically, test the effectiveness of alternative treatments (e.g., fire and manual/mechanical thinning) to evaluate whether they mimic the beneficial effects of fire at promoting fire-adapted species.		
		PINE-A4: Manage invasive plants and dense exotic plants that alter Monterey Pine Forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or could promote increased fire frequency.	Prioritize actions that can maintain intact natural communities by abating threat, or restore already degraded by exotic plants, including by: • Eradicating or control invasive eucalyptus, acacias, brooms, or other woody species that alter plant community structure and species composition, outcompete populations of rare plant species, alter native animal habitat (e.g., for monarch butterfly), and/or increase the risk of unnatural fire; • Controlling and preventing the spread of exotic herbaceous plants, that can degrade habitat and reduce rare species populations when abundant, and could increase fire frequency through addition of fine fuels; and • Preventing the invasion and spread of new invaders that can negatively impact the community and rare species populations, including by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes	• Monarch butterfly • Mountain lion • Numerous co-benefited species
		PINE-A5: Manage recreation that tramples plants, sensitive habitat features, and/or exposes soil to erosion, and enhance habitat degraded by recreation and attendant erosion.	Prioritize actions that: • Manage recreation in public lands featuring Monterey Pine Forest including Big Basin State Park, to ensure it is compatible with protection of the sensitive community and rare species, by regulating access using signage, fences, trails, patrols, and associated outreach to recreators; and • Restore areas where incompatible use has removed habitat by denuding and/or causing erosion.	• Incompatible recreation	• Monarch butterfly • Mountain lion • Numerous co-benefited species
PINE-G2: Maintain and enhance connectivity of	**PINE-O4:** Protect habitat that can connect existing protected habitat and other core habitat areas	**PINE-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat	Prioritize land as outlined in Action 1 for Objective 1 (PINE-O1 PINE-A1) that can connect and expand protected Monterey Pine Forest, as well as other intact plant communities connecting them, including coastal	• Development • Working lands • Incompatible recreation	• Monarch butterfly • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
Monterey Pine Forest to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	from conversion and other degradative land uses.	prairies, maritime chaparral, knobcone pine, and redwood forest. Priority habitat areas to maintain connectivity between including the following: • Swanton Bluffs Subwatershed and Waddell Creek Subwatershed; • Waddell Creek Subwatershed and Año Nuevo Subwatershed, a portion of which is San Mateo County outside of the RCIS Area but where landscape connectivity will be essential for protecting Monterey Pine Forest in the region.	• Unauthorized activities	• Numerous co-benefited species
	PINE-O5: Restore degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PINE-A2: Restore Habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, the recent fire and associated suppression efforts, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize areas as outlined in Action 2 for Objective 2 (PINE-O2 PINE-A2) where restoration can connect habitat. These may include cultivated areas flanking Waddell Creek, and areas of vegetation clearing as part of fire suppression in the Swanton Bluffs Subwatershed.	• Development • Working lands • Altered Fire Regimes • Incompatible recreation • Unauthorized activities • Exotic plants	• Monarch butterfly • Mountain lion • Numerous co-benefited species
	PINE-O6: Enhance connectivity within habitat to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PINE-A3: Manage fire and vegetation** using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) promote populations of Monterey pine including population regeneration; 2) create and maintain a mosaic of native plant associations of various successional stages and thus habitat conditions to promote diversity; and 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.	Prioritize areas as outlined in Action 3 for Objective 2 (PINE-O2 PINE-A3) where fire and vegetation management can prevent further fragmentation of Monterey Pine Forest, and where possible restore habitat to increase connectivity.	• Altered Fire Regimes • Climate Change	• Monarch butterfly • Mountain lion • Numerous co-benefited species
		PINE-A4: Manage invasive plants and dense exotic plants that alter Monterey Pine Forest structure and species composition, impact native	Prioritize areas as outlined in Action 4 for Objective 2 (PINE-O2 PINE-A4) where invasive plant removal can re-create the natural community structure and species composition of the Monterey Pine Forest, to promote habitat connectivity. Priorities include control of eucalyptus, Montrey cypress and jubata grass in Big Basin State Park.	• Exotic plants • Climate Change	• Monarch butterfly • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		species populations, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or could promote increased fire frequency.			
PINE-G3: Promote the recovery and long-term persistence of rare species.	**PINE-O7:** Protect habitat occupied by, or suitable for, rare species that rely on Monterey Pine Forest. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PINE-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties as outlined in Action 1 for Objective 1 (PINE-O1 PINE-A1) with an emphasis on habitat that: • supports, or provides suitable habitat for, Monterey pine or monarch butterfly; • supports other focal, non-focal, and co-benefited species; • can protect large areas of habitat that can be effectively managed using fire; and • expand, buffer, or connect existing protected habitat, including that in Big Basin State Park and Año Nuevo State Reserve.	• Development • Working lands • Incompatible recreation • Climate change	• Monarch butterfly • Mountain lion • Numerous co-benefited species
	PINE-O8: Restore habitat to enhance population size and persistence of rare species that rely on Monterey Pine Forest. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PINE-A2: Restore Habitat** that has been degraded by prior clearing (e.g., for fuel breaks), exotic plants, the recent fire and associated suppression efforts, recreation impacts (e.g., clearing and trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize restoration as outlined in Action 2 for Objective 2 (PINE-O2 PINE-A2) with an emphasis on restoring areas that: • support, or provide suitable habitat for Monterey pine and monarch butterfly; • support other focal, non-focal, and co-benefited species; • can be permanently protected or where restoration actions can otherwise be sustained. Priority restoration actions include: • Re-establishing Monterey pine stands in areas where the species was eliminated by anthropogenic causes (e.g., land use); • Enhancing overwintering habitat for monarch butterfly, by establishing and maintain suitable cluster trees and planting nectaring plants, among other treatments.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Monarch butterfly • Mountain lion • Numerous co-benefited species
		PINE-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) promote populations of Monterey pine including population regeneration; 2) create and maintain a mosaic of native plant associations of various successional stages and	Prioritize fire and vegetation management as outlined in Action 3 for Objective 2 (PINE-O2 PINE-A3), with an emphasis on: • areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on Monterey Pine Forest, including Monterey pine, monarch butterfly, and other focal, non-focal, and co-benefited species. • Design and implement vegetation management actions to protect lives and property (e.g., fuel breaks) to enhance habitat and populations of rare species, where possible.	• Altered disturbance regimes • Climate change	• Monarch butterfly • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		thus habitat conditions to promote diversity; and 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change.			
		PINE-A4: Manage invasive plants and dense exotic plants that alter Monterey Pine Forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire and vegetation management or other clearing, and/or could promote increased fire frequency.	Prioritize invasive and exotic plant management as outlined in Action 4 for Objective 2 (PINE-O2 PINE-A4), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on Monterey Pine Forest, including Monterey pine, monarch butterfly, and other focal, non-focal, and co-benefited species. Specific management priorities should be determine based on a comprehensive assessment, that addresses effects of the recent fires, which can alter the distribution and abundance of exotic species, but priority actions are likely to include the following which occurred pre-fire: • Removal of eucalyptus; and • Removal of pampas grass.	• Exotic plants • Climate change	• Monarch butterfly • Mountain lion • Numerous co-benefited species
		PINE-A5: Manage recreation that tramples plants, sensitive habitat features, and/or exposes soil to erosion, and enhance habitat degraded by recreation and attendant erosion.	Prioritize recreation management as outlined in Action 5 for Objective 2 (PINE-O2 PINE-A5), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of rare species that rely on Monterey Pine Forest including Monterey pine, monarch butterfly, and other focal, non-focal, and co-benefited species. Specific management priorities should be determine based on a comprehensive assessment but may include Big Basin Redwoods State Park.	• Incompatible recreation • Unauthorized activities	• Monarch butterfly • Mountain lion • Numerous co-benefited species
	PINE-O7: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**PINE-A6: Conduct species-specific actions** including surveys, captive breeding/rearing, seed banking and seed bulking, and other species-specific actions for Monterey pine, monarch butterfly, and other rare species, to supplement habitat protection, restoration, and management and enhancement actions, to	Prioritize actions based on a comprehensive assessment to identify management and enhancement needed to: • Maintain or increase the areal extent, abundance, and persistence; and • Prevent loss of populations. Projects that are likely to emerge as priorities based on currently available information include: • (Re-)introduce Monterey pine into areas of suitable but unoccupied habitat, including where the species occurred historically but was eliminated by lands use, fire management (e.g., clearing), or other anthropogenic factors.	• Development • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• Monarch butterfly • Numerous co-benefited species Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		ensure the persistence of the species.	○ Suitable areas should be determined through a habitat characterization and introductions should be implemented through experimental trials designed to evaluate effectiveness of introduction methods and suitability of sites. ○ All reintroductions should utilize seeds from native (rather than planted) trees to maintain locally adapted genetic complexes. • Establish *ex situ* seed banks for Monterey pine through collection of seed from native (rather than planted) trees in the natural stands, to ensure the maintenance of genetic diversity and support population recovery actions in the event of dramatic population declines that would cause bottlenecks and threaten persistence. • Monitoring for the impacts of pine pitch canker, or other diseases that could impact Monterey Pine population persistence and the structure and composition of the natural community; • Promoting use of suitable Monterey Pine Forests by overwintering monarch butterflies, including by targeting restoration to achieve necessary conditions of the groves (e.g., suitable cluster trees) and planting native plants that can provide a source of nectar for adults.		
		PINE-A7: Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.	Prioritize projects that fill key data gaps in informing understanding of the conservation ecology and management of community and rare species including: • Response to fire and vegetation management; • Response to climate change, to inform development of climate adaptation strategies.	• Development • Working lands • Exotic plants • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• Monarch butterfly • Numerous co-benefited species Numerous co-benefited species

5.3.17 Oak Woodland and Forest

Oak Woodlands and Forests

Status and Rarity

- Numerous sensitive plant communities
    - Shreve oak forests (*Quercus parvula* var. *shrevei*; 71.085.00; G2, S2) [Provisional Alliance]
    - Coast live oak woodland and forest (*Quercus agrifolia*; 71.060.00; G5, S4)
    - Canyon live oak forest and woodland (*Quercus chrysolepis*; 71.050.00; G5, S5)
    - Black oak forest and woodland (*Quercus kelloggii*; 71.000.00; G4, S4)
    - Mixed oak forest and woodland (featuring *Q. agrifolia, kelloggii, lobata, chrysolepis, and parvula* var. *shrevei*; 71.000.00; G4, S4)
- County of Santa Cruz
    - Sensitive Habitat (all oak woodlands)
    - Special Forest (San Andreas Live Oak)
- May be an Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

- Pavlik et al. 1991
- Davis et al. 2016
- CNPS 2021

Distribution and Range

- 25,381 acres (8.9% of the RCIS Area) of oak woodlands and forests, which includes (Figure 5-18):
    - 19,055 acres (6.7% of the RCIS Area) of mapped coast live oak woodland

- 6,326 acres (2.2% of the RCIS Area) of mapped coastal mixed hardwood

- Found throughout the RCIS Area in the hills and mountains at a range of elevations

Key Ecological Elements

- The Oak Woodland and Forest Element consists of numerous plant communities that are dominated (or co-dominated) by oaks (*Quercus* spp.), including coast live oak (*Q. agrifolia* var. *agrifolia*,), Shreve oak (*Q. parvula* var. *shrevei*), canyon live oak (*Q. chrysolepis*), black oak (*Q. kelloggii*), and valley oak (*Q. lobata*). These and other oaks hybridize readily, leading to genetic diversity in the RCIS Area.

- Co-occurring trees, which include hardwoods such as big leaf maple (A*cer macrophyllum*), Pacific madrone (*Arbutus menziesii*), tanoak (*Notholithocarpus densiflorus*), and California bay (*Umbellularia californica*), conifers such as Pacific Douglas-fir (*Pseudotsuga menziesii*) and coast redwood (*Sequoia sempervirens*), with the latter more abundant in the more mesic sites. The understory generally supports shade-tolerant herbs and vines in woodlands and forests, with chaparral shrubs occurring at ecotones with maritime chaparral. Oak savannas are scattered in the lower-elevation foothills and feature grassland species between oak canopies. Understory species diversity in Oak Woodlands and Forests (including savannas) is high, as is the diversity and abundance of lichens and mosses (Davis et al. 2016)

- Oak Woodlands and Forests occur as a mosaic with other vegetation in the RCIS Area, including maritime chaparral, grassland, and redwood forest. They tend to occur on loam soils in slopes and valley bottoms in mid-elevation areas that are moderately mesic; coast redwood forests occur in wetter and cooler areas, while grasslands and maritime chaparral inhabit drier microsites.

- Oak Woodlands and Forests support abundant wildlife, due in part to the nutrient-rich acorns, complex structure, cavities, and dead standing longs which provide an important food source for many species including black-tailed deer (*Odocoileus hemionus columbianus*) and acorn woodpecker (*Melanerpes formicivorus*). Rare species that rely on Oak Woodlands and Forests include slender silver moss (*Anomobryum julaceum*), robust spineflower (*Chorizanthe robusta* var. r*obusta*), woodland woollythreads (*Monolopia gracilens*) Santa Cruz black salamander (*Aneides niger*), Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), and mountain lion (*Puma concolor*).

- Oak Woodlands and Forest species are adapted to recurring fire. The fire return interval in coast live oak woodlands (the dominant type for which there has been research) is estimated to be 30 to 100 years (CNPS 2021), though indigenous burning may have resulted in intervals that were every one to two years (Greenlee and Langenheim 1990). Large oaks are generally fire resistant and recover from crown fires by resprouting; smaller trees including seedlings can be killed by fire (Sugihara et al. 2006).

- Fire exclusion has promoted increased establishment of native conifers in oak woodlands, including Pacific Douglas-fir, which would be killed by more frequent fire. These trees and other understory fuels that accumulate between fire may increase the fuel load and thus the intensity, severity, and areal extent of fires, causing greater mortality of even larger trees than would be expected with more frequent, lower-severity fires. The 2020 CZU Lightning Fire burned 3,053 acres (12%) of the Oak Woodland and Forest communities in the RCIS Area; research is needed to understand the long-term implications for the fire for the structure, species composition, and ecosystem functions of the forests.
- Oak woodlands and savannas were historically used to graze livestock including cattle throughout much of the RCIS Area, with this land use continuing primarily in large properties in the Pajaro Hills and the North Coast.
- Oak Woodlands and Forests provide important ecosystems functions and services in the RCIS Area, including maintaining habitat quality in coastal streams important for rare salmonids and other fish, controlling erosion, and carbon sequestration. They are also key to maintenance of habitat connectivity for widespread species including black-tailed deer and mountain lion.

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting the Oak Woodlands and Forests, which include the following most critical ones:

- Loss of remaining habitat, due to development, cultivated agriculture (e.g., vineyards, tree farms, and orchards), and other improvements including infrastructure;
- Fire outside of the natural regime of disturbance, including fire exclusion which promotes establishment of native conifers, and fire that is too intense or severe and kills adult trees, including as a result of fire exclusion in the landscape;
- Habitat degradation due to exotic plants, such as French broom, Monterey pine, eucalyptus, and other species, which outcompete native plants for light and soil resources, and alter the structure of the plant communities, degrading habitat for animals;
- Habitat degradation due to incompatible recreation and associated erosion;
- Habitat degradation due to incompatible grazing, which can reduce the diversity of native plants and limit oak recruitment;
- Habitat degradation caused by fuel reduction projects that are not compatible with maintaining habitat, including those that designed to create “park like” vegetation, which is less suitable for species that require understory vegetation including rare amphibians; and
- Sudden oak death caused by a fungal pathogen, *Phytophthora ramorum*, which was discovered in the San Francisco Bay Area in the mid-1990s, infects 30 native California

woody and herbaceous species, causing lethal twig and stem cankers including in coast live oak, Shreve oak, and black oak, as well as tan oak (Rizzo and Garbelotto 2003).

Climate Change Vulnerability Assessment

Oak woodlands and forests in the Santa Cruz Mountains have "High" vulnerability to climate change (EcoAdapt 2021) due to the following:

- Exposure to:
    - projected temperature increases and highly variable precipitation including drought, can together increase the climatic water deficit (i.e., reduce soil moisture) that can create drought stress for oak woodland plants, and reduce acorn production and seedling establishment and survivorship for oaks;
    - The timing of precipitation, which could inhibit oak seedling establishment if heavy rains create saturated soils;
- Moderate sensitivity to changes including the following:
    - Narrow Habitat Specificity: while coast live oak and Shreve oak are fairly widespread, black oak, valley oak, and to a lesser extent, canyon live oak, occupy more narrow distributions within the RCIS Area;
    - Interactions with Fire: Though oaks are adapted to fire, climate-driven changes in fire regimes may combine with the legacy of fire exclusion to cause more frequent or intense fires that kill oaks and drive shifts in species composition and forest structure;
    - Interactions with Disease: Increases in winter rainfall, which can promote spore production and transmission of the pathogen that causes sudden oak death;
    - Interactions with Pests: Increased insect outbreaks, caused by non-native insects such as goldspotted oak borer (*Agrilus auroguttatus*), which has caused mortality of oaks linked to drought stress in southern California (Coleman and Seybold 2008), could impact oaks if the pests expand their range northward as the climate warms (Venette et al. 2015);
    - Effects of non-climate stressors, including exotic plants, incompatible livestock grazing (which can reduce recruitment), nitrogen deposition, and development.
- Moderate adaptive capacity, due to:
    - Habitat diversity in oak woodlands, which create a range of microclimates that can be suitable for native animals and understory plants;
    - Long Life Span of oak trees, which may increase their resistance to changing conditions, particularly as adult trees are more resistant to fire, drought, and other climate-related stressors.
    - Effective restoration and management strategies available to address non-climate stressors impacting oaks woodlands and forests, including conservation grazing, prescribed fire, and active revegetation.

Overall, canyon live oak and black oak are anticipated to experience dramatic declines in their areal extent within the RCIS Area by mid-century, while coast live oak and valley oak woodlands are anticipated to increase (EcoAdapt 2021).

The goals, objectives, actions, and priorities for the Oak Woodland and Forest (Table 5-20) will help address the impacts of climate change by:

1. Protecting habitat, with an emphasis on areas that can connect and buffer existing protected areas and that feature cooler microsites and other where the future climate is anticipated to be conductive to persistence of the communities and the species they support;
2. Restoring and enhancing habitat, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and recreation, as well as emergent diseases and pests; and
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat, to facilitate the movement of species and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency;
5. Introducing rare species into suitable but unoccupied habitat, to increase populations and reduce the potential for extirpations or extinctions; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-20 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- White-rayed pentachaeta (Pentachaeta bellidiflora) [NF]
- robust spineflower (*Chorizanthe robusta* var. *robusta*) [NF]
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- California tiger salamander (*Ambystoma californiense*) [NF]
- Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) [F]
- Southwestern pond turtle (*Actinemys pallida*)

- ringed-tailed cat (*Bassariscus astutus*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

The Oak Woodland and Forest, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following:

- **Redwood and Douglas-Fir Forests:** Actions conducted as part of REDWOOD-A1 through REDWOOD-A6, as the forest communities occur as a mosaic and may experience transitions in response to climate change;
- **Ponds, Lakes, and Reservoirs**: Actions to protect, restore, and enhance upland habitat for landscape connectivity conducted as part of PLR-A14 through PLR-A18;
- **Connectivity**: Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of Oak Woodland and Forests as part of CONNECT-A1 through CONNECT-A4; and
- **Working Lands**: Actions to protect and manage working lands conducted as part of as part of WORKING-A1 through WORKING-A6 where they occur in Oak Woodlands and Forests, which provide rangelands and occur within timber harvest areas.

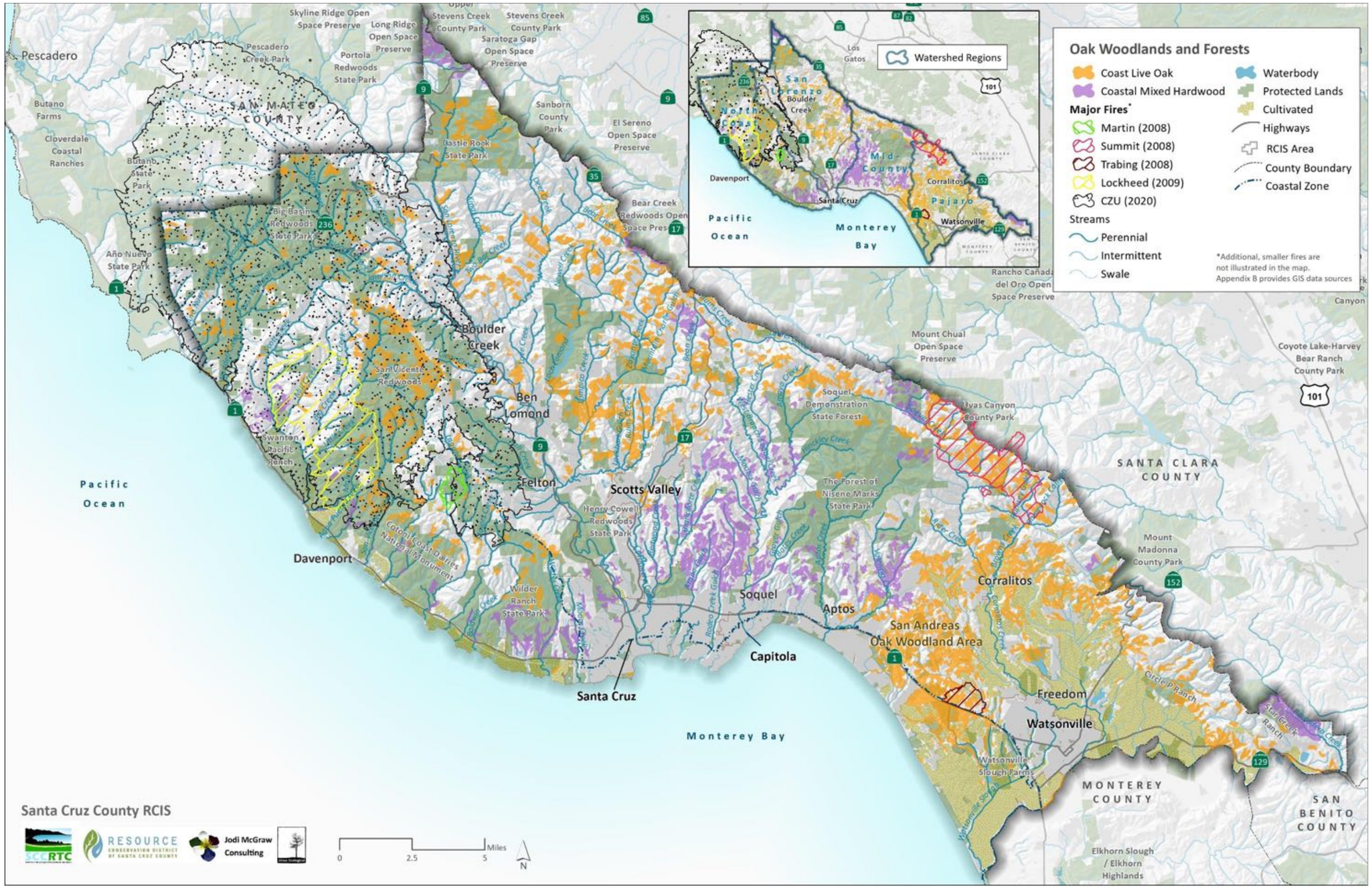

Figure 5-18: Oak Woodlands and Forests Conservation Element

Table 5-20: Conservation Strategy for Oak Woodlands and Forests

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
OAK-G1: Promote persistence and ecological integrity of the Oak Woodland and Forest communities, the rare species they support, and the ecological processes that sustain them.	**OAK-O1:** Protect at least 11,878 additional acres of oak woodland forest, including 8,813 acres in areas of coast live oak woodland and 3,065 acres in coastal mixed hardwood forest, to achieve the 75% target for conservation of this community element (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**OAK-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that can collectively conserve large, relatively intact forests of each of the main types in the RCIS Area, and that feature a range of micro- and meso-climatic conditions and land facets to support the diversity of associations and the species they support. Specific priorities include: • Protect habitat that supports rare and locally unique species that inhabit oak woodlands and forests, include slender silver moss (*Anomobryum julaceum*), robust spineflower (*Chorizanthe robusta* var. r*obusta*), woodland woollythreads (*Monolopia gracilens*) Santa Cruz black salamander (*Aneides niger*), Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*), and mountain lion (*Puma concolor*); • Protecting areas of Shreve oak woodland and forest, which are restricted to the Santa Cruz and Santa Lucia range mountains, and "San Andreas Oak Woodlands", which are unique coast live oak woodlands found on sandy soils in the western Pajaro Valley Area; • Protect areas that can be effectively managed to address altered fire regimes and other stressors, including larger areas away from development; • Protect areas featuring a diverse mosaic of land facets (i.e., due to variable soils and/or topography) and that contain potential climate change refugia (e.g., cooler microclimates), to facilitate climate change adaptation and resilience; and • Protect areas that provide additional co-benefits for water supply/quality, including streams.	• Development • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	OAK-O2: Restore or enhance oak woodland and forest to promote the natural structure, native species composition, and ecosystem functions where they have been degraded or eliminated. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**OAK-A2: Restore habitat** that has been degraded by prior land uses, exotic plants, altered fire regimes, recreation impacts (e.g., extensive or eroded trails), erosion, or sudden oak disease, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize the following areas for restoration: • Areas degraded by prior land uses, including disused agricultural areas (e.g., vineyards, orchards, etc.) or other areas that have been cleared; • Areas degraded by invasive plants, including eucalyptus, Monterey pine, acacias, and brooms, where natural community structure and species composition can be restored; • Areas that can increase populations of the rare species (focal, non-focal, and co-benefited species); • Areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained);	• Development • Working lands • Altered disturbance regimes • Exotic plants • Unauthorized activities • Incompatible recreation • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Areas that can help connect existing habitat and/or are adjacent to habitat that support rare and locally unique species; and • Areas that feature vegetative structure, and/or downed wood that provides food and cover for native animals.		• Mountain lion • Numerous co-benefited species
		OAK-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, including cultural burning where appropriate, to: 1) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity, 2) address encroachment of native conifers including Pacific Douglas-fir; 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change; 4) reduce the threat of catastrophic wildfire in the landscape; and 5) reduce fuels without degrading habitat for rare species.	Prioritize the following areas for fire management: • Long-unburned areas featuring altered structure and species composition (e.g., Pacific Douglas-fir encroachment) and fuels that create a risk of intense, severe, or large wildfire; • Areas that burned recently, where return of anthropogenic fire could have negative implications for forest succession and recovery. For fuel reduction projects, prioritize projects that maintain appropriate understory vegetation, particularly habitat for rare species including California red-legged frog and California tiger salamander, including the San Andreas oak woodland.	• Altered disturbance regimes (Fire)	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		OAK-A4: Manage invasive plants and dense exotic plants that alter the forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire or other vegetation management, and /or could promote increased fire frequency.	Prioritize actions that can maintain intact natural communities by abating threat, or restore already degraded by exotic plants, including by: • Eradicating or control invasive eucalyptus, acacias, brooms, ivy species, and other invasive plants that alter plant community structure and species composition, outcompete populations of rare plant species, degrade native animal habitat, and/or increase the risk of unnatural fire; and • Preventing the invasion and spread of new invaders that can negatively impact the community and rare species populations, including by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
					• Numerous co-benefited species
		OAK-A5: Manage recreation that tramples plants, sensitive habitat features, and/or exposes soil to erosion, and could promote the spread of pathogens, and enhance habitat degraded by recreation and attendant erosion.	Prioritize projects that: • Protect habitat occupied by or suitable for the rare species populations (including focal, non-focal, and co-benefited species) that inhabit oak woodlands and forests; • Manage recreation in lands featuring significant oak woodlands and forests including, including Castle Rock and Wilder Ranch state parks, Quail Hollow Ranch County Park, San Vicente Redwoods, and Cotoni-Coast Dairies National Monument, to ensure it is compatible with protection of the sensitive communities and rare species, by regulating access using signage, fences, trails, patrols, and conducting associated outreach to recreators and user groups to promote practices that minimize risk of spread of sudden oak death or other pathogens; and • Restore areas where incompatible use has removed habitat by denuding habitat and/or causing erosion.	• Incompatible recreation • Unauthorized activities	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
OAK-G2: Maintain and enhance connectivity of Oak Woodlands and Forests to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**OAK-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**OAK-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize land as outlined for Action 1 for Objective 1 (OAK-O1 OAK A1) and that can connect and expand protected Oak Woodland and Forest, as well as the associated intact plant communities connecting them. Priority habitat areas to protect for connectivity include the following: • Habitat in the Upper Corralitos and Pajaro Hills large habitat patches (*Connectivity Element*); • Habitat between Nisene Marks State Park and the Soquel Demonstration State Forest and Mount Madonna County Park and Star Creek Ranch further south, which can maintain connected woodland and forest habitat along the spine of the Santa Cruz Mountains between Aptos, Upper Corralitos, and Pajaro Hills large habitat patches (*Connectivity Element*); and • Habitat within, or in proximity to, population boundaries for focal species and other co-occuring species, particularly, within Larkin Valley/Freedom, and Ellicott-Buena Vista boundaries for Santa Cruz long-toed salamander.	• Development • Working lands • Altered disturbance regimes • Incompatible recreation • Unauthorized activities • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	OAK-O4: Restore degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective	**OAK-A2: Restore Habitat** that has been degraded by prior land uses, exotic plants, altered fire regimes, recreation impacts (e.g., extensive or eroded trails), erosion, or sudden oak	Prioritize areas as outlined in Action 2 for Objective 2 (OAK-O2 OAK A2) where restoration can connect habitat.	• Development • Working lands • Incompatible recreation • Unauthorized activities	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	based on the acres of habitat restored or enhanced.	disease, to promote natural community structure and species composition, and ecosystem functions and services.		• Altered disturbance regimes • Exotic species • Climate change	• California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	OAK-O5: Enhance connectivity within habitat to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**OAK-A3: Manage fire and vegetation** using treatments that mimic fire's beneficial effects for fire-adapted species, including cultural burning where appropriate, to: 1) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity, 2) address encroachment of native conifers including Pacific Douglas-fir; 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change; 4) reduce the threat of catastrophic wildfire in the landscape; and 5) reduce fuels without degrading habitat for rare species.	Prioritize areas as outlined in Action 3 for Objective 2 (OAK-O2 OAK-A3) where fire and vegetation management maintain connectivity in Oak Woodland and Forest.	• Altered disturbance regimes • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		OAK-A4: Manage invasive plants and dense exotic plants that alter the forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire or other	Prioritize areas where invasive plant removal as outlined in Action 4 for Objective 2 (OAK-O2 OAK-A4), can re-create the natural community structure and species composition of the Oak Woodlands and Forests, to promote habitat connectivity. Specific priorities include restoring forests invaded by eucalyptus and ivy in the San Andreas Oak Woodland community in the western Pajaro Valley, to restore important upland habitat used by dispersing Santa Cruz long-toed salamander.	• Exotic plants • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		vegetation management, and /or could promote increased fire frequency.			• Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
OAK-G3: Promote the recovery and long-term persistence of rare species.	**OAK-O6:** Protect habitat occupied by, or suitable for, rare species that utilize Oak Woodland and Forest. Measure progress toward this objective based on the acres of habitat protected.	**OAK-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties as outlined in Action 1 for Objective 1 (OAK-O1 OAK-A1), with an emphasis on habitat that: • supports, or provides suitable habitat for rare species, which include focal, non-focal, and co-benefited species; • can protect large areas of habitat that can be effectively managed and will be resilient to climate change and other anthropogenic impacts; and • expand, buffer, or connect existing protected habitat to increase the size of habitat patches to promote population size and persistence. Specific priorities for protection include the San Andreas Oak Woodland community in the western Pajaro Valley and Aptos regions, which support robust spineflower and Monterey spineflower, and provide important upland habitat for Santa Cruz long-toed salamander.	• Development • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	OAK-O7: Restore habitat to enhance population size and persistence of rare species that rely on Oak Woodland and Forest. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**OAK-A2: Restore Habitat** that has been degraded by prior land uses, exotic plants, altered fire regimes, recreation impacts (e.g., extensive or eroded trails), erosion, or sudden oak disease, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize restoration as outlined in in Action 2 for Objective 2 (OAK-O2 OAK-A2), with an emphasis on restoring areas that: • supports, or provides suitable habitat for rare species, which include focal, non-focal, and co-benefited species; and • can be permanently protected or where restoration actions can otherwise be sustained. Specific priorities for protection include the San Andreas Oak Woodland community in the western Pajaro Valley, which support robust spineflower and Monterey spineflower, and provide important upland habitat for Santa Cruz long-toed salamander.	• Development • Working lands • Incompatible recreation • Exotic plants • Unauthorized activities • Altered disturbance regimes • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
					• Numerous co-benefited species
		OAK-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, including cultural burning where appropriate, to: 1) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity, 2) address encroachment of native conifers including Pacific Douglas-fir; 3) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change; 4) reduce the threat of catastrophic wildfire in the landscape; and 5) reduce fuels without degrading habitat for rare species.	Prioritize fire and vegetation management as outlined in in Action 3 for Objective 2 (OAK-O2 OAK-A3), with an emphasis on: • areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on Oak Woodland and Forest, and other focal, non-focal, and co-benefited species. • vegetation management projects that can enhance habitat and populations of rare species while protecting lives and property (e.g., fuel breaks).	• Altered disturbance regimes • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
		OAK-A4: Manage invasive plants and dense exotic plants that alter the forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire or other vegetation management, and /or could promote increased fire frequency.	Prioritize invasive and exotic plant management as outlined in Action 4 for Objective 2 (OAK-O2 OAK-A4), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of the rare species. Specific priorities include restoring forests invaded by eucalyptus in the San Andreas Oak Woodland community in the western Pajaro Valley and Aptos areas, to restore important upland habitat used by dispersing Santa Cruz long-toed salamander and that can support Monterey spineflower and robust spineflower.	• Exotic plants • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		OAK-A5: Manage recreation that tramples plants, sensitive habitat features, and/or exposes soil to erosion, and could promote the spread of pathogens, and enhance habitat degraded by recreation and attendant erosion.	Prioritize recreation management as outlined in Action 5 for Objective 2 (OAK-O2 OAK-A5), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of rare species. Examples of priority actions include: • Erecting enclosures to protect rare plant populations and sensitive habitat for rare animals to prevent excessive trampling or other disturbance; and • Managing trash in parks and other open space to avoid promoting populations of corvids that prey upon other birds, and racoons and possums that prey on amphibians.	• Incompatible recreation	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower • California red-legged frog • California tiger salamander • Santa Cruz long-toed salamander • Southwestern pond turtle • Ring-tailed cat • Mountain lion • Numerous co-benefited species
	OAK-O8: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**OAK-A6: Conduct species-specific actions** including surveys, captive breeding/rearing programs, seed banking and seed bulking, and other species-specific actions for rare species, to supplement habitat protection, restoration, and management and enhancement actions, to ensure the persistence of the species.	Prioritize actions based on a comprehensive assessment to identify management and enhancement needed to: • Maintain or increase the areal extent, abundance, and persistence (as assessed based on population demography); and • Prevent loss of populations. Priority actions for the three plants include: • Establish long-term seed banks to conserve genetic diversity; and • Outplant seeds into suitable but unoccupied habitat, to (re-)establish populations; • Conduct applied research including experimental management to identify vegetation management and other treatments to maintain or enhance habitat and increase populations; and • Conduct long-term monitoring to evaluate the status and trends of populations and inform conservation and management to sustain them.	• Development • Working lands • Incompatible recreation • Exotic plants • Unauthorized activities • Altered disturbance regimes • Climate change	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower •
		CHAP-A7: Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.	Prioritize projects that fill key data gaps in informing understanding of the conservation ecology and management of the system and rare species including: • Response to fire and vegetation management; • Effects of sudden oak death and other disease on community structure and species composition; and	• Development • Working lands • Incompatible recreation • Exotic plants • Unauthorized activities • Altered disturbance regimes	• White-rayed pentachaeta • Robust spineflower • Monterey spineflower •

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Response to climate change, to inform development of climate adaptation strategies.	• Climate change	
	OAK-O9: Safeguard rock outcroppings to promote persistence of rare bryophytes and lichens as well as animals that use the important habitat features. Measure progress toward this objective based on the acres of habitat protected.	**OAK-A8: Manage rock outcroppings** to prevent factors that degrade their habitat values.	Prioritize actions that protect the condition of rock outcroppings (including limestone, sandstone, and granite) that provide native plant and animal habitat and occur within Oak Woodland and Forest and adjacent communities, including rock outcroppings in Castle Rock State Park. Priority actions can include: • Manage recreation and other human activities to prevent removal of epiphytes including mosses, liverworts, and lichens, as well as epiphytes (e.g., ferns) that grow on rocks, and that disrupt natural behaviors of animals, including bat roosting; and • Manage fire to prevent severe fires from impacting rock outcrops, which naturally have lower fuels but can experience more intense and destructive fire if fuels accumulate due to fire exclusion.	• Incompatible recreation • Unauthorized activities • Altered disturbance regimes • Climate Change	• Ring-tailed cat • Numerous co-benefited species

5.3.18 Redwood and Douglas-Fir Forest

Redwood and Douglas-Fir Forest

Status and Rarity

- Several sensitive plant communities (associations) in the Redwood Forest and Woodland Alliance, including the following:
    - *Sequoia sempervirens – Acer macrophyllum – Umbellularia californica* (86.100.14, G3, S3)
    - *Sequoia sempervirens – Arbutus menziesii* (86.100.09)
    - *Sequoia sempervirens – Arbutus menziesii / Vaccinium ovatum* (86.100.15; G3, S3)
    - *Sequoia sempervirens – Notholithocarpus densiflorus / Vaccinium ovatum* (86.100.16; G3, S3)
    - *Sequoia sempervirens – Pseudotsuga menziesii – Arbutus menziesii* (86.100.10)
    - *Sequoia sempervirens – Pseudotsuga menziesii – Notholithocarpus densiflorus* (86.100.31)
    - *Sequoia sempervirens – Pseudotsuga menziesii – Umbellularia californica* (86.100.20)
    - *Sequoia sempervirens – Pseudotsuga menziesii / Vaccinium ovatum* (86.100.12)
    - *Sequoia sempervirens – Umbellularia californica* (86.100.21; G3, S3)
    - *Sequoia sempervirens / (Pteridium aquilinum) – Woodwardia fimbriata* (86.100.02; G3, S3)
    - *Sequoia sempervirens / Oxalis oregana* (86.100.13)
    - *Sequoia sempervirens / Polystichum munitum* (86.100.25)
    - *Sequoia sempervirens / Pteridium aquilinum* (86.100.24)
    - *Sequoia sempervirens / Pteridium aquilinum – Trillium ovatum* (86.100.03)

- May be an Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

- Noss 2000
- Mooney and Dawson 2016
- CNPS 2021

Distribution and Range

- 141,667 acres (49.7% of the RCIS Area) of coast redwood and Pacific Douglas-fir forest, which includes (Figure 19):
    - 122,791 acres (43.0% of the RCIS Area) of redwood forest
    - 11,993 acres (4.2% of the RCIS Area) of redwood-Douglas-fir forest
    - 6,883 acres (2.4% of the RCIS Area) of Pacific Douglas-fir forest

  Approximate 10,306 acres of these forests are old-growth forest or older-second-growth forests.
- Predominant natural community in the mountainous terrain of the RCIS Area, and found throughout the mountains of the RCIS Area

Key Ecological Elements

- Redwood and Douglas-fir forests are found on the western slopes of the Coast Range Mountains between southern Monterey County and southern Oregon in areas within reach of the summer fog (marine layer), which provides an important source of moisture (Dawson 1998).
- The forests are often dominated by coast redwood (*Sequoia* sempervirens) and feature scattered Douglas-fir, which dominate some stands; common hardwoods including Pacific madrone (*Arbutus menziesii*), California bay (*Umbellularia californica*), and tan oak (*Notholithocarpus densiflorus*). The understory features shade-tolerant plants including herbs like redwood sorrel (*Oxalis oregana*), ferns such as sword fern (*Polystichum munitum*) and bracken fern (*Pteridium aquilinum* var. *pubescens*) and some shrubs including shrubs like evergreen huckleberry (*Vaccinium ovatum*). Redwood canopies feature a diverse assemblage of epiphytes (Williams and Sillett 2007). Rock outcroppings within and adjacent to the forests, including limestone outcrops, support diverse assemblages of native bryophytes and lichens including rare species such as tear drop moss (*Dacryophyllum falcifolium*), minute pocket moss (*Fissidens pauperculus*), Toren's grimmia (*Grimmia torenii*), and vaginulate grimmia (*Grimmia vaginulata*).
- The fauna of the forest is diverse and includes many invertebrates, including Pacific banana slug (*Ariolimax columbianus*), as well as vertebrates, though many are cryptic such as the rare Santa Cruz black salamander (*Aneides flavipunctatus niger*) and marbled murrelet (*Brachyramphus marmoratus*). Rare invertebrates include the Strohbeen's parnassian (*Parnassius clodius strohbeeni*) which was endemic to the redwood forests of

the Santa Cruz Mountains but is thought to be extinct. Marbled murrelet (*Brachyramphus marmoratus*), steelhead trout (*Oncorhynchus mykiss*), and coho salmon (*Oncorhynchus kisutch*) rely on these forests, which many additional rare species utilize in the RCIS Area, as outlined below.

- Coast redwoods are adapted to recurring fire, which in the southern part of their range are thought to have naturally occurred at approximately 50-year intervals. The thick bark of coast redwoods enable them to survive fire, which can promote reproduction and facilitate seedling establishment; however, fire is not required for recruitment and instead, natural (i.e., uncut) forests are uneven aged as a result of ongoing recruitment (Mooney and Dawson 2016). While young Douglas-fir are susceptible fire, large trees have thick bark that enable them to similarly survive fire (Sugihara et al. 2006).
- Fire exclusion may increase the fuel load and thus the intensity, severity, and areal extent of fires, causing greater individual mortality than would be expected with more frequent, lower-severity fires. The 2020 CZU Lightning Fire burned 45,735 acres (32%) of the Redwood/Douglas-fir Forest Element in the RCIS Area; research is needed to understand the long-term implications for the fire for the structure, species composition, and ecosystem functions of the forests.
- Coast redwood and Pacific Douglas-fir are used for timber production in the RCIS Area. Much of the forest was clear cut prior to the middle of the 20th century; Big Basin and Henry Cowell state parks featuring much of the remaining old-growth forests in the RCIS Area. Subsequent harvests of the 'second growth' has begun to re-create multi-age stands; trees in State Parks and other open space areas not subject to timber harvest feature dense, largely single-age stands. During the past decade (2011-2020), 9,895 acres in the RCIS Area were subject to selective harvest (CalFire 2020); clear cutting is not allowed in the Santa Cruz Mountains, where additional forest practices rules also require protection of stream corridors.
- Redwood and Douglas-fir forests (particularly redwood) constitute the riparian vegetation along most of the streams within the Santa Cruz Mountains portion of the RCIS Area, where they are critical to maintaining instream habitat for salmonids and other riverine species including by contributing large woody debris, and helping regulate water temperatures (Section 5.3.2). Redwood and Douglas-fir forests provide important habitat for many plants and animals that inhabit riparian areas including ring-tailed cat.
- Redwood and Douglas-fir forest provide important ecosystems functions including controlling erosion and carbon sequestration. They are also key to maintenance of habitat connectivity for widespread species including black-tailed deer and mountain lion.

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting the Redwood and Douglas-fir Forest, which include the following most critical ones:

- Loss of remaining habitat, due to development and infrastructure improvements;
- Fire outside of the natural regime of disturbance, including fire that is too intense or severe and thus kills trees, including as a result of fire exclusion in the landscape;
- Habitat degradation due to exotic plants, such as French broom and other species promoted by disturbance including timber harvest and fire, and which outcompete native plants for light and soil resources, and alter the structure of the plant communities, degrading habitat for animals;
- Habitat degradation due to incompatible recreation and associated erosion; and
- Habitat degradation due to incompatible timber harvest practices.

Climate Change Vulnerability Assessment

Coast redwood forest in the Santa Cruz Mountains have "Moderate" vulnerability to climate change (EcoAdapt 2021):

- Exposure to:
    - projected temperature increases and highly variable precipitation including drought, which together can increase the climatic water deficit that can create drought stress for trees and other plants;
    - potential declines in the frequency of days with coastal fog and low clouds, which could be reduced by 12-20% (O'Brien et al. 2013), though the effects of climate change on fog incidence are uncertain (Langridge 2018); and
    - altered fire regimes, which may drive shifts in species composition and forest structure.
- Moderate sensitivity to changes including the following:
    - Location within Range: The RCIS Area is in the southern portion of the coast redwood range, where they experience slower growth due to current moisture stress which is anticipated to be exacerbated by climate change. Many co-occurring species also have northern affinities and may be outside of their adapted climate envelope as a result of climate change in the region.
    - Narrow Habitat Specificity: the community occurs in a relatively narrow coastal band within reach of coastal fog which moderates temperatures;
    - Interactions with Fire: the thick bark protects coast redwood, though the species can be killed by intense fires, which can also remove the forest canopy and alter microclimatic conditions to which co-occuring species are adapted.
- Moderate adaptive capacity, as a result of:
    - Long Life Span of coast redwoods, the keystone species within the forest which creates the microclimatic conditions (i.e., cool, moist forest) to which many other species are adapted. The long life span and low rate of sexual reproduction of coast redwood could also reduce the pace of genetic shifts towards traits adapted to the new climate (Fernandez al. 2015); and

- Adaptation to disturbance, including fire and floods, from which coast redwood can resprout and grow rapidly.

Overall, Redwood forests are projected to contract their range within the RCIS Area and broader Santa Cruz Mountains under the warmer temperature and normal precipitation scenario for the region (Fernandez et al. 2015).

The goals, objectives, actions, and priorities for the Redwood and Douglas-Fir Forest (Table 5-21) will help address the impacts of climate change by:

1. Protecting habitat, including remaining old-growth forests and older second growth forests, with an emphasis on areas that can connect and buffer existing protected areas and that feature cooler microsites and other areas (i.e., climate refugia) where the future climate is anticipated to be conductive to persistence of the communities and the species they support;
2. Restoring and enhancing habitat, to accelerate achievement of late-seral structure and species composition to support species adapted to old-growth forests, to increase the area of suitable habitat, the diversity of habitat conditions, and the size of species populations, all of which can facilitate species persistence in the face of environmental change and stochasticity;
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and recreation;
4. Increasing habitat connectivity, by protecting habitat and restoring and managing habitat, to facilitate the movement of species and ecological processes (e.g., gene flow) through the landscape, to maintain diversity and promote resiliency;
5. Introducing of rare species into habitat that is suitable but unoccupied, to increase populations and reduce the potential for extirpations or extinctions due to demographic and environmental stochasticity; and
6. Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-21 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- Monarch butterfly (*Danaus plexippus*) [NF]
- coho salmon (*Oncorhynchus kisutch*) [F]
- steelhead trout (*Oncorhynchus mykiss*): CCC and SCC DPSs (NF]

- Foothill yellow-legged frog (*Rana boylii*) [NF]
- California red-legged frog (*Rana draytonii*) [NF]
- Southwestern pond turtle (*Actinemys pallida*)
- marbled murrelet (*Brachyramphus marmoratus*) [F]
- ringed-tailed cat (*Bassariscus astutus*) [NF]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

The Redwood and Douglas-Fir Forest communities, along with their associated focal, non-focal, and co-benefited species, will also benefit from actions to achieve the goals and objectives for the following:

- **Riparian and Riverine:** Actions that protect, restore, or enhance riparian communities as part of the Riparian and Riverine community element, as redwood and Douglas-fir forests line much of the streams in the RCIS Area;
- **Oak Woodland/Forest**: Actions conducted as part of OAK-A1 through OAK-A7 to protect, restore, or enhance Oak Woodlands and Forests, which occur as a mosaic with Redwood and Douglas-Fir Forests throughout much of the RCIS Area;
- **Working Lands:** Actions that protect, restore, and enhance working forests, which are redwood and Douglas-fir forests, as part of WORKING-A1 through WORKING-A6;
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of Redwood and Douglas-Fir Forest communities as part of CONNECT-A1 through CONNECT-A4.

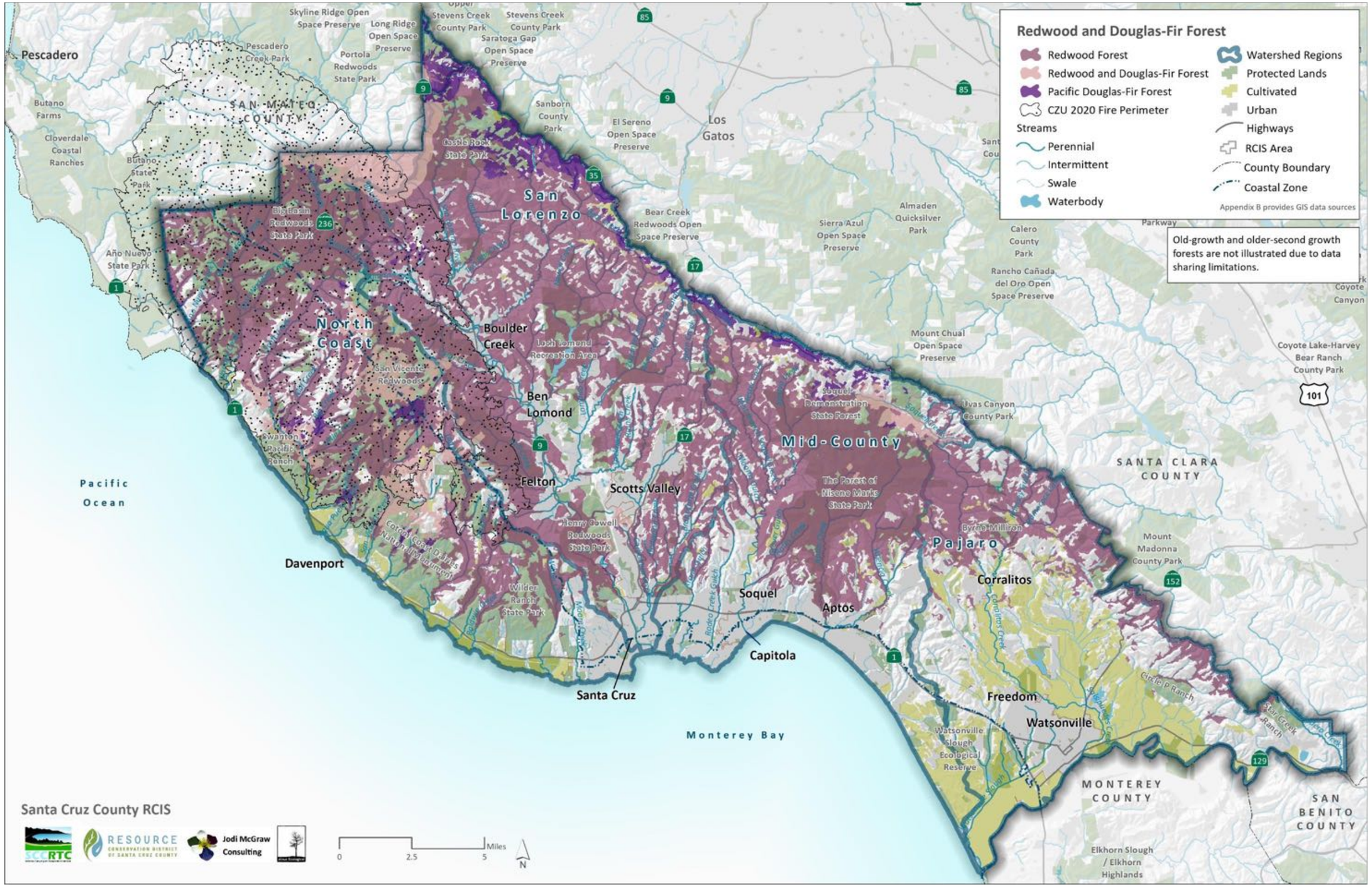

Figure 5-19: Redwood and Douglas-Fir Forest Conservation Element

Table 5-21: Conservation Strategy for Redwood and Douglas-Fir Forest

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
REDWOOD-G1: Promote persistence and ecological integrity of the Redwood and Douglas-Fir Forests, the rare species they support, and the ecological processes that sustain them.	**REDWOOD-O1:** Protect at least 14,060 additional acres of redwood and Douglas-fir forest, including at least 13,156 acres of mapped redwood forest, 65 acres of Redwood- Douglas-Fir forest, and 840 acres of Douglas-Fir forest, to achieve the 75% target for conservation of this element, and 2,102 additional acres of old-growth and older-second-growth forests to achieve the 90% protection target for older forests (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**REDWOOD-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses. [This action is consistent with and can complement efforts to maintain or enhance policies, incentives, and other programs to support timber production and prevent forest conversion.]	Prioritize properties that can collectively conserve large, relatively intact forests in the RCIS Area that feature old-growth forests, a range of seral conditions (time since harvest or fire), with an emphasis on older forests, and a range of micro- and meso- climatic conditions to support the diversity of associations and the species they support. Specific priorities include lands that can protect: • Remaining old-growth forests, which provide important nesting habitat for marbled murrelet and assemblages of other plants and animals that require late-seral conditions; • Older second-growth forests, particularly where they adjoin and can buffer old growth forests; • Habitat supporting additional rare and locally unique species that inhabit these forest communities, such as tear drop moss (*Dacryophyllum falcifolium*), Santa Cruz manzanita (*Arctostaphylos andersonii*), black salamander, Vaux's swift (*Chaetura vauxi*), and Townsend's big-eared bat (*Corynorhinus townsendii townsendii*); • The range of redwood forest associations in the RCIS Area, which reflect the various geology, soils, and disturbance histories, and support different assemblages of plants and animals; • Protect important streams and riparian areas, including coho salmon streams; • Protect areas that can be effectively managed to address altered fire regimes and other stressors, including larger areas away from development; • Protect areas featuring a diverse mosaic of land facets (i.e., due to variable soils and/or topography) and that contain potential climate change refugia (e.g., steep canyons, north-facing slopes, and other areas with cooler microclimates), to facilitate climate change adaptation and resilience; and • Protect areas that provide additional co-benefits for water supply/quality, including streams	• Development • Working lands • Incompatible recreation • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
	REDWOOD-O2: Restore or enhance Redwood and Douglas-Fir Forests to promote the natural structure, native species composition, and ecosystem functions	**REDWOOD-A2: Restore habitat** that has been degraded by prior land uses, exotic plants, altered fire regimes, recreation impacts (e.g., extensive or eroded trails), and erosion, to promote natural community	Prioritize the following areas for restoration: • Areas degraded by prior land uses, including disused agricultural areas (e.g., vineyards, orchards, tree farms, cannabis cultivation areas, etc.), and intensive timber harvest areas (e.g., unneeded roads, landings);	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	where they have been degraded or eliminated. Measure progress toward this objective based on the acres of habitat restored or enhanced.	structure and species composition, and ecosystem functions and services.	• Areas within priority recovery watersheds for coho salmon and steelhead, and areas that can otherwise restore or enhance riparian and riverine habitat including important linkages; • Areas degraded by invasive plants, including eucalyptus, acacias, and brooms, where natural community structure and species composition can be restored; • Areas that can increase populations of the rare species (focal, non-focal, and co-benefited species); • Areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained); and • Areas that can help connect existing habitat.	• Climate change	• Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A3: Restore late-seral conditions to areas of prior harvest and other disturbance, to recreate the community structure, species composition, and microclimate required by many species including large, multi-age stands featuring large trees, snags, and other trees important for native animals, and woody debris on the forest floor.	Prioritize the following areas for restoration of late-seral conditions: • Areas near existing old growth and that can buffer, expand, and connect older forests; • Areas that can buffer, expand, and connect habitat for species adapted to old-growth forests and older forests, including marbled murrelet; and • Areas featuring existing forest structure and microsite conditions conducive to facilitating late-seral conditions. Treatments can include variable-density thinning, strategic crown injury to increase structural complexity, and reintroduction of low-to moderate-intensity fire through prescribed burns. (Restoration projects that generate large woody debris can be used to enhance adjacent streams as part of the Riparian and Riverine and Bar-Built Estuary conservation elements).	• Working lands • Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A4: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity, 2) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change; and 3) reduce the	Prioritize the following areas for fire management: • Long-unburned areas featuring altered structure and species composition and fuels that create a risk of intense, severe, or large wildfire; • Areas that burned recently, where return of anthropogenic fire could have negative implications for forest succession and recovery.	• Altered disturbance regimes (Fire)	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		threat of catastrophic wildfire in the landscape.			
		REDWOOD-A5: Manage invasive plants and dense exotic plants that alter the forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire, selective harvest, and other vegetation management, and /or could promote increased fire frequency.	Prioritize actions that can maintain intact natural communities by abating threat, or restore already degraded by exotic plants, including by: • Eradicating or control invasive eucalyptus, acacias, brooms, periwinkle (*Vinca major*) and other vines (e.g., *Hedera helix*, *Delairea odorata*), that alter plant community structure and species composition, outcompete populations of rare plant species, degrade native animal habitat, and/or increase the risk of unnatural fire; and • Preventing the invasion and spread of new invaders that can negatively impact the community and rare species populations, including by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A6: Manage recreation that tramples plants, sensitive habitat features, and/or exposes soil to erosion, and enhance habitat degraded by recreation and attendant erosion.	Prioritize projects that: • Manage recreation in public lands featuring Redwood and Douglas-Fir Forest including, including Big Basin, Henry Cowell, Castle Rock, Nisene Marks, and Wilder Ranch state parks, to ensure it is compatible with protection of the sensitive communities and rare species, by regulating access using signage, fences, trails, patrols, and associated outreach to recreators and user groups; and • Restore areas where incompatible use has removed habitat by denuding habitat and/or causing erosion.	• Incompatible recreation	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A7: Manage unauthorized activities including illegal camping and cannabis cultivation, which degrade habitat through a variety of mechanisms.	Prioritize projects that: • Protect habitat in public and private conservation lands, including parks and conservation easement areas; • Safeguard populations of rare species; and • Protect associated conservation elements, including riparian and riverine communities.	• Unauthorized activities	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		Redwood-A8: Promote sustainable timber harvest to	Prioritize actions that:	• Development • Working lands	• Monarch butterfly • Coho salmon

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		promote natural community structure and native species composition, and enhance ecosystem services and functions of working forests.	• maintain working forests to prevent conversion of habitat to more intensive land uses that are less compatible with the goals and objectives for this conservation element; • enhance effective management of working forests to increase compatibility of timber harvest with the biological resources.	• Altered disturbance regimes	• Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
REDWOOD-G2: Maintain and enhance connectivity of Redwood and Douglas-Fir Forest to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**REDWOOD-O3:** Protect habitat that can connect existing protected habitat and other core habitat areas and promote landscape connectivity. Measure progress toward this objective based on the acres of habitat protected.	**REDWOOD-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses. [This action is consistent with and can complement efforts to maintain or enhance policies, incentives, and other programs to support timber production and prevent forest conversion.]	Prioritize land as outlined in Action 1 for Objective 1 (REDWOOD-O1 REDWOOD-A1) and that can connect and expand protected Redwood and Douglas-Fir Forest, as well as the associated intact plant communities connecting them. Priority habitat areas to protect for connectivity include the following: • Forests surrounding Big Basin, Castle Rock, and Wilder Ranch state parks, and San Vicente Redwoods, which are in North Coast, Ben Lomond Mountain, Upper San Lorenzo, and Loch Lomond large habitat patches (*Connectivity Element*); • Forests between Nisene Marks State Park and the Soquel Demonstration State Forest and Mount Madonna County Park and Star Creek Ranch further south, which can maintain connected forest habitat along the spine of the Santa Cruz Mountains between the Aptos, Upper Corralitos, and Pajaro Hills large habitat patches.	• Development • Working lands • Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
	REDWOOD-O4: Restore degraded habitat to promote habitat connectivity and dispersal between remaining habitat areas. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**REDWOOD-A2: Restore Habitat** that has been degraded by prior land uses, exotic plants, altered fire regimes, recreation impacts (e.g., extensive or eroded trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize areas as outlined in Action 1 for Objective 2 (REDWOOD-O2 REDWOOD-A2) where restoration can connect habitat.	• Development • Working lands • Altered disturbance regimes • Exotic species • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A3: Restore Late-Seral Conditions to areas of prior harvest and other disturbance, to recreate the	Prioritize areas as outlined in Action 3 of Objective 2 (REDWOOD-O2 REDWOOD-A3), where the restoration of late-seral conditions can help expand and connect older forests, including old growth and older-second growth.	• Working lands • Altered disturbance regimes	• Monarch butterfly • Marbled murrelet • Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		community structure, species composition, and microclimate required by many species including large, multi-age stands featuring large trees, snags, and other trees important for native animals, and woody debris on the forest floor.		• Climate change	• Numerous co-benefited species
	REDWOOD-O5: Enhance connectivity within habitat to facilitate species movements. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**REDWOOD-A4: Manage fire and vegetation** using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions to promote diversity, 2) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change; and 3) reduce the threat of catastrophic wildfire in the landscape.	Prioritize areas as outlined in Action 4 of Objective 2 (REDWOOD-O2 REDWOOD-A4) where fire and vegetation management maintain connectivity in Redwood and Douglas-Fir Forests.	• Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A5: Manage invasive plants and dense exotic plants that alter the forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire, selective harvest, and other vegetation management, and /or could promote increased fire frequency.	Prioritize areas where invasive plant removal as outlined in Action 3 of Objective 2 (REDWOOD-O2 REDWOOD-A5), can re-create the natural community structure and species composition of the Redwood and Douglas-Fir Forest, to promote habitat connectivity. Priorities for management include controlling French Broom (*Genista monspessulana*), periwinkle (*Vinca major*), English ivy (*Hedera helix*) other invasive species in Henry Cowell, Big Basin, and Nisene Marks state parks.	• Exotic plants • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
REDWOOD-G3: Promote the recovery and long-term	**REDWOOD-O6:** Protect habitat occupied by, or suitable for, rare species that utilize Redwood and	**REDWOOD-A1: Protect Habitat** through fee title acquisition or conservation easements to permanently protect habitat	Prioritize protection of habitat as outlined in Action 1 of Objective 1 (REDWOOD-O1 REDWOOD-A1) with an emphasis on habitat that: • supports, or provides suitable habitat for rare species, which include focal, non-focal, and co-benefited species;	• Development • Working lands • Incompatible recreation	• Monarch butterfly • Coho salmon • Steelhead

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
persistence of rare species.	Douglas-Fir Forest. Measure progress toward this objective based on the acres of habitat protected.	from conversion and other degradative land uses. [This action is consistent with and can complement efforts to maintain or enhance policies, incentives, and other programs to support timber production and prevent forest conversion.]	• can protect large areas of habitat that can be effectively managed and will be resilient to climate change and other anthropogenic impacts; and • expand, buffer, or connect existing protected habitat to increase the size of habitat patches to promote population size and persistence.	• Climate change	• California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
	REDWOOD-O7: Restore habitat to enhance population size and persistence of rare species that rely on Redwood and Douglas-Fir Forest. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**REDWOOD-A2: Restore Habitat** that has been degraded by prior land uses, exotic plants, altered fire regimes, recreation impacts (e.g., extensive or eroded trails), and erosion, to promote natural community structure and species composition, and ecosystem functions and services.	Prioritize restoration as outlined in Action 2 of Objective 2 (REDWOOD-O2 REDWOOD-A2) with an emphasis on restoring areas that: • support, or provides suitable habitat for rare species, which include focal, non-focal, and co-benefited species; and • can be permanently protected or where restoration actions can otherwise be sustained.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A3: Restore Late-Seral Conditions to areas of prior harvest and other disturbance, to recreate the community structure, species composition, and microclimate required by many species including large, multi-age stands featuring large trees, snags, and other trees important for native animals, and woody debris on the forest floor.	Prioritize areas as outlined in Action 3 of Objective 2 (REDWOOD-O2 REDWOOD-A3), where the restoration of late-seral conditions can promote populations of rare species including marbled murrelet.	• Working lands • Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A4: Manage fire and vegetation using treatments that mimic fire's beneficial effects for fire-adapted species, to: 1) create and maintain a mosaic of native plant communities of various successional stages and thus	Prioritize fire and vegetation management as outlined in Action 4 of Objective 2 (REDWOOD-O2 REDWOOD-A4), with an emphasis on • areas where management can increase the areal extent, abundance, and population persistence of the rare species that rely on Redwood and Douglas-Fir Forest, and other focal, non-focal, and co-benefited species; and	• Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Southwestern pond turtle • Marbled murrelet

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		habitat conditions to promote diversity, 2) maintain a range of microclimatic and other abiotic conditions that can add resiliency in the face of climate change; and 3) reduce the threat of catastrophic wildfire in the landscape.	• vegetation management projects can enhance habitat and populations of rare species, as well as help protect lives and property (e.g., shaded fuel breaks).		• Mountain lion • Numerous co-benefited species
		REDWOOD-A5: Manage invasive plants and dense exotic plants that alter the forest structure and species composition, impact native species populations, have the potential to spread following disturbance including fire, selective harvest, and other vegetation management, and /or could promote increased fire frequency.	Prioritize invasive and exotic plant management as outlined in Action 5 of Objective 2 (REDWOOD-O2 REDWOOD-A5), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of the rare species.	• Exotic plants • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A6: Manage recreation that tramples plants, sensitive habitat features, and/or exposes soil to erosion, and enhance habitat degraded by recreation and attendant erosion.	Prioritize recreation management as outlined in Action 6 of Objective 2 (REDWOOD-O2 REDWOOD-A6), with an emphasis on areas where management can increase the areal extent, abundance, and population persistence of rare species. Examples of priority actions include: managing trash in parks and other open space, to avoid promoting populations of corvids which prey upon marbled murrelet eggs and nestlings.	• Incompatible recreation	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A7: Manage unauthorized activities including illegal camping and cannabis cultivation, which degrade habitat through a variety of mechanisms.	Prioritize management of unauthorized uses as outlined in Action 4 of Objective 2 (REDWOOD-O2 REDWOOD-A7), with an emphasis on projects that can protect rare species. Examples include: addressing illegal camping that reduces water quality and quantity in streams for steelhead, coho, and other stream species, or increases abundance of native predators (e.g., corvids), that can impact marbled murrelet.	• Unauthorized Uses	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
					• Mountain lion • Numerous co-benefited species
	REDWOOD-O8: Maintain or increase rare species populations to promote species persistence. Measure progress toward this objective based on the number of rare species populations increased or maintained.	**REDWOOD-A8: Conduct species-specific actions** including surveys, captive breeding/rearing programs, seed banking and seed bulking, and other species-specific actions for rare species, to supplement habitat protection, restoration, and management and enhancement actions, to ensure the persistence of the species.	Prioritize actions based on a comprehensive assessment to identify management and enhancement needed to: • Maintain or increase the areal extent, abundance, and persistence (as assessed based on population demography); and • Prevent loss of populations.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		REDWOOD-A9: Conducting research and long-term monitoring to increase understanding of community changes, population trends, and climate change impacts to inform conservation and management.	Prioritize projects that fill key data gaps in informing understanding of the conservation ecology and management of the community and rare species including: • Response to fire and vegetation management; • Response to climate change, to inform development of climate adaptation strategies.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Monarch butterfly • Coho salmon • Steelhead • California red-legged frog • Foothill yellow-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
	REDWOOD-O9: Safeguard rock outcroppings to promote persistence of rare bryophytes and lichens as well as animals that use the important habitat features. Measure progress toward this objective based on the acres of habitat protected.	**REDWOOD-A10: Manage rock outcroppings** to prevent factors that degrade their habitat values.	Prioritize actions that protect the condition of rock outcroppings (including limestone, sandstone, and granite) that provide native plant and animal habitat and occur within Redwood and Douglas-Fir forests and adjacent communities. Priority actions can include: • Manage recreation and other human activities to prevent removal of epiphytes including mosses, liverworts, and lichens, as well as epiphytes (e.g., ferns) that grow on rocks, and that disrupt natural behaviors of animals, including bat roosting; and • Manage fire to prevent severe fires from impacting rock outcrops, which naturally have lower fuels but can experience more intense and destructive fire if fuels accumulate due to fire exclusion.	• Incompatible recreation • Altered disturbance regimes • Climate Change	• Numerous co-benefited species

5.3.19 Marbled Murrelet

Marbled Murrelet

Status and Rarity

- Federally threatened (ESA)
- State endangered (CESA)
- Rarity Ranks: State: S1 Federal: G3G4

Detailed Descriptions

USFWS 1997

USFWS 2019d

Peery and Henry 2010

Distribution and Range

Breeds from the Santa Cruz Mountains and southern Alaska; found in southern California during the non-breeding season. Santa Cruz County contains the following areas (Figure 5-20):

- 11,420 acres identified as Important Area for the species (Singer 2012b)
- 83,736 acres in the Marbled Murrelet nesting range (Singer 2012b); and
- 26,880 acres of designated critical habitat for marbled murrelet.

Key Ecological Elements

- Coastal seabird that fishes in the ocean within 2 kilometers of the shore and nests in old-growth and older-second growth forests within 80 kilometers of the ocean (USFWS 1997).
- Nests often occur in Douglas-fir and coast redwood trees in forests with large multistoried trees with moderate to high canopy closure. The density of old-growth cover and the presence of coastal redwood are the strongest predictors of marbled murrelet nest locations (USFWS 1997).

- The Santa Cruz Mountains population is the southernmost population, and is small and isolated; therefore, it is especially vulnerable (USFWS 1997). In the Santa Cruz Mountains, there are approximately 10,000 acres of old-growth habitat, most of which is in Big Basin State Park; this habitat supports most of the marbled murrelet nesting habitat in the region, with other nesting habitat largely occurring in Butano and Portola state parks in adjacent San Mateo County (USFWS 1997). An additional approximately 5,000 acres of mature second-growth forests have been identified on public and private lands (Halbert and Singer 2017).
- In 2016, 657 individuals estimated in the regional population intersecting Santa Cruz County (Conservation Zone 6; Henry and Tyler 2017).
- Nests are located on 'platforms' created by large branches or deformities (often caused by mistletoe). Branches are approximately 4 inches in diameter and 33 feet in height, and located approximately two thirds up the tree (Evans Mack et al. 2003).
- Nests are located far apart from each other except when no other habitat is available; the closest distance recorded is 141 feet (USFWS, 1997). Nests are obscured from above and below and covered in moss, lichen, or leaf litter, which create a depression.
- Their average lifespan is ten years and reproduction begins in approximately their third year. Pairs incubate a single egg together, alternating 24-hour shifts between the male and female sitting on the egg while the other parent forages at the ocean. They express some nest fidelity between years (USFWS 1997).
- The small clutch sized combined with high rates of nest predation (Pressures and Stressors) leads to low fecundity (0.02 to 0.19 female young produced per adult female per year; USFWS, 1997) which is likely insufficient to sustain the population (Peery et al. 2006, Beissinger et al. 2007).
- Remote, old second-growth stands may provide better nesting opportunities than old-growth forests because of fewer nest predators including corvids found in many old-growth forests that offer recreation(Singer 2012b), which promotes use of habitat by corvids that reduce nest success
- The Santa Cruz Mountains population appears genetically distinct from populations to the north (Friesen et al. 2007)
- They exclusively eat fish and marine invertebrates which they hunt by diving, commonly catching Pacific sand lance (*Ammodytes hexapterus*), but also Pacific herring (*Clupea harengus*), northern anchovy (*Engraulis mordax*), and smelts (*Osmeridae* spp.). In the winter, krill (Euphausiids) are important part of their diet (USFWS 1997).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting marbled murrelet, which include the following most critical ones:

- Habitat loss, due to an 85-96% reduction in the areal extent of California coast's old-growth redwood forests due to logging which has greatly reduced nesting habitat (USFWS 1997).
- Habitat degradation due to timber harvest, fires, and storms:
    - Virtually all old-growth forest has been removed from private land, and regulations including the California Forest Practice Rules and the Migratory Bird Species Act do not sufficiently protect nesting areas in forests where the marbled murrelet is present (USFWS 2019d).
    - Large fires or windthrows can greatly reduce desirable old-growth nesting habitat (USFWS 1997).
- Nest predation, most of which is caused by corvids including common raven (*Corvus corax*) and Steller's jay (*Cyanocitta stelleri*; Peery and Henry 2010), and is exacerbated by habitat fragmentation and recreation, particularly that which promotes corvid populations such as campgrounds (Marzluff and Neatherlin 2006).
    - Nest disturbance is 2.5 times as great at the edges of forests, adjacent to areas where forests have been harvested or converted to other uses, than within the interior (Malat and Lank 2009).
    - About half of known marbled murrelet nests in central California are within 1 km of heavily used campgrounds in a Big Basin Redwoods State Park (Peery and Henry 2010).
    - Approximately 77% of the 10,000 acres (4,047 ha) of old-growth nesting habitat in the Santa Cruz Mountains is contained in just five areas, much of which includes recreation that attracts nest predators.
- Ocean hazards, including oil spills, which could extirpate an entire population, fishing nets, which harm diving murrelets, and poor marine conditions that reduce the quantity and quality of fish which reduces nesting success rate (USFWS 1997, USFWS 1999).
- Small population size, low population growth, and resulting potential loss of genetic diversity due to genetic bottlenecks, which could reduce overall genetic diversity of the species as the Santa Cruz Mountains population is genetically distinct (Friesen et al. 2005).

Climate Change Vulnerability Assessment

Marbled murrelet has "High" vulnerability to climate change in the Santa Cruz Mountains (EcoAdapt 2021). This overall rating reflects the following:

- Exposure to climate change both in their terrestrial and marine environments:
    - Increased air temperatures, changes in precipitation patterns including increased drought, and potentially reduced incidence of summer fog are all anticipated to decrease the area of suitable nest sites, by reducing the cover of epiphytes, which are used to make nests, and reducing the areal extent of forest areas with

cooler and moisture summer microclimatic conditions, in which marbled murrelet nests are preferentially located within the coast redwood forest;

- Causing climate-driven changes in fire regimes, including more severe fires that could reduce nesting habitat in old-growth forest which are particularly vulnerable where they are surrounded by dense second-growth forests with high fuel availability and continuity. These specialized nesting sites (i.e., platforms) can take centuries to be restored after loss from fire or other disturbance.
- Climate change is expected to increase the intensity and/or frequency of storm events that can cause windthrow, especially at forest edges, which could cause a loss of mature trees or limbs used for nesting.
- In the ocean, changes to sea surface temperature, currents, and ocean acidification can reduce the abundance of prey (fish) associated with cooler waters and strong upwelling, and which promote reproductive success.
- Hypoxic, anoxic, and Harmful Algal Bloom events are expected to grow in intensity and extent with climate change, resulting in reduced prey availability and reproductive success for marbled murrelet (USFWS 2019d).
- Other non-climate stressors including predation from corvids, timber harvest, fire suppression, and commercial fisheries compound with any climate stressors to the murrelet.
- It is currently unknown if marbled murrelet physiology is sensitive to increasing temperatures.

- Low adaptive capacity due to the following:
  - Low dispersal ability because of their dependence on coastal old-growth habitat, which is largely fragmented and has a limited range;
  - Low reproductive rates and thus low population growth, which renders them vulnerable to extirpation due to stochastic events.
  - Susceptibility to nest predators renders them vulnerable to climate-driven degradation of nesting habitat.
  - Dependence on both suitable marine foraging habitat and terrestrial nesting habitat in close proximity limits their ability to disperse to more suitable habitat.

The goals, objectives, actions, and priorities for marbled murrelet (Table 5-22) will help address the impacts of climate change by:

1. Protecting and restoring suitable habitat in large blocks, to decrease the negative effects associated with fragmentation including windthrow due to storms (USFWS 2019d);
2. Promoting late-seral forest conditions including to advance the growth of large trees to create suitable nest platforms (USFWS 2019d) to offset the anticipated climate-driven reduction in suitable nesting habitat (EcoAdapt 2021);

3. Managing fire using prescribed fire and other vegetation management in nesting habitat to reduce the severity and frequency of fires that could degrade nesting habitat; and
4. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and recreation;
5. Promoting marbled murrelet population growth by reducing nest predation by corvids—a non-climate stressor that compounds the effects of climate change; and
6. Conducting research and long-term monitoring to increase understanding of population trends and their drivers, including climate change impacts.

Species Associated with the Conservation Element

The following focal (F) and non-focal (NF) species are associated with this conservation element. Table 5-22 identifies the specific actions for this conservation element that will benefit each species. Table 5-2 highlights each species key ecological requirements and relationship to the conservation elements.

- coho salmon (*Oncorhynchus kisutch*) [F]
- steelhead trout (*Oncorhynchus mykiss*) – CCC DPS (NF]
- California red-legged frog (*Rana draytonii*) [NF]
- Southwestern pond turtle (*Actinemys pallida*)
- ringed-tailed cat (*Bassariscus astutus*) [F]
- mountain lion (*Puma concolor*) [F]

Other Actions that Benefit this Conservation Element

Marbled murrelet along with their associated focal, non-focal, and co-benefited species will also benefit from actions to achieve the goals and objectives for the following additional conservation elements:

- **Redwood and Douglas-Fir Forest:** Actions conducted as part of the Redwood and Douglas-Fir Forest conservation element (REDWOOD-A1 through REDWOOD-A8); and
- **Connectivity:** Actions to maintain connectivity of habitat that involve protection, restoration, and enhancement of redwood and Douglas-fir forest communities including habitat suitable for marbled murrelet as part of CONNECT-A1 through CONNECT-A4.

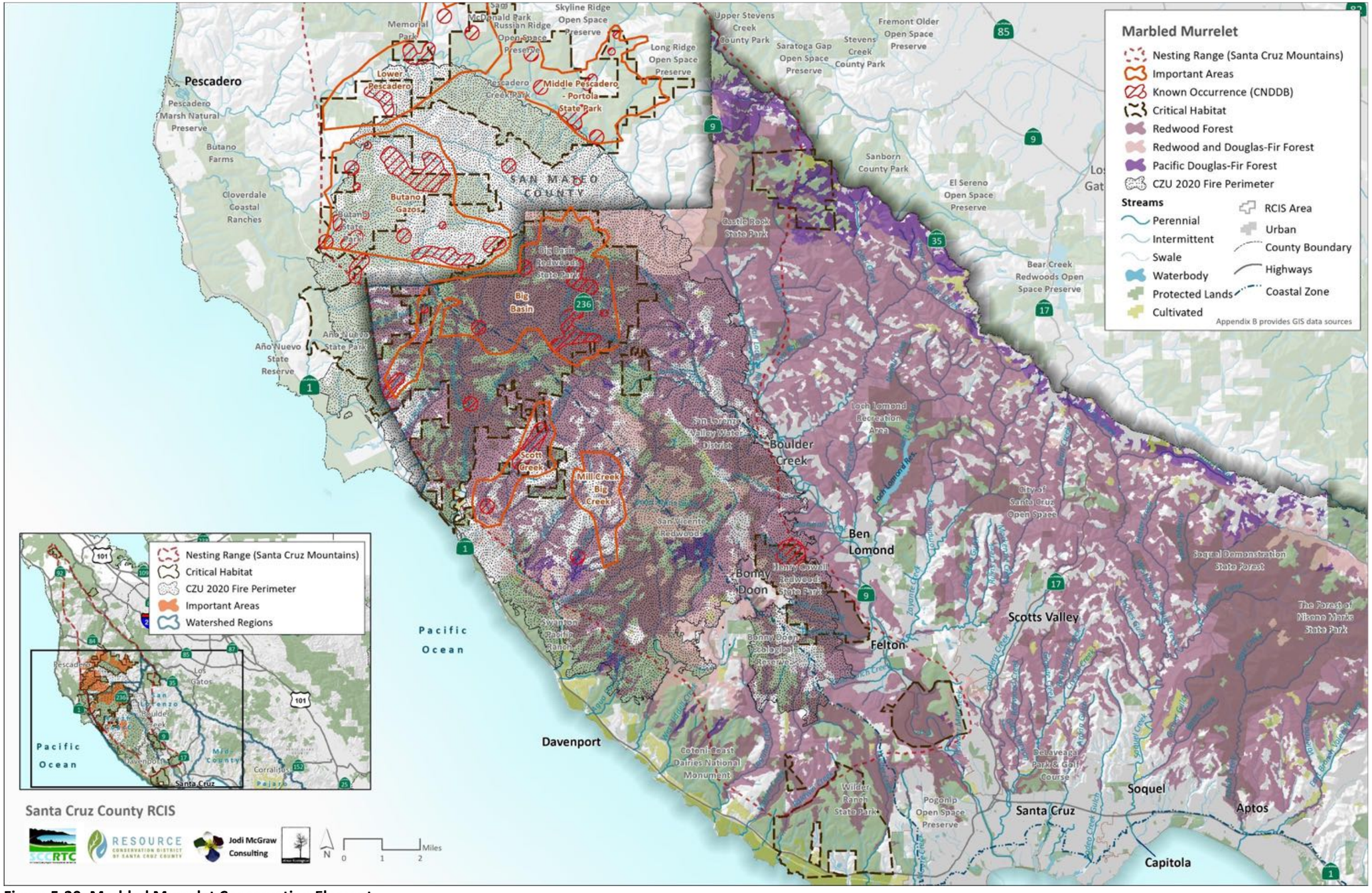

Figure 5-20: Marbled Murrelet Conservation Element

Table 5-22: Conservation Strategy for Marbled Murrelet

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
MURRELET-G1: Promote the recovery and long-term persistence of marbled murrelet.	**MURRELET-O1:** Protect habitat that can support Marbled Murrelet including at least an additional 480 acres of designated critical habitat, 2,393 acres within the Important Areas for Marbled Murrelet, and 18,323 acres in the nesting range, to achieve the 100%, 90%, and 90% targets, respectively for conservation of these areas (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**MURRELET-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties identified as priorities for habitat protection for marbled murrelet in prior plans and reports. Specific priorities include: • Protecting habitat within the Marbled Murrelet Important Areas (Figure 5-20), which identify areas of old-growth forest and older second growth forest that are important for the species based on a synthesis of available data about the species nesting activity in the region and an analysis of the forest structure using stereoscopic imagery (Singer 2012b); • Protecting habitat identified in the recovery plan, which includes suitable but unoccupied habitat, buffer areas surrounding occupied habitat, areas that can connect existing occupied habitat, and can otherwise create large habitat blocks with low levels of fragmentation, (USFWS 1997); • Other remaining old-growth forests and older-second growth forests, particularly those within the nesting range (Figure 5-20). Additional considerations for protecting habitat, including: • Protect forests that can buffer old-growth and older-second-growth forests, to reduce impacts of land uses and other human activities on adjacent nesting habitat; • Protect areas that can be effectively managed to address altered fire regimes, corvid populations, and other stressors; • Protect areas with cooler and moister microclimates where habitat suitable for nesting is anticipated to persist with climate change.	• Development • Working lands • Incompatible recreation • Climate change	• Coho salmon • Steelhead • California red-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
	MURRELET-O2: Restore or enhance habitat to promote marbled murrelet population distribution, abundance, and persistence. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**MURRELET-A2: Restore nesting habitat** for marbled murrelet that has been degraded by prior land uses including timber harvest that removed large trees and fragmented nesting habitat.	Prioritize the following areas for restoration: • Areas adjacent to or that can otherwise buffer, expand, and connect existing nesting habitat; • Areas that feature existing forest structure conducive to re-creating the late-seral forest conditions and nest habitat features that are required as detailed in the recovery plan (USFWS 1997); • Areas with cooler, moister microsite conditions that are likely to be conducive to marbled murrelet nesting as the climate warms; and • Areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained).	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Coho salmon • Steelhead • California red-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		MURRELET-A3: Manage fire and vegetation using treatments that mimic fire's beneficial effects in redwood	Prioritize areas for fire management that feature extensive contiguous fuels that present a risk of catastrophic wildfire in or adjacent to nesting habitat.	• Altered disturbance regimes (fire)	• Coho salmon • Steelhead • California red-legged frog

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		and Douglas-fir forest and promote resiliency of marbled murrelet nesting habitat by reducing the threat of a large catastrophic wildfire in the landscape.			• Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
		MURRELET-A4: Manage recreation to reduce the direct and indirect impacts on marbled murrelet nesting.	Prioritize projects that manage recreation and associated infrastructure to reduce its effects on nesting habitat. Direct impacts of recreation including human activities that create light and noise pollution that deter habitat use and cause nest disturbances that reduce nesting success, particularly that near the immediate coast, which is the preferred habitat. Indirect impacts of recreation include promotion of corvid populations through artificial food sources. Priority projects can include: • installation of infrastructure to prevent corvid access to artificial food sources, including wildlife proof trash bins and food lockers, and signage and associated education programs to discourage wildlife feeding; and • Relocating recreation facilities that promote corvid populations, including campgrounds and picnic areas away, from suitable nesting habitat (i.e., outside of old-growth and older second growth forests) and otherwise managing human activities to avoid promoting corvids. Projects should be prioritized in recreational areas that feature suitable nesting habitat, including Big Basin, Henry Cowell, and Wilder Ranch state parks, and San Vicente Redwoods and Cotoni-Coast Dairies National Monument.	• Incompatible recreation	• Marbled murrelet
		MURRELET-A5: Manage unauthorized activities including illegal camping and cannabis cultivation, which degrade habitat through a variety of mechanisms.	Prioritize projects that protect marbled murrelet habitat and can promote populations, including by limiting nest disturbance and predation by unnaturally large populations of native predators attracted to human activities including camping.	• Unauthorized activities	• Coho salmon • Steelhead • California red-legged frog • Southwestern pond turtle • Marbled murrelet • Mountain lion • Numerous co-benefited species
	MURRELET-O3: Increase marbled murrelet	**MURRELET-A6: Conduct species-specific conservation actions** in the RCIS Area to	Prioritize additional actions that result in positive population growth, including:	• Development • Working lands	• Marbled murrelet

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	population growth rates to promote the species persistence in the Santa Cruz Mountains. Measure progress toward this objective based on the number of rare species populations increased.	increase fecundity and otherwise promote population growth.	• Implementing murrelet egg aversion programs, in which murrelet-mimic eggs containing vomit-inducing compounds (i.e., carbachol) are used to deter corvid consumption of murrelet eggs, in addition to managing recreation and unauthorized activities that create unnaturally large covid populations as described above; • Addressing causes of mortality and reduced fecundity that are related to the marine environment, including oil spills, bycatch, and derelict fishing nets; • Conducting additional research and long-term monitoring to: 1) characterize and map the distribution of habitat in the RCIS Area (and broader Santa Cruz Mountains), 2) identify and address anthropogenic or other causes of reduced fecundity and/or survivorship, 3) determine the genetic structure of the populations, 4) evaluate the effects of forest management; and 5) monitor overall population trends.	• Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	
		MURRELET-A8: Conduct research and long-term monitoring to increase understanding of population trends and their drivers, including climate change impacts	Prioritize research to address the most significant data gaps to informing conservation and management.	• Development • Working lands • Incompatible recreation • Exotic plants • Altered disturbance regimes • Climate change	• Marbled murrelet

5.3.20 Bat Habitat

Bat Habitat

Status and State and Global Ranks

- California Cave Protection Area protects caves
- Several bat species have special regulatory status, as noted below, though none are state or federally listed as endangered
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

Hammerson et al. 2017

EcoAdapt 2021

Distribution and Range

Much if not all of the RCIS Area constitutes bat habitat, as these species use a diverse array of habitat for foraging and roosting. For this reason, a map was not developed to identify bat habitat.

Key Ecological Elements

- The RCIS Area is home to 14 native bat species, including the following five: special-status species: Townsend's big-eared bat (*Corynorhinus townsendii*), fringed myotis (*Myotis* thysanodes), pallid bat (*Antrozous pallidus*), western red bat (*Lasiurus blossevillii*), and western mastiff bat (*Eumops perotis californicus*). Other more widespread species include: long-legged myotis (*Myotis volans*), Yuma myotis (*M. yumanensis*), Western small-footed myotis (*Myotis ciliolabrum),* silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), among others (EcoAdapt 2021).

- Bats utilize a wide diversity of vegetation and other land cover in the RCIS Area, including general vegetation types such as grasslands, shrublands, and hardwood and conifer woodlands and forests including riparian habitats. While foraging occurs across the entire landscape, bats in Santa Cruz Mountains are often associated with wetlands, complex redwood forests, and mature sycamores and/or cottonwoods in riparian forests (Kunz and Lumsden 2005).
- Bats seek shelter and roost in caves, rocky crevices, trees, and cliffs for protection from the elements and predators, and a place to rear their young. They also roost in and use anthropogenic structures including abandoned mines, barns, buildings, culverts, and bridges. Roosts are a highly important part of habitat and are a critical component of their life history, limiting their use in many areas for foraging.
- Roosting habitat varies depending on the species, sex, age class, time of year, and time of day/night. Some sites are used year-round while others are used seasonally as diurnal roosts, nocturnal roosts, hibernation sites, and by maternity colonies.
    - Hibernacula are roosts used by bats to hibernate or go into torpor over the winter, and that provide consistent temperature and protection from weather and predators; they include rock and cliff crevices, tree hollows, caves, mines, and anthropogenic structures.
    - Maternity roosts are day roosts where females gather to raise their young and, require specific habitat characteristics and microclimate. Crevice-roosting bats often establish maternity roots in such warm, thermally stable locations as mines, larger-diameter trees within riparian forests, attics of homes or barns, or crevices in concrete bridges and culverts.
    - Night roosts are also critical types of roosts that provide safe easily accessible shelter for rest, digestion, grooming, and socialization, typically in close proximity to foraging sites. There are also other types of day roosts including bachelor roosts and migratory roosts. Foliage roosters such a western red bats and hoary bats require foliage for roosting, preferring trees with dense high canopies.
- Species-specific traits and habitat requirements play a role in the degree to which bat movement and dispersal is impacted by anthropogenic land uses and other barriers. Specialists are more easily impacted, whereas some species are less impacted and able to utilize human-created structures.
- Bats provide valuable ecosystem services including seed dispersal, pollination, and insect control.

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting Bat Habitat, which include the following most critical ones:

- Development and other land conversion (e.g., cultivation), which cause direct loss of foraging and roosting habitat, or reduces water availability. Development, incompatible agriculture, urbanization, or recreation can also cause disturbance that leads to roost site abandonment. Maternity roosts and hibernacula are particularly sensitive to even minor disturbances, which can lead to abandonment of roosts, loss of reproductive cycles, and ultimately a decline in a population (Rueegger and Goldingay 2018, Elliott et al. 2017).
- Removal or exclusion of access to anthropogenic structures used for roosting, such as attics or bridges, can lead to a loss of day-roosting, maternity, or night roosting sites, which may cause a population to decline.
- Agriculture can support some bat species adapted to open habitat; however monocultures of annual crops and pesticides reduce habitat value and prey availability (Olimpi and Philpott 2018).
- Contaminants, such as pesticides can cause both direct mortality or sub-lethal physiological and neurological impacts including immune suppression, reproductive failure, and behavioral changes that impact survival (Bayat et al. 2014, Olimpi and Philott 2018).
- Negative public perception has caused some people to consider bats as pests and historically pesticides have been applied directly to roosts for extermination (Kunz and Rumage 1977).
- Timber harvest and fire exclusion, which change forest structure and remove large-diameter trees preferred by cavity-roosting and foliage-roosting bats, can limit the availability of maternity roosts (Law et al. 2016, Rueegger et al. 2018).
- Emergent diseases which can lead to high rates of mortality, such as the white-nose syndrome which has impacted cave-dwelling Eastern bat species; though it has not yet been found in Santa Cruz Mountains, it has reached several western U.S. states suggesting continued spread (Hammerson et al. 2017, Haase et al. 2020).
- Incompatible recreation, which can disturb cave-dwelling species such as Townsend's big-eared bat that are easily disturbed from their roosts; such disturbance is particularly problematic during hibernation when arousal causes fat loss and increases vulnerability to disease (Elliott 2017, Thomas 2017).

Climate Change Vulnerability Assessment

Bats as a group exhibit high vulnerability to climate change. They have a high level of sensitivity and exposure to climate change and moderate adaptive capacity (EcoAdapt 2021). Severe population declines and extirpation from large portions of their range, coupled with low reproductive rates, may slow recovery from disturbance events (EcoAdapt 2021).

Bats are sensitive to the following aspects of climate change:

- Increases in temperature, which can:
  - cause rapid shifts in plant and insect phenology, creating mismatches between bat migration and peak food availability that can cause starvation or reproductive failure (Sherwin 2013);
  - lead to early arousal from hibernation, in response to increased winter temperatures, causing depletion of fat reserves and increase susceptibility to fungal disease (Jones et al. 2009);
  - cause mortality from heat stress during heat waves, particularly for young bats, which are more sensitive to high temperatures (Jones et al. 2009; O'Shea 2016). Indirectly, heat waves may dry out water sources and reduce food supply.
- Changes in precipitation patterns, which can:
  - Alter streamflow and increased frequency of drought, which can reduce reproductive success by reducing water for lactating females (Adams and Hayes 2008);
  - Create drier conditions that increase bat energy expenditures because they must travel longer distances to water sources and a higher rate of evaporative water loss means more frequent visits (Adams and Hayes 2008); and
  - Cause drought which can decrease insect production, reducing prey availability (Jones et al. 2009).
- Changes in wildfire regimes which can:
  - impact bats directly from injury or mortality from heat and smoke, which young bats cannot avoid (Carter et al. 2002, Perry 2012)l
  - increase insect prey availability from nutrient pulses (Malison and Baxter 2010); and
  - Maintain more open forest conditions and the creation of snags used for roosting (Buchalski et al. 2013).

Bats are rated as having moderate adaptive capacity to climate change due to the following:

- Species dispersal ability is high, especially among the generalist species (Sherwin et al. 2013);
- Limited distribution, as a result of habitat loss in the Santa Cruz Mountain region (Jones et al. 2009);
- Intraspecific/life history diversity: Open and edge adapted foragers have greater flexibility to tolerate severe climate-influenced disturbances (Denzinger and Schnitzler 2013), while other foragers or high-fidelity roosters may be more vulnerable (Adams and Hayes 2008)
- Some Management potential:
  - Many types of climate threats are difficult to manage and control (EcoAdapt 2021);

- Increasing habitat availability and complexity by reducing pesticides and restoring riparian habitat would provide more available prey and roosting locations (Golet et al. 2008, Olimpi and Philpott 2018).

The goals, objectives, actions, and priorities for Bat Habitat (Table 5-23) will help address the impacts of climate change by:

1. Protecting bat habitat, with an emphasis on important roosting habitat, including hibernacula and maternity roosts, water sources, and other habitat that will persist in a future climate that is hotter and drier, including large-diameter trees, which can provide day-roosting for crevice and foliage roosters, as well as foraging habitat.
2. Restoring habitat, to increase habitat availability and complexity to enhance population size and stability and support recovery of species sensitive to disturbances (EcoAdapt 2021), including by restoring foraging habitat, increasing roost availability, diversifying crops, increasing non-crop vegetation, and reducing pesticide use (increased bat activity can benefit growers by improving bat-mediated pest control).
3. Creating new habitat, including by installing and maintaining bat roosting structures (including but not limited to crevice day-roosting and night-roosting habitat) to support existing bat populations or to encourage a population back into an area, while providing educational opportunities for the community to better understand and appreciate bat species.
4. Using active management to ameliorate the effects of anthropogenic pressures and stressors that are anticipated to be exacerbated by climate change (Heller and Zavaleta 2009), including alterations to the natural fire regime, exotic plants, and recreation, as well as emergent diseases and pests; and
5. Conducting research and long-term monitoring to increase understanding of population trends and climate change impacts.

Species Associated with the Conservation Element

Many focal and non-focal species can benefit from the goals, objections, actions, and priorities for bat habitat, given the diverse habitat of bat species. The magnitude of the benefit of this conservation element will depend on the specific action, including its location, and the co-occurring species' life history. The rare bat species in the RCIS Area will benefit for this element; they are co-benefited species in this RCIS (as they are not state or federally listed).

Other Actions that Benefit this Conservation Element

Bat habitat will benefit from actions to achieve the goals and objectives for many of the community and other conservation elements, including (but not limited to): Grassland, Oak Woodland and Forest, Redwood and Douglas-Fir Forest, Ponds, Lakes, and Reservoirs, Riparian and Riverine, Freshwater Wetlands, Working lands, and Habitat Connectivity. Specifically, bats and their habitat will benefit from actions in these as well as other elements where they protect, restore, create, or manage habitat important for bat species or otherwise increase the resiliency of bat populations.

Table 5-23: Conservation Strategy for Bat Habitat

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited

BATS-G1: Promote persistence and ecological integrity of bat habitat, the bat species it supports, and the ecological processes that sustain the habitat and bat populations.	**BATS-O1:** Protect at least 27,052 total acres of natural and semi-natural habitat to achieve the 50% protection target for this bat habitat in the RCIS Area (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**BATS-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize properties that:
			• contain important roosting habitat for special-status bat species, such cliffs, rock outcroppings, and forests with large diameter trees and snags, and anthropogenic features that provide important habitat (e.g., barns, etc.);
			• contain important foraging habitat, including sources of water;
			• feature habitat that can be restored to have increased complexity and other important habitat characteristics for various bat species;
			• contain habitat that can facilitate adaptation to climate change, including:
			  ○ feature climate refugia (e.g., north-facing slopes);
			  ○ a range of land facets due to variable topography and soils; and/or
			  ○ can help connect existing protected habitat to facilitate migration.
			• have multiple benefits, including advancing the goals and objectives of other conservation strategies in this RCIS, and protection of water, scenic, and cultural resources.
				• Development
				• Mining/quarrying
				• Working lands
				• Incompatible recreation
				• Unauthorized activities
				• Climate change
					• Co-benefited species
					• Townsend's big-eared bat
					• pallid bat
					• western red bat
					• western mastiff bat
					• fringed myotis
					• California myotis
					• Yuma myotis
					• silver-haired bat
					• hoary bat
					• little brown bat
					• big brown bat
					• Mexican free-tailed bat
					• long-legged myotis
					• long-eared myotis

	BATS-O2: Protect at least 20 maternity roosts or hibernacula to safeguard this important habitat. Measure progress toward this objective based on the number of sites protected.	**BATS-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses.	Prioritize protection of sites that: • Are utilized by rare species; • support multiple species; • will persist and be suitable in the face of climate change.	• Development • Mining/quarrying • Working lands • Incompatible recreation • Unauthorized activities • Climate change	• As in BATS-A1
	BATS-O3: Restore or enhance bat habitat to promote ecosystem functions and natural community structure and species composition where it has been degraded or eliminated through prior land use or human activities. Measure progress toward this	**BATS-A3: Restore habitat** that has been degraded by prior land use including intensive agriculture and vegetation clearing, or other factors.	Prioritize the following areas for restoration: • areas in or near roost sites or other important bat habitat; • habitat that, if restored, can support rare species, to expand their distribution and abundance, and that can connect or buffer existing protected lands or habitat; • areas that are permanently protected, or where restoration actions will otherwise be durable (i.e., maintained); and • areas that can buffer and expand existing bat habitat, including areas that have experienced encroachment. Projects can include:	• Development • Working lands • Mining/quarrying • Incompatible recreation • Climate change	• As in BATS-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	objective based on the acres of habitat restored or enhanced.		• Install and/or maintain bat roosting structures where roosting limits populations and habitat use. Structures should be created from materials with high thermal inertia (e.g., concrete) to increase use. • Enhance bat habitat in agricultural areas, including by diversifying crops, and installing hedgerows and other non-crop vegetation in agricultural lands to buffer and provide habitat complexity, and reducing pesticide use. • Manage vegetation in natural and seminatural land cover types to promote large-diameter trees and to retain trees with cavities. • Increase the availability of water for bats, including by establishing new water sources, and retrofitting existing ponds to improve accessibility and safety for bats and other animals (Taylor and Tuttle 2012).		
		BATS-A4: Manage fire and vegetation using treatments that mimic fire's beneficial effects (i.e., fire surrogates) to manage habitat within the range of variation of the natural fire to prevent unnaturally large, intense, or severe fires that can degrade important bat habitat, such as large diameter trees.	Prioritize fire management in areas where fire can be used to: • re-establish native plants and restore natural community structure and species composition in long-unburned areas featuring senescent vegetation and/or unnatural succession; and • expand the area of open grassland habitat that is successional in transitional areas at the ecotone with non-grassland communities.	• Altered disturbance regimes (fire)	• As in BATS-A1
		BATS-A5: Manage recreation that degrades bat habitat or disturbs bat roosts.	Prioritize projects that safeguard maternity roots, hibernacula, and other important roosts, including by installing gates to prevent human access to caves where needed and increasing public awareness of bat habitat and bats.	• Incompatible recreation • Unauthorized activities	• As in BATS-A1
	BATS-O4: Create bat roosting habitat to promote populations limited by availability of roosting habitat. Measure progress toward this objective based on the number of new roosting structures installed.	**BATS-A6: Create new bat roosting** structures in areas to promote bat populations and habitat use.	Prioritize projects that increase bat habitat availability and quality to support existing bat populations and encourage a population back into an area.	• Development • Working lands • Mining/quarrying • Incompatible recreation • Climate change	• As in BATS-A1
	BATS-O5: Increase understanding of bat populations to inform their	**BATS-A7: Conduct surveys and long-term monitoring** to increase understanding of	Prioritize projects that: • Increase understanding of the distribution, abundance, and habitat use by bats;	• Climate change	• As in BATS-A1

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	conservation.	population trends and climate change impacts to inform conservation and management.	• monitor populations to examine trends and the effects of climate change.		
		BATS-A8: Conduct public and partner outreach to increase awareness of valuable ecosystem services and need for reduced contaminants	Prioritize projects that: • include public and partner outreach and education to combat negative public perception that bats are pests. • reduce pesticide use and facilitate use of bat-mediated pest control in agricultural systems. • Create, install, and maintain bat roosting structures to support existing bat populations or encourage a population back into an area and to provide educational opportunities for the community.	• Development • Working lands • Mining/quarrying • Incompatible recreation • Climate change	• As in BATS-A1

5.3.21 Habitat Connectivity

Habitat Connectivity

Status and Rarity

- Connectivity is addressed as part of the California Environmental Quality Act
- Environmental Sensitive Habitat Area (ESHA) within the Coastal Zone

Detailed Descriptions

Merenlender and Feirer 2011

Mackenzie et al. 2011

Penrod et al. 2013

Distribution and Range

- Seven significant habitat patches and complexes (Figure 5-21) totaling 248 square miles within the Santa Cruz Mountains occur entirely or partially within the RCIS Area, where they occupy 37% of the (166 square miles) RCIS Area (446-square-mile) (Merenlender and Feirer 2011, Mackenzie et al. 2011).
- Six areas between these large habitat patches have identified as critical to maintaining habitat permeability to facilitate connectivity within the RCIS Area (Mackenzie et al. 2011; Figure 5-21).
- Regionally, the RCIS Area is connected to core habitat in adjacent mountain ranges via three landscape linkages (Figure 5-21) which connect the Santa Cruz Mountains to: 1) the Gabilan Range through the Aromas Hills, 2) the Diablo Range via Coyote Valley, and 3) the Diablo Range via the Upper Pajaro Floodplain (Mackenzie et al. 2011).
- 64 streams totaling 292 miles have been identified as Key Riparian Corridors (Penrod et al. 2013, Figure 5-21): these streams facilitate migration of anadromous fish (including steelhead and coho salmon) between the ocean and upstream habitat to complete their

life history; intact riparian and other communities along these streams can also provide essential movement corridors for terrestrial species.

Key Ecological Elements

Section 2.4.6 describes habitat connectivity in the RCIS Area. The following briefly summarizes the key components relevant to the conservation strategy as illustrated in Figure 5-21.

- **Importance of Habitat Connectivity:** Habitat connectivity is essential to maintaining biodiversity, rare species, natural communities, and ecosystem functions. It can help: 1) support populations of species with large home ranges, such as mountain lion (*Puma concolor*), for which habitat within each range or portions thereof is insufficient to support persisting populations; 2) allow individuals to migrate seasonally in response to changes in habitat suitability, or to disperse to establish a new territory; 3) facilitate recolonization of habitat patches after a disturbance (e.g., fire); 4) promote exchange of genetic material to facilitate population viability; and 5) enable migration in response to climate change.
- **Large Habitat Patches and Patch Complexes:** The RCIS Area features large patches of relatively intact habitat that are largely unfragmented by (paved) roads or significant development and cultivation (Table 2-10, Figure 5-21). These patches are: 1) are essential to the persistence of populations of species with large home ranges, such as mountain lion and American badger, 2) can facilitate species adaptation to climate change, by protecting potential climate change refugia and facilitate dispersal to them, 3) help maintain intact natural communities, including by enabling effective management of pressures and stressors, and 4) sustain important ecosystem functions (e.g., disturbance regimes) and services (e.g., source water).
- **Critical Areas to Maintain Permeability:** Maintaining or increasing permeability of habitat so that plants, animals, and ecological processes can move between these large habitat patches will be essential to maintain genetic diversity, sustain populations (e.g., following extirpations), and facilitate adaptation to climate change.
- **Critical Landscape Linkages:** Safeguarding landscape connectivity between the Santa Cruz Mountains Bioregion and adjacent ecoregions within the Central Coast will require protecting and enhancing the critical landscape linkages in the southern portion of the RCIS Area: 1) along the Pajaro River floodplain to facilitate dispersal to the Diablo Range, and 2) in the Aromas Hills to provide a link to the Gabilan Range (Figure 5-21).[7] Additionally, promoting connectivity to the Diablo Range Mountains through the Coyote Valley, which is in the Santa Clara County RCIS Area (Figure 5-21), will require protecting and enhancing habitat between the Upper Corralitos/Summit Road region of the RCIS Area and habitat on the eastern slope of the Santa Cruz Mountains. Both of these linkages between the Santa Cruz Mountains and adjacent mountain ranges will

[7] The Santa Cruz Mountains to Gabilan Range Linkage traverses land in four counties: Santa Cruz, Santa Clara, and Monterey have RCISs that address the importance of the linkage, as well as San Benito County, which does not yet have an RCIS, but where habitat actions will be essential to safeguard connectivity between the ranges.

require connectivity across Highway 101, which currently acts as a barrier to movement by many species.

- **Aquatic Connectivity:** Sustaining and enhancing aquatic biodiversity including populations of anadromous fish will require enhancing connectivity within and between streams and between ponds and wetlands and upland habitat.
    - Key Riparian Corridors (Penrod et al. 2013), including by removing anthropogenic barriers to upstream migration including the factors outlined in the Pressures and Stressors below. Additionally, protecting headwaters areas can facilitate species movements between riparian and riverine areas between adjacent watersheds. Ensuring that bar-built estuaries open and close at ecologically appropriate times can facilitate migration between the ocean and streams, and between estuaries via the ocean.
    - Enhancing riparian corridors can facilitate movement through the landscape, can be critical to animal movement (e.g., dispersal and migration) through cultivated and urbanized areas (Hilty and Merenlender 2004), and is important for species that breed in streams but utilize adjacent upland communities (e.g., California red-legged frog).
    - Likewise, maintaining or enhancing connectivity between ponds, lakes, and reservoirs and adjacent upland communities is essential for pond-breeding amphibians and reptiles and amphibians (e.g., Santa Cruz long-toed salamander and Southwestern pond turtle) that utilize upland habitat for foraging, aestivation, dispersal, and migration.
- **Redundancy:** Alternative linkages promote functional connectivity and resilience. Compared to a single pathway, multiple connections between habitat patches that account for the different movement needs of multiple species and increase movement across landscapes by a wider variety of species. Corridor redundancy also enhances resilience in response to changed conditions due to disturbance (e.g., floods and fires) and climate change, by providing alternate routes (Olson and Burnett 2008, Pinto and Keitt 2008, McRae et al. 2008, McRae et al. 2012, Cushman et al. 2013).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting habitat connectivity within the RCIS Area, which include the following most critical ones:

- Habitat loss and fragmentation due to development, working lands, and infrastructure improvements including associated impediments to movement such as fences;
- Development, expansion, and maintenance of transportation and utility corridors;
- Fire outside of the natural regime of disturbance, which can cause unnatural succession that fragments natural communities (i.e., due to fire exclusion), or type conversion of natural communities if fire is too frequent to replace species.
- Habitat degradation due to exotic plants, particularly large species (e.g., eucalyptus) or abundant species (e.g., exotic herbaceous plants) that alter the structure of

communities (e.g., convert grasslands to shrublands or forests, or shrublands to forests or grasslands);

- Incompatible recreation, which can fragment habitat, degrade habitat by causing erosion and promoting the invasion and spread of exotic plants, and deter habitat use by animals that are wary of humans;
- Factors that inhibit instream migration and movement along riparian corridors, including: channelization, culverting, or burying of streams; loss of riparian vegetation; surface water diversions and groundwater extraction; encroachment from various land-uses and development; and dams and reservoirs; and
- Loss of genetic diversity due to inhibition of gene flow (due to habitat fragmentation); reduction in the sizes of effective populations due to habitat loss, fragmentation, and degradation; and genetic bottlenecks.

Climate Change Vulnerability Assessment

Climate change is anticipated to impact habitat connectivity via a variety of mechanisms including by:

- Causing transitions between community types (e.g., forests to shrublands), due to increased climatic water deficit, which can fragment habitats (Thorne et al. 2016);
- Altering the hydrology of streams, ponds, lakes, reservoirs, wetlands, and other aquatic systems, which can similarly fragment habitat and inhibit species movements; and
- Altering natural disturbance regimes, including fire and floods, which can cause type conversions or otherwise alter community composition.

Reductions in habitat connectivity will, in turn, increase the vulnerability of species and natural communities to the effects of climate change by:

- Inhibiting migration by species, which may be required to stay within their adapted climatic envelope, such as by moving to higher elevations and latitudes, to other cooler microsites (i.e., climate refugia);
- Limiting the ability of species to recolonize habitat following fire, flood, or other disturbance that extirpates populations; and
- Reducing genetic diversity, which could limit the resilience of populations to a changing climate.

The goals, objectives, actions, and priorities for the Habitat Connectivity Element (Table 5-24) will help address the impacts of climate change by:

1. Protecting large habitat patches, which will: 1) protect potential climate refugia, such as cooler microclimates (e.g., north-facing slopes); 2) maintain or enhance populations, which reduces their vulnerability to climate-change-induced reductions; 3) sustain genetic diversity in populations, which can aid adaptation to climate change;

2. Restoring and enhancing habitat permeability between large habitat patches, and connectivity in critical landscape linkages and along Key Riparian Corridors, to facilitate movement that is critical to sustaining populations over time (I.e., maintaining genetic diversity and facilitating recolonization events, and facilitating migration in response to climate change);
3. Using active management to ameliorate the effects of anthropogenic pressures and stressors that climate change is anticipated to exacerbate (Heller and Zavaleta 2009), including alterations to the natural disturbance regimes (fire and flood), exotic plants, incompatible recreation, water use, and flood control; and
4. Facilitating wildlife passage through transportation corridors that bisect important habitat areas within RCIS boundaries, including large habitat patches, and corridors between the coast and inland areas, and between the RCIS Area and adjacent areas where landscape connectivity is essential to sustaining populations including by maintaining genetic diversity as well as migration in response to climate change;
5. Conducting research and long-term monitoring to increase understanding of areas important for connectivity including in response to climate change.

Species Associated with the Conservation Element

All of the RCIS focal and non-focal species (which are listed below) can benefit from the goals, objections, actions, and priorities for the Habitat Connectivity Element; the magnitude of the benefit will depend on the specific action, including its location, and the co-occurring species' life history. For this reason, each of the focal species and community element conservation strategies also feature goals, objectives, actions, and priorities related to habitat connectivity.

Species denoted with an asterisk (*) are anticipated to benefit from management of fire, flood, and other disturbance regimes as outlined in Action CONNECT-A3. Species denoted with a cross (†) are anticipated to benefit from actions that manage incompatible recreation (CONNECT-A4) and unauthorized activities (CONNECT-A5).

- Monterey spineflower [NF]* †
- Scotts Valley spineflower [NF]* †
- Robust spineflower [NF]* †
- Ben Lomond wallflower [NF]*†
- Santa Cruz cypress [NF]* †
- Santa Cruz tarplant [F]* †
- White-rayed pentachaeta [NF]*
- San Francisco popcorn flower [NF]
- Scotts Valley polygonum [NF]*
- Pacific Grove clover [NF]*
- Monarch butterfly [NF] †
- Ohlone tiger beetle [NF]* †
- Western bumblebee [NF]*
- Mount Hermon June beetle [NF] †
- Zayante band-winged grasshopper [F]* †
- Tidewater goby [NF] *
- Coho salmon [F] *†
- Steelhead [NF] CCC and SCC DPSs*†
- California tiger salamander [NF] †
- Santa Cruz long-toed salamander [F]
- Foothill yellow-legged frog [NF] *
- California red-legged frog [NF] *
- San Francisco garter snake [NF] †
- Southwestern pond turtle [F]*

- Golden eagle [NF] *
- Swainson's hawk [NF]
- White-tailed kite [NF]
- Tricolored blackbird [NF]
- Western snowy plover [NF] †
- American peregrine falcon [NF]
- Bald eagle [NF]
- California brown pelican [NF] †
- Marbled murrelet [F] †
- Mountain lion [F]
- Ring-tailed cat [NF]

Other Actions that Benefit this Conservation Element

The Habitat Connectivity Conservation Element goals and objectives will be promoted by numerous actions in the conservation strategies for the natural communities and focal species, all of which feature goals related to promoting habitat connectivity.

Actions in the RCISs for adjoining counties (Santa Clara and Monterey) will also help facilitate the connectivity goals in this conservation element. Specifically, in the Monterey County RCIS (AECOM 2021), actions that support HC Goal 1, which focuses on protecting terrestrial connectivity including between the Gabilan Range and the Santa Cruz Mountains, will support this conservation element. Similarly, action HC-1 in the Santa Clara County RCIS (ICF 2019), which focuses maintaining and enhancing connectivity between the Santa Cruz Mountains and the Diablo and Gabilan ranges, will also support this conservation element.

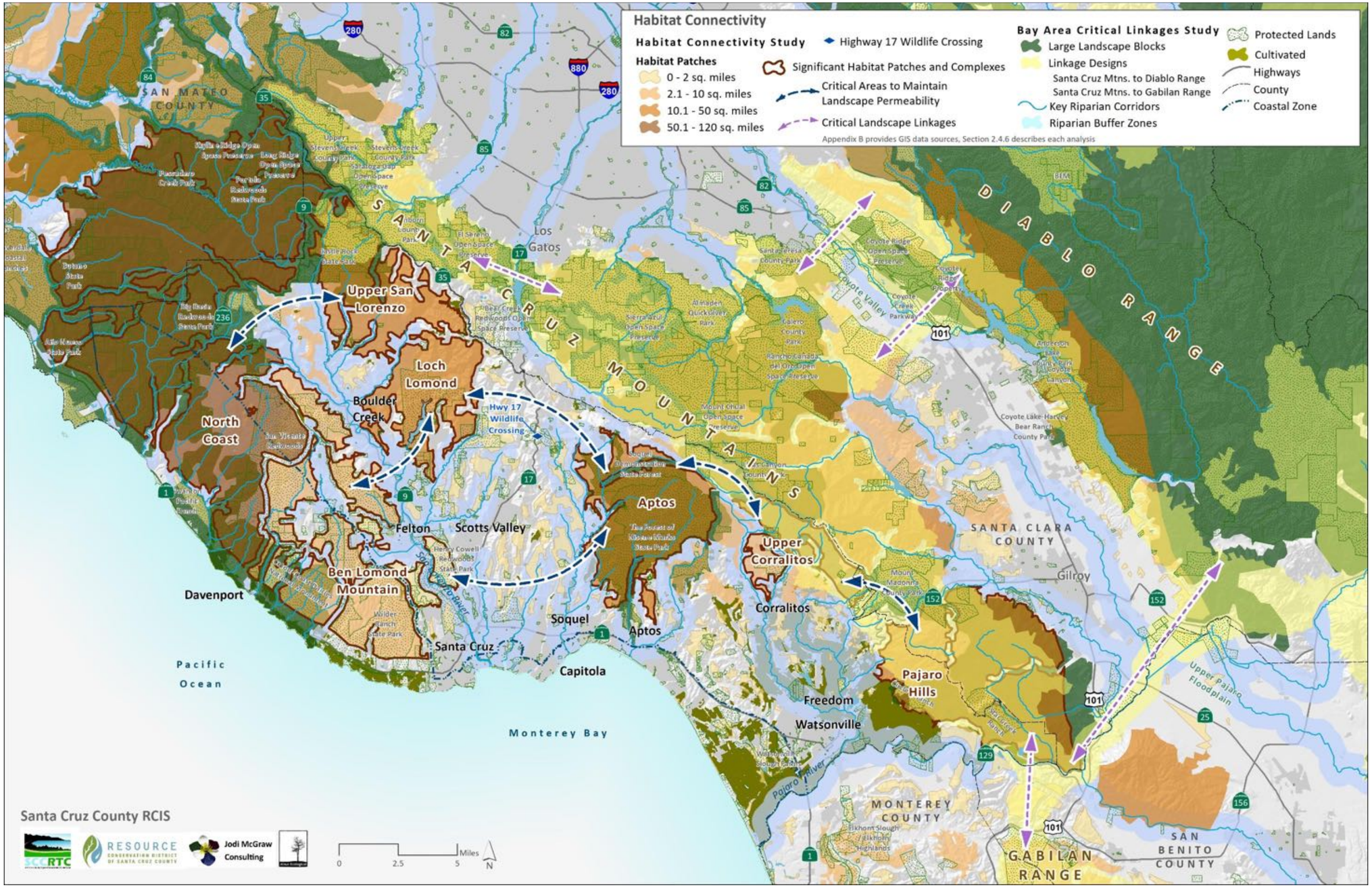

Figure 5-21: Habitat Connectivity Conservation Element

Table 5-24: Conservation Strategy for Habitat Connectivity

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
CONNECT-G1: Maintain and enhance habitat connectivity to promote dispersal, and other ecological processes including gene flow and facilitate migration in response to climate change.	**CONNECT-O1:** Protect at least 23,500 additional acres within the large habitat patches identified in the RCIS Area to achieve the 75% target for conservation of this element (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**CONNECT-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses. This land protection action is intended to complement (not replace) existing and new policies and programs designed to maintain working lands, including compatible working forests and grazing, as discussed in the Working lands strategy.	Prioritize properties that can conserve relatively large portions of the seven priority Habitat Patches. Specific priorities include: • Protect areas that can buffer and expand Big Basin State Park (North Coast), San Vicente Redwoods and Coast Dairies National Monument (Ben Lomond Mountain), Castle Rock State Park (Upper San Lorenzo), Loch Lomond Recreation Area (Loch Lomond), Nisene Marks State Park and Soquel Demonstration Forest (Aptos), the Byrne-Milliron Forest (Upper Corralitos), and Star Creek Ranch (Pajaro Hills). • Protect areas that feature a diverse mosaic of representative native plant communities in the RCIS Area, to maximize diversity. • Protect areas that can be effectively managed using fire, including larger areas away from development. • Protect areas featuring a diverse mosaic of land facets (i.e., due to variable soils and/or topography) and that contain potential climate change refugia (e.g., cooler microclimates), to facilitate climate change adaptation and resilience. • Protect and maintain multiple alternative pathways to provide redundancy and thus resiliency.	• Development • Mining/quarrying • Working lands • Climate change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
	CONNECT-O2: Protect areas of remaining intact habitat between the large habitat patches to maintain landscape permeability and facilitate dispersal and migration through transportation corridors. Measure progress toward this objective based on the acres of habitat protected.	**CONNECT-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses. This land protection action is intended to complement (not replace) existing and new policies and programs designed to maintain working lands, including compatible working forests and grazing, as discussed in the Working lands strategy.	Specific priorities include habitat that will facilitate movement between the following large habitat patches (Figure 5-21): • The North Coast and Upper San Lorenzo, through the SR 236 and SR 9 transportation corridors. • The Ben Lomond Mountain and Loch Lomond, through the SR 9 corridor; • Ben Lomond and Loch Lomond to Aptos, through the SR 17 corridor; • Aptos and Upper Corralitos, through Eureka Canyon/Highland Drive; • Upper Corralitos and the Pajaro Hills, including through the SR 152 corridor.	• Development • Mining/quarrying • Working lands • Climate change	• Most other focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
	CONNECT-O3: Protect habitat to facilitate landscape connectivity to the Gabilan and Diablo range mountains to	**CONNECT-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses. This land	Prioritize properties that can facilitate movement through the critical choke points between the mountain ranges including: • The Pajaro Hills in the southern tip of the Santa Cruz Mountains, where maintaining habitat is essential to facilitating migration between the Gabilan Range as well as the Diablo Range via the Upper Pajaro River.	• Development • Mining/quarrying • Working lands • Climate change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	maintain connectivity between the Santa Cruz Mountains and the adjacent coast ranges. Measure progress toward this objective based on the acres of habitat protected.	protection action is intended to complement (not replace) existing and new policies and programs designed to maintain working lands, including compatible working forests and grazing, as discussed in the Working lands strategy.	• The Summit Region where habitat in the RCIS Area adjoins intact habitat on the eastern slope of the Santa Cruz Mountains which connects to Coyote Valley—the narrow restriction in the Santa Clara Valley where species movement between the Santa Cruz and Diablo Range mountains is most feasible.		
	CONNECT-O4: Protect streams and riparian corridors to maintain their function as essential corridors for aquatic and terrestrial species. Measure progress toward this objective based on the acres of habitat protected, and in consideration of the condition and width of the riparian corridor.	**CONNECT-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion and other degradative land uses. This land protection action is intended to complement (not replace) existing and new policies and programs designed to maintain working lands, including compatible working forests and grazing, as discussed in the Working lands strategy.	Prioritize properties that: • can maintain connectivity between streams, estuaries, and the ocean, to facilitate migration by anadromous fish and dispersal of species between watersheds; • Can maintain connectivity between headwaters streams adjacent watersheds, to facilitate dispersal between watersheds by species that use streams and riparian habitat that line them; • Protect Key Riparian Corridors (Figure 5-21)—coastal streams supporting anadromous fish, which require connectivity between the ocean and upper stream reaches to complete their life history, and also provide essential corridors for terrestrial species movement. Specific priorities should include riparian corridors that: • Are essential for anadromous fish and other aquatic species; • Provide essential connectivity between the large habitat patches; • Facilitate movement within developed or cultivated areas (e.g., the San Lorenzo and its tributaries, and the Pajaro River); • Can promote movement to the adjacent mountain ranges (i.e., Pajaro River and Pescadero Creek in the Pajaro River Watershed). • Can protect and maintain multiple alternative pathways to provide redundancy and thus resiliency.	• Development • Mining/quarrying • Working lands • Climate change	• Most other focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
	CONNECT-O5: Restore and enhance habitat to promote its use by species and ecological processes to move through the landscape. Measure progress toward this objective based on	**CONNECT-A2: Restore habitat** that has been degraded by prior land and water use, stream modifications, exotic plants, incompatible recreation, and other anthropogenic factors that degrade connectivity, to facilitate species movements, promote natural community structure	Prioritize areas for restoration based on the following criteria focused on promoting habitat connectivity, while providing redundancy (i.e., alternative pathways): • Critical landscape linkages between the RCIS Area (and broader Santa Cruz Mountains) and adjacent mountain ranges; • Areas critical to maintain landscape permeability to facilitate movement between large habitat patches in the RCIS Area; and • Key Riparian Corridors, including areas that feature in-stream impediments to aquatic species movement, and/or degradation to	• Development • Mining/quarrying • Working lands • Climate change	• Most other focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	the acres of habitat restored or enhanced.	and species composition, ecosystem functions and services.	the riparian habitat lining the stream, which limits its use as a corridor.		
		CONNECT-A3: Manage disturbance including fire and floods within the natural range of variation of the disturbance regime, to prevent unnatural succession and maintain areas of connected habitat.	Prioritize actions in disturbance-adapted systems where alterations to disturbance regimes have altered habitat conditions and fragmenting habitat. In terrestrial communities, these are anticipated to include: • grasslands successional to coastal scrub in coastal prairies of the North Coast and the Pajaro Hills; and • Long-unburned maritime chaparral and knobcone pine forest subject to encroachment by oaks, Pacific Douglas-fir, or other species establish in the absence of fire, including in the Larkin Valley area. In aquatic communities, these are anticipated to include: • Managing bar-built estuaries to ensure that they are opened at ecologically appropriate times to facilitate movement of species between the ocean and streams. • Developing multi-benefit flood management projects that result in removal or modification of existing hardened infrastructure and improve instream habitat complexity.	• Alteration of natural disturbance regimes • Climate change	• Disturbance-adapted focal and non-focal species (actual list depends on the project): • Numerous co-benefited species
		CONNECT-A4: Manage recreation to limit its negative effects on habitat connectivity and wildlife movement, including disruptions to natural behaviors for species wary of humans.	Prioritize recreation management in areas important for landscape connectivity and habitat permeability, including the mapped landscape linkages and large habitat patches. Priority actions could include: 1) limiting the types, seasonality, or intensity of allowed activities, and 2) closing areas to recreation, where needed, to facilitate wildlife movement in key areas.	• Incompatible recreation • Climate change	• Focal and non-focal species impacted by recreation (actual list depends on the specific project). • Numerous co-benefited species
		CONNECT-A5: Manage unauthorized activities including illegal cannabis cultivation and illegal camping, which fragment and degrade habitat and can reduce the permeability of the landscape through a variety of mechanisms.	Prioritize projects that: • Safeguard habitat in the areas identified as most important for habitat connectivity: the large habitat patches, areas critical for permeability, and the landscape linkages (Figure 5-21); • Protect habitat in public and private conservation lands, including parks and conservation easement areas; • Maintain populations of rare species; and • Protect associated conservation elements.	• Unauthorized activities	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
	CONNECT-O6: Enhance habitat connectivity by removing or	**CONNECT-A6: Remove anthropogenic barriers to fish passage** to facilitate access to important upstream habitat.	Prioritize removal of fish passage barriers based on their value for connectivity using the current Santa Cruz County Fish Passage Barrier database and the State Passage Assessment Database (PAD), the Integrated Watershed Restoration Program Technical Advisory	• Development • Working lands • Increased Fine Sediment • Water use	• Coho • Steelhead (SCCC and CCC) • Tidewater goby

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
	mitigating barriers to movement where it is currently constrained. Measure progress toward this objective based on the number of barriers removed, miles of streams accessible following barrier removal, and/or the acres of habitat restored or enhanced.		Committee, and input from local experts. Priorities can include removal of barriers that are important for: • coho salmon (a focal species), including barriers in Core, Phase 1, and Phase 2 watersheds in the coho salmon recovery plan; • steelhead, a non-focal species, including barriers in the Core 1 areas in the SCCC steelhead recovery plan; • co-benefited anadromous species (e.g., Pacific lamprey).	• Climate change	• Numerous co-benefited species
		CONNECT-A7: Improve stream flows to facilitate movement of fish and other aquatic species within streams.	Prioritize actions in streams that meet the criteria for Action 6 for Objective 6 (CONNECT-O6 CONNECT-A6).	• Development • Working lands • Water use • Climate change	• Coho salmon • Steelhead (SCCC and CCC) • Tidewater goby • California red-legged frog • Foothill yellow-legged frog • Numerous co-benefited species
		CONNECT-A8: Reduce anthropogenic impediments such as fences where they restrict movement in important connectivity areas.	Prioritize actions in the following areas, while providing redundancy and alternative pathways (Figure 5-21): • Along Key Riparian Corridors, to enable wildlife to access riparian areas from adjacent land; • The three main landscape linkages connecting habitat in the RCIS Area to adjacent habitat in other mountain ranges; and • The six general areas between habitat patches where it is essential to maintain habitat permeability; and • Other areas identified as important for wildlife movement. Projects can include installing wildlife-friendly fences to replace less permeable fences, where fences are needed (e.g., to contain livestock).	• Development (incl. transportation and infrastructure) • Working lands • Climate change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
		CONNECT-A9: Implement wildlife crossing infrastructure improvement projects to facilitate safe passage by animals through transportation corridors, including (but not limited to): new or retrofitted bridges (underpasses, overpasses, land bridges) and culverts (including tunnels); and directional fencing (to	Prioritize actions in areas most critical for maintaining wildlife movement, while providing redundancy and alternative pathways, including based on the following criteria: • Located in an identified landscape linkage, choke point, or other area where wildlife movement has been identified as crucial but is inhibited by transportation or other development or infrastructure; • Is a partial or total barrier to movement based on movement data analysis (e.g., road kill, GPS collars, camera traps) or population genetics, etc.; and • Connects suitable habitat on either side, ideally that is protected or will remain intact due to other factors (e.g., constraints to development).	• Development (incl. transportation and infrastructure) • Mining/quarrying • Working lands • Climate change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		funnel wildlife to crossing structures).	Priorities for the landscape linkage to the Gabilan Range, are currently being developed as part of the South Santa Cruz Mountains Wildlife Connectivity Study (POST and Pathways for Wildlife *in prep.*). These recommendations will address connectivity through SR 129 in the RCIS Area, as well as Highway 101 just beyond the RCIS, where connectivity will be critical to maintaining the landscape linkage. Highway 1, which inhibits movement between the coast and inland areas, is a hot spot for road kill (Breheme and Fisher 2018, UCD 2021). Highway 17, where a tunnel is currently being built at Laurel Curve, is also a hot spot for road kill; additional transportation improvements along this highway could prevent east-west bisection of the RCIS Area.		
	CONNECT-O7: Increase understanding of areas important for connectivity including for species adaptation in response to climate change.	**CONNECT-A10: Conduct research and long-term** monitoring to examine species habitat use and factors influencing habitat permeability and identify priority connectivity conservation, restoration, and enhancement projects.	Prioritize projects that fill key data gaps in informing understanding of connectivity including: • Areas important to protect, restore, or enhance connectivity; and • factors influencing habitat use by species.	• Development (incl. transportation and infrastructure) • Mining/quarrying • Working lands • Climate change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

5.3.22 Mountain Lion

Mountain Lion

Status and Rarity

- State Candidate for Listing, (Southern California and Central Coast Evolutionary Significant Unit)

Detailed Descriptions

Yap and Rose 2019

Distribution and Range

- Found throughout much of western North American and South America
- In the RCIS Area, occupies all terrestrial communities (Figure 5-22), and preferentially occurs in natural and semi-natural vegetation in open space and areas connected to open space (Wang et al. 2015).

Key Ecological Elements

- Utilizes all terrestrial communities in the RCIS Area. May occur preferentially in habitat supporting black-tailed deer, which comprise 70% of their diet; however, mountain lions are opportunistic predators that also take other prey (Currier 1983, Iriarte et al. 1990).
- Dens (where kittens are kept) are located in dense vegetation or other cover (Young and Goldman 1946), generally located away from roads and human disturbance (~600 m; Wilmers et al. 2013).
- Mountain lion adults are solitary (except for females with kittens), have large home ranges (100-150 square miles for males) comprised of heterogeneous habitat, and therefore occur at low density in the landscape (Beier 1993, Morrison and Boyce 2009). The effective population size of the entire Central Coast North mountain population, which includes the Santa Cruz Mountains as well as northern Diablo Range Mountains, is 15.1 – 18.2 (Gustafson et al. 2018).

- The Santa Cruz Mountains population is at risk due to current habitat and genetic concerns, at-risk internal habitat and connectivity, limited external connectivity, and lack of protected habitat. Without immigration, the Santa Cruz Mountains population could decline below levels needed to maintain genetic diversity or a persisting population (Thorne et al. 2002, Gustafson 2018).
- Dispersal from adjacent habitat in the Gabilan and Diablo mountain ranges is constrained by habitat fragmentation including roads. While US Highway 101 features crossing structures used by mountain lions, Monterey Highway limits migration through Coyote Valley. Migration from the Gabilan Range is limited by US Highway 101 near Prunedale.
- Vehicle traffic and attendant development through the SR 17 corridor create a partial barrier to east-west movement through the RCIS Area and may impede gene flow (Wilmers et al. 2013).
- Although they are apex predators with no natural predators in the Central Coast and can live up to 13 years, lifespans are much shorter due to vehicle strikes, depredation, intraspecific aggression, rodenticide poisoning, and poaching (Yap and Rose 2019). Among mountain lions collared as part of the Santa Cruz Puma Project, human caused mortality is the leading cause of death (Wang et al. 2017). Depredation, which usually results from mountain lions killing livestock, disproportionately kills dispersing males, and exacerbates the effects of habitat fragmentations and roads at reducing gene flow (Vickers et al. 2017).

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting mountain lion within the RCIS, which include the following most critical ones:

- Habitat loss and fragmentation due to primarily to residential development and cultivation, including cannabis.
- Development, expansion, and maintenance of transportation corridors, including associated vehicle strikes;
- Depredation, which limits dispersal and thus gene flow, and reduces the mean age of the population in ways that could affect fitness and population growth[8];
- Rodenticide poisoning, which may increase susceptibility to notoedric mange—a parasitic skin disease linked to mountain lion mortality (Riley et al. 2007);
- Incompatible recreation, which can deter mountain lion habitat use and alter behaviors (Wilmers et al. 2013, Suraci et al. 2019)

[8] In 2020, CDFW developed a new policy for mountain lion depredation, which has greatly reduced reported and legal depredations (T. Kasteen, pers. comm. 2021).

- Loss of genetic diversity due to reduced gene flow (as a result of habitat fragmentation); reduction in the size of the effective populations due to habitat loss, fragmentation, and degradation; and genetic bottlenecks (Gustafson et al. 2018).

Climate Change Vulnerability Assessment

Climate change may impact mountain lion populations by (EcoAdapt 2021):

- reducing populations of black-tailed deer, their main prey, by reducing the quality and availability of their forage (due to increased drought, climatic water deficit, invasive species, and vegetation transitions), reducing water availability, and increasing the frequency of fire; and
- increasing susceptibility to the impacts of disease including notoedric mange which is exacerbated by exposure to anticoagulant rodenticides.

While their generalist habitat use and prey base as well as high mobility reduces mountain lion vulnerability to climate change, the following factors may increase mountain lion vulnerability to the effects of climate change (EcoAdapt 2021):

- low population density and slow growth rate, which reduce the rate of recovery of the population following events that cause declines;
- low genetic diversity due to reduced gene flow resulting from habitat fragmentation.

The goals, objectives, actions, and priorities for mountain lion (Table 5-25) will help address the impacts of climate change by:

1. Protecting habitat to safeguard large habitat patches, which will: 1) protect potential climate refugia, such as cooler microclimates (e.g., north-facing slopes) that can support prey populations; 2) maintain or enhance the size of populations, which reduces their vulnerability to climate-change-induced reductions in abundance; and 3) sustain or enhance genetic diversity in populations, including by promoting dispersal from adjacent mountain ranges, which can aid adaptation to climate change;
2. Restoring and enhancing habitat connectivity in critical linkages between the Santa Cruz Mountains and the Gabilan and Diablo mountain ranges and along the Key Riparian Corridors, and maintaining or enhancing the permeability of habitat between the large habitat patches, to facilitate movement that is critical to sustaining populations, including by increasing genetic diversity, and facilitating migration in response to climate change;
3. Reducing factors that cause mortality and reduce the mean age of the population in ways that could have implications for its size (e.g., reduced fitness), including the frequency of depredation and mortality and morbidity due to notoedric mange;
4. Managing recreation in open space lands that provide important habitat for mountain lion to reduce impacts on key behaviors, including communications and reproduction;
5. Facilitating safe movement through transportation corridors that threaten connectivity within the RCIS Area, and between the RCIS Area and adjacent areas where landscape

connectivity is essential to sustaining populations including by maintaining genetic diversity as well as migration in response to climate change; and

6. Conducting research and long-term monitoring to increase understanding of population trends and their drivers, including climate change impacts.

Species Associated with the Conservation Element

Many additional focal and non-focal species can benefit from the goals, objections, actions, and priorities for mountain lion, given the wide range of the species; the magnitude of the benefit will depend on the specific action, including its location, and the co-occurring species' life history.

Other Actions that Benefit this Species

Mountain lion will benefit from actions to achieve the goals and objectives for Habitat Connectivity Conservation Element (CONNECT-A1 to CONNECT-A6), which were developed to enhance connectivity for wide-ranging species as well as promote overall permeability of the landscape which benefits all species. Accordingly, the goals, objectives, actions, and priorities for mountain lion build upon those identified in the Habitat Connectivity Conservation Element.

Mountain lion will also benefit from many habitat protection, restoration/enhancement, creation, and connectivity actions identify for the conservation elements for the natural communities, particularly Grasslands, Oak Woodlands and Forests, and Redwood and Douglas-Fir Forest, and six focal species.

Figure 5-22: Mountain Lion Conservation Element

Table 5-25: Conservation Strategy for Mountain Lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
PUMA-G1: Promote the long-term persistence of mountain lion (puma) populations in the RCIS Area and thus broader Santa Cruz Mountains Bioregion.	**PUMA-O1:** Protect at least 27,502 additional acres of habitat suitable for mountain lion in the RCIS Area to achieve the 50% target for conservation of this focal species (Table 5-3), while maintaining large areas of intact habitat, landscape linkages, and habitat permeability, to facilitate dispersal and migration through developed areas and transportation corridors. Measure progress toward this objective based on the acres of habitat protected.	**PUMA-A1: Protect habitat** through fee title acquisition or conservation easements to permanently protect habitat from conversion, fragmentation, and degradation due to incompatible land uses.	Prioritize properties that can conserve areas of intact habitat that are important for connectivity as outlined for Action 1 in Objectives 1 through 4 in the conservation strategy for Connectivity (CONNECT-A1 in CONNECT-O1 through CONNECT-O4). Specific habitat protection priorities for mountain lion include areas that: • feature low levels of human habitation and activity; • are in the landscape linkages connecting the Santa Cruz Mountains to the Gabilan Range Mountains to the south, and the Diablo Range Mountains to the east, via the Upper Pajaro River; and/or • can facilitate permeability through developed areas, including movement along Key Riparian Corridors and through transportation corridors (SR 9, SR 17, SR 152, and SR 236).	• Development • Mining/quarrying • Working lands (cultivation) • Climate change	• Mountain lion • All focal and non-focal species have potential to benefit, with the actual list depending on the specific project • Numerous co-benefited species
	PUMA-O2: Restore and enhance habitat to promote its use by mountain lion and its movement through the landscape. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PUMA-A2: Restore habitat** that has been degraded by prior land use, such as former mines, tree farms, and cultivated areas.	Prioritize areas for restoration based as outlined in Action 2 for Objective 5 of the Connectivity conservation strategy (CONNECT-O5 CONNECT-A2), based on the following criteria, which are focused on promoting habitat connectivity: • Critical landscape linkages between the RCIS Area (and broader Santa Cruz Mountains) and adjacent mountain ranges; • Areas critical to maintain landscape permeability to facilitate movement between large habitat patches in the RCIS Area; and • Key Riparian Corridors, including areas that feature in-stream impediments to aquatic species movement, and/or degradation to the riparian habitat lining the stream, which limits its use as a corridor; • Facilitate movement through transportation corridors (SR 9, SR 17, SR 152, and SR 236).	• Development • Mining/quarrying • Working lands • Climate change	• Mountain lion • All focal and non-focal species have potential to benefit, with the actual list depending on the specific project • Numerous co-benefited species
		PUMA-A3: Manage fire within the natural range of variation of the disturbance regime, to prevent unnatural succession, maintain areas of connected habitat, and prevent a large-	Prioritize actions as outlined in Action 3 for Objective 5 of the Connectivity conservation strategy (CONNECT-O5 CONNECT-A3), and that are in disturbance-adapted systems where alterations to disturbance regimes have altered habitat conditions, fragmenting habitat. These are anticipated to include: • grasslands successional to coastal scrub in coastal prairies of the North Coast and Pajaro Hills; and	• Alteration of natural disturbance regimes • Climate change	• Mountain lion • All focal and non-focal species adapted to disturbance have the potential to benefit, with the actual list depending on the specific project

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		scale fire that could reduce populations.	• Long-unburned maritime chaparral and knobcone pine forest subject to encroachment by oaks, Pacific Douglas-fir, or other species establish in the absence of fire, including in the Larkin Valley area.		• Numerous co-benefited species
		PUMA-A4: Manage recreation to limit its negative effects on habitat connectivity and wildlife movement, including disruptions to natural behaviors for species wary of humans.	Prioritize recreation management in areas as outlined in Action 4 for Objective 5 of the Connectivity conservation strategy (CONNECT-O5 CONNECT-A4) that are important for landscape connectivity and habitat permeability, including the mapped landscape linkages and large habitat patches. Priority actions could include: 1) limiting the types and/or intensity of activities, and 2) closing areas to recreation, where needed, to facilitate mountain lion habitat use in key habitat areas necessary to maintain the population.	• Incompatible recreation • Climate change	• Mountain lion • All focal and non-focal species sensitive to recreation have the potential to benefit, with the actual list depending on the specific project • Numerous co-benefited species
	PUMA-O3: Enhance habitat permeability by removing or mitigating barriers to movement where it is currently constrained. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**PUMA-A5: Reduce anthropogenic impediments such as fences** where they restrict movement in important connectivity areas.	Prioritize actions in areas as outlined in Action 8 for Objective 5 of the Connectivity conservation strategy (CONNECT-O5 CONNECT-A4) in the following areas: • Along Key Riparian Corridors, to enable wildlife to access riparian areas from adjacent land; • Landscape linkages; • Critical areas to maintain habitat permeability between large habitat patches • Through critical transportation corridors (SR 9, SR 17, SR 152, and SR 236); and • Other areas identified as important for mountain lion movement. Projects can include installing wildlife-friendly fences to replace less permeable fences, where fences are needed (e.g., to contain livestock).	• Development (incl. transportation and infrastructure) • Working lands • Climate change	• Mountain lion • Numerous co-benefited species
		PUMA-A6: Implement wildlife crossing infrastructure improvement projects to facilitate safe passage by mountain lion through transportation corridors, including (but not limited to): new or retrofitted bridges (underpasses, overpasses, land bridges) and culverts (including tunnels); and directional fencing (to funnel wildlife to crossing structures).	Prioritize actions in areas most critical for maintaining mountain lion movement, as outlined in Action 8 for Objective 5 of the Connectivity conservation strategy (CONNECT-O5 CONNECT-A8), including based on the following criteria: • Located in an identified landscape linkage, choke point, or other area where wildlife movement has been identified as crucial but is inhibited by transportation or other development or infrastructure; • Is a partial or total barrier to movement based on analysis of data on evaluating movement (e.g., road kill, GPS collars, camera traps) or population genetics, etc.; and • Connects suitable habitat on either side, ideally that is protected or will remain intact due to other factors (e.g., constraints to development).	• Development (incl. transportation and infrastructure) • Mining/quarrying • Working lands • Climate change	• Mountain lion • Additional focal and non-focal animal species, dependent on the specific project • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			Priorities for the landscape linkage to the Gabilan Range are currently being developed as part of the South Santa Cruz Mountains Wildlife Connectivity Study (POST and Pathways for Wildlife *in prep.*). These include projects within the RCIS Area, such as promoting connectivity through SR 129, as well as just beyond the RCIS Area in San Benito County, where promoting connectivity through Highway 101 will be essential to maintaining the landscape linkage.		
	PUMA-O4: Maintain or increase mountain lion population persistence, including by increasing effective population size and mean age in the RCIS Area and broader Santa Cruz Mountains Bioregion. Measure progress toward this objective based on effective population size, mean age, or other metrics that indicate improved population persistence.	**PUMA-A6: Implement programs and community outreach** to reduce exposure to anticoagulant rodenticides.	Prioritize actions that can reduce mortality and morbidity caused by exposure to anticoagulant rodenticide by: • Reduce the use of rodenticides, to reduce their impacts on mountain lions and other non-target species (bobcats, coyotes, owls, etc.); • Conducting outreach to residences and businesses, including agricultural operations, to reduce the use of rodenticides and encourage other methods of rodent control, such as containing refuse, forage, and other food sources, and reducing access to structures that provide habitat.	• Development (incl. transportation and infrastructure) • Mining/quarrying • Working lands • Climate change	• Mountain lion • Focal and non-focal species that consume rodents including: • Golden eagle • Swainson's hawk • White-tailed kite • Ring-tailed cat • Numerous co-benefited species
		PUMA-A7: Implement programs and community outreach to reduce depredation.	Prioritize actions that can reduce mortality due to depredation, including: • Developing education programs on how to safeguard pets and animals in areas where mountain lions occur; • Developing and implementing programs that promote safe animal keeping, by reducing vulnerability of pets and livestock (excluding range cattle) to mountain lion predation, including by encouraging them to be enclosed overnight; • Developing programs to compensate ranchers for the economic costs of loss of range cattle verified to have resulted from mountain lion attack.	• Development (incl. transportation and infrastructure) • Mining/quarrying • Working lands • Exotic animals • Climate change	• Mountain lion
		PUMA-A8: Implement mediated dispersal or other actions to increase genetic diversity needed to promote individual health and long-term population persistence.	Prioritize actions that can promote persistence of populations and their resilience to climate change and other pressures and stressors.	• Loss of genetic diversity	• Mountain lion
		PUMA-A8: Conduct research and long-term monitoring to increase understanding of population trends and their	Prioritize research to address the most significant data gaps to informing conservation and management.	• Development (incl. transportation and infrastructure) • Mining/quarrying	• Mountain lion

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
		drivers, including climate change impacts		• Working lands • Exotic animals • Climate change • Loss of genetic diversity	

5.3.23 Working Lands

Working Lands

Status and State and Global Ranks

- No official state or federal status
- Agricultural land impacts addressed as part of California Environmental Quality Act
- County of Santa Cruz General Plan and Local Coastal Program protects agricultural lands

Detailed Descriptions

Mackenzie et al. 2011

CDFW 2016

Schmidt et al. 2015

Distribution and Range

- 113,964 acres (16% of the RCIS Area; Figure 5-23)
    - 26,414 ac. of cultivated lands;
    - 68,306 ac. zoned for timber production, 9,895 harvested between 2011 and 2019; and
    - 19,244 ac. suitable for grazing (DOC 2016).
- Cultivated Lands occur primarily in the Pajaro Valley and along the North Coast
- Rangelands occur in the grasslands of the North Coast and Pajaro Hills
- Timberlands occur throughout the mountains and are concentrated in the North Coast

Key Ecological Elements

Section 2.2.3 summarizes the working lands in the RCIS Area. The following briefly highlights the substantial ecological value of working lands for native species when managed with sustainable practices.

- Working lands for crop production, livestock grazing, and timber production depend upon, and can be managed to promote, healthy soil, pollinators, water supply, and a stable climate. Working with landowners and land managers to protect and improve the provisioning of ecosystem services and ecological functions should be a priority for conservation (Schmidt et al. 2015).
- Redwood forests in the RCIS Area that are harvested to produce timber products provide extensive habitat important for wide-ranging species, including mountain lion. These forests can be harvested using techniques that can also promote biodiversity conservation by: 1) protecting and buffering remaining old-growth stands and other sensitive habitats, including streams and riparian corridors; 2) retaining important trees for native animals, and 3) promoting late-seral forest conditions characterized by fewer, more widely spaced trees (O'Hara et al. 2010, Plummer et al. 2012).
- In the absence of large native herbivores, appropriate grazing of cattle, sheep, and goats is a valuable management tool in grasslands, where it can reduce invasive plant dominance, and wildfire fuel loads and thus promote populations of native plants and animals (Jackson and Bartolome 2007). Rangelands on the North Coast and in the Pajaro Valley region feature human-created ponds that support pond-breeding species, and provide extensive adjacent upland habitat suitable for these species as well as many native animals that require grassland habitat, such as raptors.
- Some cultivated areas also provide foraging habitat for species, such as tricolored blackbird and Swainson's hawk. Additionally, some farms feature hedgerows of trees and shrubs that provide cover, food (e.g., fruit, pollen), or other resources, and may help promote animal movement through fragmented landscapes (Davies and Pullin 2007). Depending on location and management, agricultural lands can provide critical movement corridors for wildlife between adjacent natural communities and open spaces.

Pressures and Stressors

Table 4-2 highlights the pressures and stressors affecting sustainable working lands, which include the following most critical ones:

- Conversion of working lands to development, which also fragments remaining lands that presents challenges for operations (e.g., crop production adjacent to sensitive receptors).

- Invasive species including yellow starthistle, gypsy moth, Asian longhorn beetle, light brown apple moth, giant reed (*Arundo donax*), which reduce the economic productivity of rangelands (Duncan et al. 2004) and farmland (Sumner et al. 2006).
- Fire exclusion to prevent loss of timber, which can increase fuel loads and lead to catastrophic (large, intense, and severe) wildfires that are outside of the natural disturbance regime to which species have adapted.

In addition, certain working lands practices can be incompatible with the conservation of biodiversity, including:

- Incompatible activities in cultivated landscapes, such as water use, tilling, pest control, use of plastics, clearing of riparian vegetation, erecting high fences, and use of bait stations;
- Incompatible activities on working landscapes that can degrade water quality, such as soil disturbance and erosion, overapplication or improper use of nutrients and pesticides, and poor manure management.
- Fire exclusion to prevent loss of timber which, in the absence of active management, can promote type conversion of forest communities, increase fuel loads, and lead to catastrophic (large, intense, and severe) wildfires that are outside of the natural disturbance regime to which species have adapted.
- Measures implemented to reduce risk to food safety resulting from evidence of animal activity in or near cultivated lands, including vegetation clearing, extensive fencing, bait stations, and rodenticide use, which reduce, degrade, and fragment habitat and affect animal populations (Jakes et al. 2005; Quinn et al. 2019).
- Depredation due to livestock predation by mountain lion.

Complex external social, regulatory, and economic drivers can limit the ability of working lands to be managed compatibly with conservation of biodiversity. These include the following:

- Barriers encountered by land owners and managers during planning or implementing conservation projects such as conflicting guidance and requirements from different agencies, and challenges navigating the permitting process.
- Concern from land owners and managers that involvement from management agencies, regulatory processes, and/or permit requirements will be overly burdensome, or otherwise add complexity to running an already complex business.
- Insufficient funds, labor, or other resources needed to implement and/or maintain conservation projects.
- Concern about the monitoring, reporting, maintenance, or other requirements associated with some grant funding for conservation projects.
- Loss of productivity and profitability including that resulting from taking land out of production.

These externalities should be considered and addressed where possible to improve the feasibility of implementation.

Climate Change Vulnerability Assessment

- As the future climate of the region is projected to be generally drier, with higher frequency of drought, less groundwater recharge, and increased climatic water deficit, there will be an increase in the demand for irrigation water (County of Santa Cruz 2019a).
- Low-elevation coastal cultivated lands are vulnerable to sea level rise, which can cause loss of land and saltwater intrusion to groundwater (CDFW 2016).
- Working forests and rangelands in the RCIS Area are moderately vulnerable to climate change (EcoAdapt 2021), as described in the conservation strategies for Redwood and Douglas-Fir Forests (Section 5.3.18) and Grasslands (Section 5.3.12).
- Climate change may impact working forests indirectly by altering the fire regime to which trees and other species are adapted, as was seen in the high severity/high intensity of the CZU Lightning Complex Fire in August 2020 (SCMBC 2020).

The goals, objectives, actions, and priorities for working lands (Table 5-26) will help address the impacts of climate change by:

1. Protecting working lands from conversion to other more intensive uses, to conserve the habitat they support including grasslands, forests, and aquatic systems;
2. Enhancing management of forests, rangelands, and cultivated lands to reduce the pressures and stressors that impact the habitat they support, and promote their economic viability, including by controlling invasive species, enhancing riparian buffers, enhancing pollinator habitat, and increasing water use efficiency to reduce water use;
3. Partnering with working land managers, to promote water conservation measures and acquiring water rights, where appropriate, to support aquatic systems and species;
4. Using economic incentives such as assisting with permitting processes to enhance management of working lands to promote biodiversity and natural resources; and
5. Monitoring working forests, rangelands, and cultivated areas to plan for and adapt to climate change.

Species Associated with the Conservation Element

All of the RCIS focal and non-focal species (which are listed below) can benefit from the goals, objectives, actions, and priorities for the Working Lands conservation element; the magnitude of the benefit will depend on the specific action, including its location, and the co-occurring species' life history.

Letter designations are used to indicate species that are anticipated to benefit from conservation actions associated with the following types of working lands:

- Cultivated lands (C);
- Rangeland (R), including conservation grazing practices; and

- Working forests (F).

These designations indicate species that inhabit an area or adjacent area, or are anticipated to benefit from actions in the working lands strategy that are designed to enhance compatibility of working lands with biodiversity conservation.

- Ben Lomond spineflower [NF] C
- Monterey spineflower [NF] C, R
- Scotts Valley spineflower [NF] R
- Robust spineflower [NF] R
- Ben Lomond wallflower [NF] C
- Santa Cruz cypress [NF] F
- Santa Cruz tarplant [F] C, R
- White-rayed pentachaeta [NF] F
- San Francisco popcorn flower [NF] C, R
- Scotts Valley polygonum [NF] R
- Pacific Grove clover [NF] R
- Monarch butterfly [NF] C, F
- Ohlone tiger beetle [NF] R
- Western bumblebee [NF] C, R
- Mount Hermon June beetle [NF] C
- Zayante band-winged grasshopper [F] C
- Tidewater goby [NF] C, R, F
- Coho salmon [F] C, R, F
- Steelhead: CCC and SCC DPSs [NF] C, R, F
- California tiger salamander [NF] C, R
- Santa Cruz long-toed salamander [F] C, R
- Foothill yellow-legged frog [NF] R, F
- California red-legged frog [NF] C, R, F
- San Francisco garter snake [NF] C, R, F
- Southwestern pond turtle [F] C, R, F
- Golden eagle [NF] C, R, F
- Swainson’s hawk [NF] C, R
- White-tailed kite [NF] C, R
- Tricolored blackbird [NF] C, R

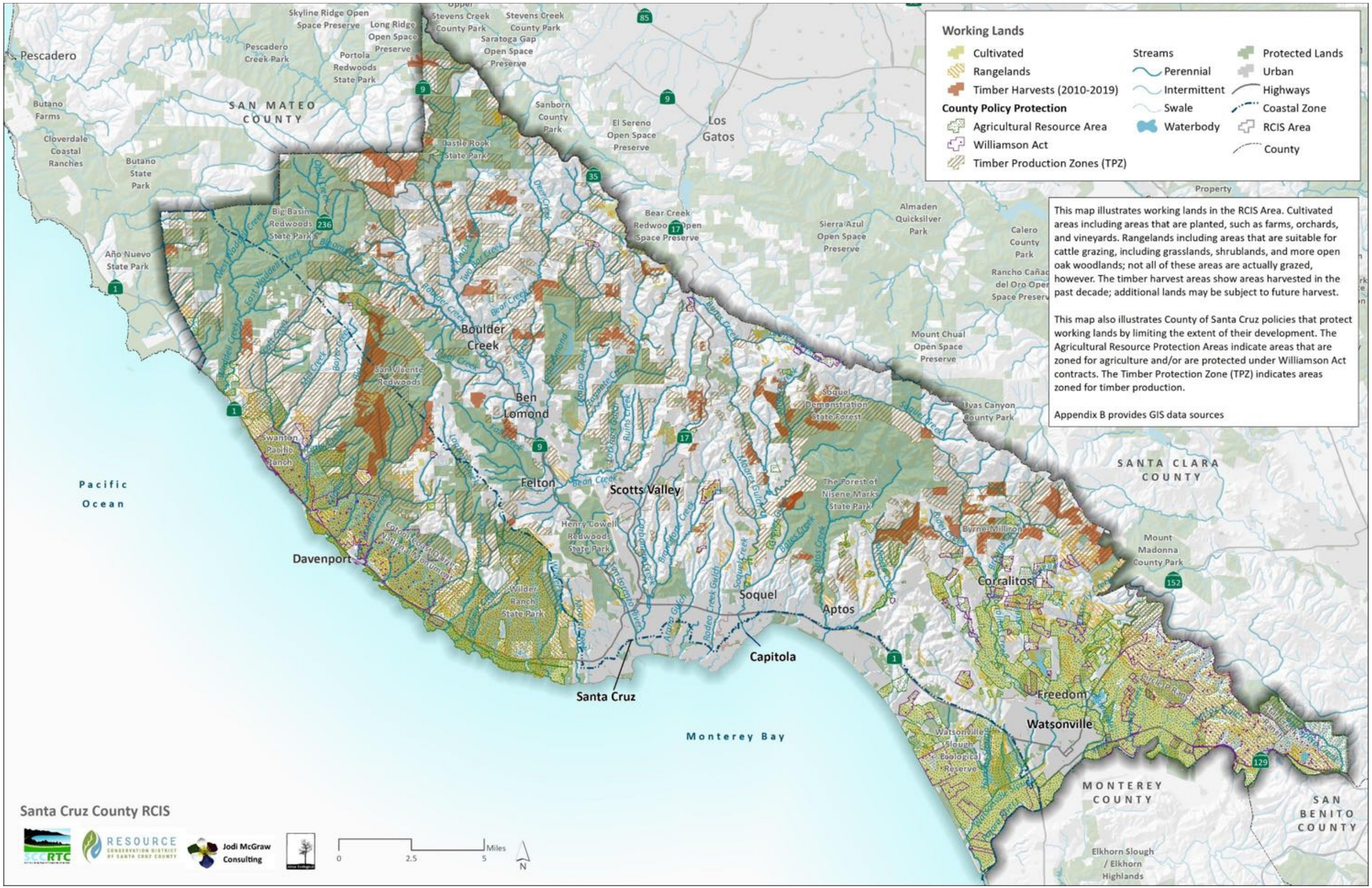

Figure 5-23: Working Lands Conservation Element

Table 5-26: Conservation Strategy for Working Lands

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited

WORKING-G1: Protect, restore, and enhance sustainable working lands to promote biodiversity conservation.	**WORKING-O1:** Protect at least 21,052 total acres of sustainable working lands, including: 9,145 acres of working forests, 2,059 acres of rangelands, and 9,808 acres of cultivated land, to achieve the 50% targets for these lands (Table 5-3). Measure progress toward this objective based on the acres of habitat protected.	**WORKING-A1: Protect land** through fee title acquisition or conservation easements to permanently protect working lands from conversion to urban and other degradative land uses and keep working lands working. This land protection action is intended to complement (not replace) existing and new policies and programs designed to maintain working lands, including compatible working forests and grazing.	Prioritize properties or projects that:
			• Prevent conversion of sustainable working lands to development and other land uses that are less compatible with biodiversity conservation;
			• Are identified as priorities in prior plans, or meet the criteria used to prioritize land in such plans;
			• Have multiple benefits such as protection of habitat, flood control, and protection of scenic or cultural resources;
			• Can be restored or managed to provide important habitat for native species including by enhancing landscape connectivity;
			• Can facilitate adaptation to climate change, including:
			  ○ Feature important water sources including surface and ground water;
			  ○ feature climate refugia (e.g., north-facing slopes);
			  ○ a range of land facets due to variable topography and soils; and/or
			  ○ can help connect existing protected habitat to facilitate migration.
				• Development
				• Working Lands (Incompatible Practices)
				• Mining/quarrying
				• Water use
				• Increased Fine Sediment
				• Exotic plants
				• Incompatible recreation
				• Unauthorized activities
				• Climate change
					• Most focal and non-focal species (actual list depends on the specific project)
					• Numerous co-benefited species

	WORKING-O2: Restore or enhance habitat to promote ecosystem functions and restore natural community structure and species composition where they have been degraded or eliminated through prior land use. Measure progress toward this objective based on the acres of habitat restored or enhanced.	**WORKING-A2: Restore habitat** within working lands that has been degraded by prior land use including intensive agriculture and historic clear-cutting, by addressing altered soils, exotic plants, and altered disturbance regimes, to restore sustainable working lands with increased suitability of habitat for rare species.	Prioritize working lands for restoration and sustainable management that: • If restored, enhanced, and managed sustainably, can support rare species, to expand their distribution and abundance, and that can connect or buffer existing protected lands or habitat. • Can restore marginal agricultural lands prone to flooding to restore floodplain habitat and reduce flooding risk upstream to sustain regional agricultural operations. • Are permanently protected, or where restoration actions will otherwise be durable and incorporated into long-term management compatible with production practices on the working lands (i.e., maintained); and/or • Can buffer and expand existing working lands, including areas that have experienced encroachment. • Can protect important and irreplaceable biological systems including riparian corridors, wetlands, and late seral forests.	• Development • Working lands (Incompatible Practices) • Mining/quarrying • Water use • Increased Fine Sediment • Exotic plants • Incompatible recreation • Unauthorized activities • Climate change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
		WORKING-A3: Enhance habitat within working lands to promote rare species and enhance sensitive natural communities.	Prioritize the following areas for enhancement: • Sensitive aquatic habitats including estuaries, streams, ponds, lakes, and wetlands identified in the conservation strategies for Bar-Built Estuaries; Riparian and Riverine; Ponds, Lakes, and Reservoirs; Freshwater Wetlands; and coho salmon.	• Development • Working lands (Incompatible Practices) • Mining/quarrying • Water use • Increased Fine Sediment	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Areas supporting sensitive terrestrial habitat including grasslands, old-growth and older second growth forests, and the rare species that they support; • Promote use of livestock ponds by native animals, including by maintaining appropriate hydrology and vegetation structure and using wildlife-friendly fencing; and • Areas adjacent to existing protected lands	• Exotic plants • Incompatible recreation • Unauthorized activities • Climate change	
		WORKING-A4: Manage fire and vegetation in working forests and rangelands using treatments that mimic fire's beneficial effects (i.e., fire surrogates) to manage habitat within the range of variation of the natural fire regime to: 1) maintain habitat suitable for rare species adapted to recurring fire and the conditions that it creates, 2) create and maintain a mosaic of native plant communities of various successional stages and thus habitat conditions, and 3) maintain a range of microclimatic and other abiotic conditions that can facilitate adaptation to a changing climate.	WORKING-P4: Prioritize fire management to: • Create uneven-aged stands in areas that were historically clear cut; • Restore long-unburned, where succession and litter accumulation are causing the extirpation of species that require open canopy and bare mineral soil; • Reset succession in long-unburned areas that feature senescent vegetation (e.g., buckbrush chaparral, knobcone pine forest); • Prevent succession of oak woodland and forest to conifer forest due to establishment of Pacific Douglas-fir, which is facilitated by fire exclusion; • Expand the area of open grassland habitat that is successional in transitional areas at the ecotone with non-grassland communities; • Control dense exotic grasses promoted by thatch accumulation; • Restore cultural burning practices to the land, where they are compatible with management of habitat and species.	• Altered disturbance regimes (Fire) • Climate Change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
		WORKING-A5: Manage invasive plants and dense exotic plants which alter community structure, and impact native species populations.	Prioritize projects that: • Eradicate or control invasive plants including eucalyptus, brooms, acacias, ivies, and other species that degrade habitat for are species, reduce water resources, increase the risk of unnatural fire, or otherwise alter plant community structure, species composition, or ecosystem functions. • Use managed disturbance and other treatments to reduce the area of habitat degraded by dense exotic herbaceous plants. • Prevent the invasion and spread of new invaders by using Early Detection-Rapid Response.	• Exotic Species • Altered disturbance regimes • Climate Change	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
WORKING-G2: Increase compatibility of working lands with the conservation of biological and water resources.	**WORKING-O3:** Build partnerships, incentives, outreach, and technical and financial assistance programs to work collaboratively with landowners and land managers to promote sustainability of working lands and the protection of sensitive habitat and persistence of rare species. Measure progress toward this objective based on the acres of sustainably managed working lands.	**WORKING-A6: Manage cultivated lands to enhance compatibility with biological resources** including by protecting, restoring, and enhancing sensitive habitat and species.	Prioritize projects that safeguard species and sensitive habitat adjacent to cultivated lands, including by: • Maintaining sensitive habitats along aquatic systems, including riparian and wetland vegetation, which supports rare species; • Installing hedgerows, buffer strips, or otherwise create or maintain habitat that can support pollinator populations and promote landscape connectivity; • Managing pesticides to reduce their impacts off-farm and to non-target species, including through: use of Integrated Pest Management practices; use of owl boxes and raptor perches; elimination or reduction of anticoagulant rodenticides; and other methods to reduce incidental poisoning of native animals; • Managing fencing and other barriers to facilitate movement of native animals through agricultural landscapes; and • Providing irrigaiotn and nutrient management technical assistance.	• Working lands (Incompatible Practices) • Exotic plants	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species
		WORKING-A7: Manage working lands to enhance water quality to promote sensitive aquatic habitat and species.	Prioritize projects that: • Reduce erosion and sedimentation of streams associated with timber harvest (as in RR-A46); • Manage cultivated lands, cannabis operations, and adjacent areas to reduce soil loss and transport of sediment and nutrients into streams (as in RR-A47); • Improve water quality adjacent to and/or downstream of ponds, lakes, and reservoirs and/or improve the quality of groundwater that supports these aquatic ecosystems; • Promote erosion control and sediment management; • Manage irrigation to protect the quantity and quality of water; • Manage nutrients including fertilizer and manure; • Reduce, capture, treat, and/or reuse farm runoff; • Use vegetated and/or bioreactor treatment systems or treatment wetlands to remove sediment, nutrient, pesticide, and bacteria; • Restore riparian habitat to increase canopy cover; • Use voluntary fallowing and rotational cover crops to reduce runoff and improve infiltration; • Identify and implement collective water treatment projects; and • Support long term maintenance of these practices. Priority areas for projects include: • Those identified in RR-A47, PLR-A2, and PLR-A4;	• Working lands (Incompatible Practices) • Water use • Increased fine sediment	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

Goal	Objective	Action	Priorities	Pressures Addressed	Species Potentially Benefited
			• Areas in the North Coast (Waddell, Scott, Molino, Laguna, Majors, and Baldwin creeks) and Pajaro Valley (Pajaro River, Corralitos Creek, and Salsipuedes Creek/College Lake); and • Areas within critical habitat designated by USFWS.		
		WORKING-A8: Manage working lands to address water supply issues including degradation of surface/groundwater interactions.	Prioritize projects that: • Promote water conservation, including through irrigation scheduling, and increased use of recycled water, as outlined in PLR-A26; • Increase groundwater recharge including to minimize saltwater intrusion, as outlined in PLR-A25; • Address critical infrastructure to manage saltwater extent and exchange; • Promote fallowing of marginal land to reduce groundwater overdraft and improve regional agricultural sustainability; • Support long term maintenance of these practices; • Occur within areas addressed in the three groundwater sustainability plans within the RCIS Area; Priority areas for projects include: • Properties outlined in PLR-A2, PLR-A4: • Areas with high infiltration capacities, connectivity to groundwater aquifers, and are within coastal areas with high rates of seawater intrusion; • Are within critical habitat designated by USFWS; • Are within Key Riparian Corridors; • Areas that address the recommendations of the Groundwater Basin Management Plans for the Pajaro Valley Basin, including areas that lack an impermeable clay layer (PVWMA 2021); the Santa Margarita Basin (SMGA 2021); and the Mid-County Groundwater Basin (SCMCGA 2019).	• Working lands (Incompatible Practices) • Water use	• Most focal and non-focal species (actual list depends on the specific project) • Numerous co-benefited species

5.4 Consistency with Other Plans and Strategies

The RCIS was developed in consideration of existing recovery plans and habitat conservation plans in the RCIS Area (Section 2.3) and was designed to complement the RCISs developed for the two adjoining counties.

5.4.1 Recovery Plans

The RCIS is consistent with, and can help implement the recovery plans for species in the RCIS Area as outlined in Table 5-27.

5.4.2 Natural Community Conservation Plans and Habitat Conservation Plans

The RCIS is consistent with and can complement the habitat conservation plans the RCIS Area as outlined in Table 5-28. There are no natural community conservation plans in the RCIS Area. The RCIS can help complement the efforts of the Santa Clara Valley Habitat Plan, which is the adopted regional HCP/NCCP in adjacent Santa Clara County (ICF 2012).

5.4.3 Complementarity with other RCISs

In addition, the RCIS complements the adjoining RCISs prepared for Santa Clara and Monterey counties to promote regional conservation by:

- Providing conservation strategies that will protect, restore, and enhance the rare as well as widespread natural communities, many of which will also be protected through conservation actions for focal species habitat and other conservation elements in the adjoining RCIS. Community-based strategies in this RCIS will complement the other RCIS by providing strategies for:
    - Riparian and Riverine systems and Bar-Built Estuaries, which together will promote diverse assemblages of special-status animals identified as focal or non-focal species in the Santa Clara and/or Monterey RCISs, including steelhead (SCC and CCC DPSs), tidewater goby, and California red-legged frog;
    - Ponds, Lakes, and Reservoirs, as well as Freshwater Wetlands, which will similarly help support strategies for California red-legged frog and California tiger salamander, which are focal species in both adjoining RCISs;
    - Monterey pine forest, which is also address in the Monterey County RCIS. Collectively, the two RCISs promote protection of two of the four native populations of this narrowly endemic species and the sensitive native plant communities that it dominates;
- Developing conservation strategies for focal species that are also addressed in the adjoining RCISs, including:

  - Santa Cruz long-toed salamander, which is a focal species in the Monterey RCIS, to provide for a comprehensive strategy for this species endemic to the two counties;
  - mountain lion, which is a focal species in both adjoining RCISs, and which can benefit from the collective strategies to sustain this important wide-ranging, top predator;
  - Southwestern pond turtle, which is addressed as a non-focal species in the Santa Clara RCIS.

- Featuring a conservation strategy for bat habitat, which can complement the strategy in the Monterey RCIS for pallid bat;
- Including conservation strategies for connectivity, which will help address regional landscape linkages between the two counties, including the Santa Cruz Mountains to Diablo linkage through Coyote Valley and through the Upper Pajaro River, which is addressed in the Santa Clara RCIS, and the Santa Cruz Mountains to Gabilan Linkage, which is addressed in the RCISs for both adjoining counties;
- Providing a conservation strategy for working lands, to maintain land used for agriculture including cultivation, grazing, and timber harvest, which are also addressed in the RCISs for Santa Clara (all three) and Monterey (grazing and cultivated agriculture) counties;

Table 5-27: Consistency of the RCIS strategies with Recovery Plans

Species	Recovery Plan	Assessment of Consistency
Multiple Species		
Ben Lomond spineflower, Ben Lomond wallflower, Scotts Valley spineflower, Scotts Valley polygonum, Mount Hermon June beetle, Zayante band-winged grasshopper, Ohlone tiger beetle	Recovery Plan for Insect and Plant Taxa from the Santa Cruz Mountains in California (USFWS 1998d)	• Zayante band-winged grasshopper is a focal species; all others are non-focal species. • Strategies for grasslands address Scotts Valley spineflower, Scotts Valley polygonum, and Ohlone tiger beetle; strategies for sandhills address the other species covered by the recovery plan. • Actions in both strategies include the following recovery actions: protect additional habitat, restore habitat, and manage habitat to address exotic plants, fire (and succession), erosion, recreation; and conduct species-specific population management actions, where needed, to maintain or increase population persistence.
Plants		
marsh sandwort	Recovery Plan for Marsh Sandwort *(Arenaria paludicola)* and Gambel's Watercress *(Rorippa gambelii*) (USFWS 1998b, 2019a)	The RCIS Area is within the historic range of this species, though all known natural populations have been extirpated and an experimental population established in the early 2010s did not persist. The Freshwater Wetland conservation strategy contains actions consistent with the recovery plan including protection, restoration, enhancement, and management of freshwater wetlands suitable for the species, and rare plant introductions into suitable habitat.
Monterey spineflower	Seven Coastal Plants and the Myrtle's Silverspot Butterfly Recovery Plan (USFWS 1998c, 2019b)	• Monterey spineflower is a non-focal species. • Monterey spineflower can benefit from the conservation strategies for Maritime Chaparral and Knobcone Pine Forest; Oak Woodland and Forest; and Beaches, Dunes, and Rocky Shores. These strategies incorporate the following actions in the

Species	Recovery Plan	Assessment of Consistency
		recovery plan: habitat protection, restoration, vegetation management, exotic pant management, and recreation management.
Robust spineflower	Recovery Plan for *Chorizanthe robusta var. robusta* (Robust Spineflower) (USFWS 2004a)	• Robust spineflower is a non-focal species. • Robust spineflower can benefit from the conservation. Strategies for Maritime Chaparral and Knobcone Pine Forest; Oak Woodland and Forest; and Beaches, Dunes, and Rocky Shores. These strategies incorporate the following recovery actions: protect existing habitat, manage habitat, conduct management-oriented research, and establish new populations.
Santa Cruz cypress	Recovery Plan for the Santa Cruz Cypress *(Cupressus [Hesperocyparis] abramsiana)* (USFWS 1998e)	• Santa Cruz cypress is a non-focal species. • Santa Cruz cypress forest is a conservation element. • Actions for Santa Cruz cypress forest include the following recovery actions: protect additional habitat, restore habitat, manage habitat to address exotic plants, fire (and succession), erosion, recreation, and conduct species-specific population management actions (e.g., seed banking) to maintain or increase population persistence that include many outstanding actions identified in the recovery plan.
White-rayed pentachaeta	Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area (USFWS 1998f)	• White-rayed pentachaeta is a non-focal species. • The Santa Cruz cypress, Grassland, and Oak Woodland and Forest conservation elements include habitat protection, restoration, and management actions that can benefit the species, including for the Eagle Rock area where white-rayed pentachaeta previously occurred.

Species	Recovery Plan	Assessment of Consistency
		• Action Cypress A-6 includes species-specific population actions for white-rayed pentachaeta that are consistent with the recovery plan goals and objectives
Fish		
Central California Coast steelhead	Final Coastal Multispecies Recovery Plan (NMFS 2016b)	• CCC Steelhead is a non-focal species. • Conservation strategies for Coho Salmon, Riparian and Riverine, and Bar-Built Estuaries, were developed to implement recovery actions, including improving stream habitat complexity, reducing input of fine sediments, improving instream flows, removing passage barriers, and restoring habitat in BBEs. Four additional conservation strategies including the Redwood and Douglas-Fir Forest strategy, will also promote recovery of CCC steelhead.
South-Central California Coast steelhead	South-Central California Coast Steelhead Recovery Plan (NMFS 2013)	• SCC Steelhead is a non-focal species. • Conservation strategies for Riparian and Riverine and Bar-Built Estuaries, were developed to implement recovery actions, including improving stream habitat complexity, reducing input of fine sediments, improving instream flows, removing passage barriers, and restoring habitat in BBEs. Three additional conservation strategies including the Redwood and Douglas-Fir Forest strategy, will also promote recovery of SCC steelhead.
Central California Coast coho salmon	Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit (NMFS 2012) and Recovery strategy for California Coho Salmon (CDFW 2004)	• Coho salmon is a focal species. • The conservation strategies for Coho Salmon, Riparian and Riverine, and Bar-Built Estuaries, were developed to implement recovery actions, including expansion of the existing captive broodstock program, improving instream habitat complexity, reducing input of fine sediments, improving dry season instream

Species	Recovery Plan	Assessment of Consistency
		flows, removing passage barriers, and managing BBEs to ensure adults can enter coho salmon streams and smolts can return to the ocean. Five additional conservation strategies including the one for Redwood and Douglas-Fir Forest, will also promote recovery of coho salmon.
Tidewater goby	Recovery Plan for the Tidewater goby (*Eucyclogobius newberryi*) (USFWS 2005b)	• Tidewater goby is a non-focal species. • Conservation strategies for Bar-Built Estuaries, Coho Salmon, and Riparian and Riverine communities, were developed to implement recovery actions, including protection and restoration of key habitats upon which this species relies. Three additional conservation strategies including the Redwood and Douglas-Fir Forest strategy, will also promote recovery of SCC steelhead.
Amphibians and Reptiles		
California red-legged frog	Recovery Plan for the California Red-legged Frog *(Rana aurora draytonii)* (USFWS 2002a)	• California red-legged frog is a non-focal species. • Conservation strategies for Ponds, Lakes, and Reservoirs, Riparian and Riverine, Freshwater Wetlands, and various upland habitats were developed to implement recovery actions including to protect existing habitat, manage habitat to remove exotic species, conduct management-oriented research, and establish new populations.
California tiger salamander	Recovery Plan for the Central California Distinct Population Segment of the California Tiger Salamander *(Ambystoma californiense*) (USFWS 2017a)	• California tiger salamander is a non-focal species. • Conservation strategies for Ponds, Lakes, and Reservoirs, Freshwater Wetlands, and Grasslands were developed to implement recovery actions to protect existing habitat, manage habitat to remove exotic species, improve water quality and

Species	Recovery Plan	Assessment of Consistency
		quantity, conduct management-oriented research, and establish new population. with the recovery plan goals and objectives.
Santa Cruz long-toed salamander	Draft Revised Recovery Plan for the Santa Cruz Long-toed Salamander (*Ambystoma macrodactylum croceum*) (USFWS 2004b)	• Santa Cruz long-toed salamander is a focal species. • Conservation strategies for Ponds, Lakes, and Reservoirs, Freshwater Wetlands, and various upland habitat including Oak Woodland and Forest were developed to implement recovery actions to protect existing habitat, manage habitat to remove exotic species, improve water quality and quantity, conduct management-oriented research and establish new populations.
San Francisco garter snake	Recovery Plan for the San Francisco garter snake (*Thamnophis sirtalis tetrataenia*) (USFWS 1985b)	• San Francisco garter snake is a focal species. • Six of the conservation strategies, including those for Freshwater Wetlands and Ponds, Lakes, and Reservoirs, and various upland communities including Grasslands, include habitat protection, restoration/enhancement, and management actions that are consistent with the recovery plan goals and objectives.
Birds		
California least tern[5]	California Least Tern Recovery Plan (USFWS 1985a)	Though within the historic range of California least tern, which historically bread at the mouth of the Pajaro River, the RCIS Area does not currently support this species. There are no recovery actions targeting the RCIS Area, which is not mentioned in the most recent five-year review (USFWS 2020b). Protection, restoration, and management of riparian habitat as part of the Beaches, Dunes, and Rocky Cliffs conservation element calls for habitat protection,

Species	Recovery Plan	Assessment of Consistency
		restoration, and management, including for recreation and exotic species, which is nonetheless consistent with the recovery plan.
Least Bell's vireo[4]	Draft Recovery Plan For the Least Bell's Vireo (*Vireo bellii pusillus*) (USFWS 1998a)	Though within the historic range of Least Bell's vireo, the RCIS Area does not current support this species. There are no recovery actions targeting the RCIS Area, which is also not within designated critical habitat for the species, nor is the region mentioned in the most recent five-year review (USFWS 2006). Protection, restoration, and management of riparian habitat as part of the Riparian and Riverine conservation element is nonetheless consistent with the general actions in the recovery plan.
Marbled murrelet	Recovery Plan for the Threatened Marbled Murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California (USFWS 1997)	• Marbled murrelet is a focal species. • The conservation strategy for marbled murrelet includes the actions identified in the recovery plan including terrestrial habitat protection (i.e., of older forests), restoration (i.e., hastening late-seral forest conditions), and recreation management (to reduce nest disturbance and predators), and species research and monitoring to inform conservation. • The Redwood and Douglas-Fir Forest conservation strategy features additional habitat protection, restoration, and management strategies that can promote recovery of the species.
Western snowy plover	Recovery Plan for the Pacific Coast Population of the Western snowy plover (*Charadrius alexandrinus nivosus*) *(*USFWS 2007a)	• Western snowy plover is a non-focal species. • The conservation strategy for Beaches, Dunes, and Rocky Shores includes actions to help implement the recovery plan including habitat protection, restoration, and recreation management (to reduce nest disturbance and predators), and species research and monitoring to inform conservation.

Species	Recovery Plan	Assessment of Consistency
Mammals		
southern sea otter	Final Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris nereis*) (USFWS 2003a)	Southern sea otter was not included as a focal or non-focal species in this RCIS, as it inhabits the marine environment located outside of the RCIS Area (i.e., Santa Cruz County). While the recovery plan for southern sea otter focuses on species-specific conservation and management, the conservation strategies for Beaches, Dunes, and Rocky Cliffs, Bar-Built Estuaries, and Riparian and Riverine communities, will improve habitat conditions particularly water quality in near-shore environment used by the species.

Table 5-28: Consistency of the RCIS strategies with HCPs in the RCIS Area

Habitat Conservation Plan	Species Addressed that Occur in the RCIS Area	Consistency of the RCIS with the HCP
Programmatic Habitat Conservation Plans		
Draft City of Santa Cruz Anadromous Salmonid Habitat Conservation Plan (City of Santa Cruz *in prep.*)	steelhead and coho salmon	The HCP covered species are either focal species (coho salmon) or a non-focal species (steelhead) in this RCIS. These and many other aquatic species will benefit from the RCIS strategies to protect, restore, enhancement, connect, and manage the Bar-Built Estuaries and Riparian and Riverine communities, as well as the additional strategies developed to increase populations and resiliency of coho salmon as a focal species.
City of Santa Cruz Operations and Maintenance Habitat Conservation Plan (City of Santa Cruz 2021)	Ben Lomond spineflower, robust spineflower, Santa Cruz tarplant, San Francisco popcornflower, Ohlone tiger beetle, Mount Hermon June beetle, tidewater goby, Pacific lamprey, California red-legged frog, Southwestern pond turtle	All of the HCP covered species are non-focal species (except Pacific Lamprey which is a co-benefited species) in this RCIS and are addressed in the following RCIS strategies: for Riparian and Riverine; Bar-Built Estuary, Ponds, Lakes, and Reservoirs; Freshwater Wetlands; Grasslands; Sandhills; Oak Woodland and Forests; Santa Cruz tarplant, coho salmon; and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat, as well as increase populations of rare species.
Pacific Gas and Electric Company Multiple Region Operation and Maintenance Habitat Conservation Plan (PG&E 2020)	California tiger salamander, California red-legged Frog, marbled murrelet, Mount Hermon June beetle, Ohlone tiger beetle, Santa Cruz long-toed salamander, Zayante band-winged grasshopper, Monterey spineflower, robust spineflower	All of the HCP covered species are either focal species (Zayante band-winged grasshopper, Santa Cruz long-toed salamander, and marbled murrelet) or non-focal species (all others) in this RCIS and are addressed in the following RCIS strategies: for Riparian and Riverine; Bar-Built Estuary, Ponds, Lakes, and Reservoirs; Freshwater Wetlands; Beaches, Dunes, and Rocky Cliffs; Grasslands; Sandhills; Oak Woodland and Forests; Redwood and Douglas-Fir Forest; Santa Cruz tarplant, coho salmon; and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and

Habitat Conservation Plan	Species Addressed that Occur in the RCIS Area	Consistency of the RCIS with the HCP
		co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.
Interim Programmatic Habitat Conservation Plan for Mount Hermon June Beetle, Ben Lomond Spineflower (USFWS et al. 2011)	Mount Hermon June beetle, Ben Lomond spineflower	The HCP covered species are non-focal species in this RCIS and are addressed in the RCIS conservation strategies for Sandhills and Zayante band-winged grasshopper. The HCP covered species, as well as may other focal, non-focal, and co-benefited species in the sandhills communities, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.
PGE Vegetation Management Habitat Conservation Plan (PG&E 2018)	Santa Cruz long-toed salamander, California red-legged frog, Monterey spineflower	The HCP covered species are focal (Santa Cruz long-toed salamander) or non-focal species (all others) in this RCIS and area addressed in the RCIS conservation strategies for Sandhills and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.
Project-Specific Habitat Conservation Plans (Listed in order of acreage)		
Quail Hollow Quarry (Graniterock 1998)	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond wallflower, Ben Lomond spineflower	The HCP covered species are either focal species (Zayante band-winged grasshopper) or non-focal species (all others) in this RCIS and are addressed in the RCIS conservation strategies for the Sandhills and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and co-benefited species in the sandhills communities, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.

Habitat Conservation Plan	Species Addressed that Occur in the RCIS Area	Consistency of the RCIS with the HCP
Seascape Uplands (Reid 1994)	Santa Cruz long-toed salamander	The HCP covered species is a focal species in this RCIS and is addressed in several conservation strategies including those for Ponds, Lakes, and Reservoirs; Freshwater Wetlands; Maritime Chaparral, Oak Woodlands and Forests; and Santa Cruz long-toed salamander (as a focal species). The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of the rare species.
Wilder Quarry (Granite Rock 1998[1])	California red-legged Frog	The HCP covered species is a non-focal species in this RCIS and is addressed in several conservation strategies including those for: Ponds, Lakes, and Reservoirs; Freshwater Wetlands; and Santa Cruz long-toed salamander (as a focal species). The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of the rare species.
Santa Cruz Gardens Unit 12 (Arnold and Lyons 2008)	Santa Cruz tarplant, Ohlone tiger beetle	The HCP covered species are focal species (Santa Cruz tarplant) and non-focal species (Ohlone tiger beetle) in the RCIS and are addressed in the RCIS conservation strategies for Grasslands and Santa Cruz tarplant (as a focal species). The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of the rare species.
Tucker Pond (Reid and Biosearch 2006)	Santa Cruz long-toed salamander, California red-legged frog	The HCP covered species are a focal species (Santa Cruz long-toed salamander) and non-focal species (California red-legged frog) in this RCIS and are addressed in several conservation strategies including

Habitat Conservation Plan	Species Addressed that Occur in the RCIS Area	Consistency of the RCIS with the HCP
		those for: Ponds, Lakes, and Reservoirs; Freshwater Wetlands; Maritime Chaparral, Oak Woodlands and Forests; and Santa Cruz long-toed salamander (as a focal species). The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of the rare species.
UCSC Ranch View Terrace (Jones and Stokes 2005)	California red-legged frog, Ohlone tiger beetle	The HCP covered species are both non-focal species in this RCIS and are addressed in several conservation strategies including those for: Ponds, Lakes, and Reservoirs; Freshwater Wetlands; Grasslands; Oak Woodlands and Forests; Santa Cruz long-toed salamander; and Santa Cruz tarplant. The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of the rare species.
Hanson Aggregates Felton Plant (HRG 1999)	Mount Hermon June beetle, Zayante band-winged grasshopper	The HCP covered species are focal species (Zayante band-winged grasshopper) or non-focal species (Mount Hermon June beetle) in this RCIS and are addressed in the RCIS conservation strategies for the Sandhills and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and co-benefited species in the sandhills communities, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.
City of Santa Cruz Graham Hill Water Treatment Plant (EMS and Arnold 2013)	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond spineflower	The HCP covered species are either focal species (Zayante band-winged grasshopper) or non-focal species (all others) in this RCIS and are addressed in the RCIS conservation strategies for the Sandhills and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and co-benefited species in the

Habitat Conservation Plan	Species Addressed that Occur in the RCIS Area	Consistency of the RCIS with the HCP
		sandhills communities, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.
Bonny Doon Quarries (1999[1])	California red-legged Frog	The HCP covered species is a non-focal species in this RCIS and is addressed in several conservation strategies including those for: Ponds, Lakes, and Reservoirs; Freshwater Wetlands; and Santa Cruz long-toed salamander (as a focal species). The HCP covered species, as well as many other focal, non-focal, and co-benefited species, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of the rare species.
Numerous Separate Low-effect HCPs for Sandhills Species in Residential Areas (Arnold 2002; Arnold 2008a,b,c,d[1]; Arnold 2009a,b; Arnold 2014; Arnold et al. 2008; Arnold and Bandel 2014; McGraw 2007b; McGraw 2008a,b; McGraw 2009a,b; McGraw 2012, McGraw 2016, McGraw 2017a,b,c; and McGraw 2019	Mount Hermon June beetle, Zayante band-winged grasshopper, Ben Lomond spineflower, Ben Lomond wallflower	The covered species in these HCPs are either focal species (Zayante band-winged grasshopper) or non-focal species (all others) in this RCIS and are addressed in the RCIS conservation strategies for the Sandhills and Zayante band-winged grasshopper. The HCP covered species, as well as many other focal, non-focal, and co-benefited species in the sandhills communities, will benefit from the RCIS objectives and actions to protect, restore, enhance, connect, and manage habitat as well as increase populations of rare species.

[1] These HCPs are listed on the Ventura Fish and Wildlife Office website; however, the HCPs could not be located.

6 RCIS Implementation, Monitoring, and Adaptive Management

This chapter describes approaches to implementing the RCIS (Section 6.1), identifies the monitoring and adaptive management framework (Section 6.2), and describes the specific methods to monitor progress toward achieving the goals and objectives (Section 6.3). It then outlines methods to maintain the RCIS through updates, extensions, and amendments (Section 6.4).

6.1 Implementation

The RCIS is a voluntary, non-binding guidance document that aims to increase conservation investments and direct those investments to where they can be most beneficial to achieving biodiversity conservation goals within Santa Cruz County and the broader region. Implementation of the RCIS is not the purview or responsibility of any one entity; rather, the strategy will be implemented through the actions of many agencies, organizations, and individuals seeking to conduct conservation projects through a variety of mechanisms. Coordinated implementation of the RCIS can enhance effectiveness of the strategy at achieving its goals.

6.1.1 Implementation Approaches

The RCIS outlines many different types of actions to achieve conservation goals and objectives, including habitat protection, creation, restoration, and enhancement, which includes methods to promote habitat connectivity, enhance water quality, and increase water quantity. It also identifies incentives and assistance programs that support land stewardship and education programs. For each action, the RCIS identifies priorities that specify where or how to implement the action to achieve the greatest benefit.

Entities that could implement the RCIS in Santa Cruz County are diverse and include: conservation agencies, organizations, and non-profits; tribes and tribal organizations; local, state, and federal resource agencies; state and local and parks departments; public infrastructure agencies in the transportation, water, and other sectors, as well as public works departments and environmental health departments; other public and private landowners, including private individuals, and many others. These entities differ in roles, missions, and mandates as it relates to conservation and work in different capacities.

For this reason, the RCIS does not endeavor to prioritize between actions within a conservation element, or actions between conservation elements. Instead, implementers of this RCIS can use it to inform their work including project identification and selection processes to both guide and justify allocation of effort and resources. Project proponents can elect to develop projects based on the actions and priorities that align with that entity's particular policies, programs, or ways of working, as well as the specific goals of their project.

For example, land trusts and other non-profit organizations might use the RCIS as a tool to guide land acquisition and stewardship strategies on protected lands. The RCD and other technical assistance providers could use the RCIS to focus outreach and planning efforts, working with private and public landowners to identify and advance priority habitat restoration and enhancement projects. Public land managers might identify preservation or stewardship needs on lands that they manage that align with RCIS priorities which could provide win-win mitigation opportunities. Resource agencies can use the RCIS to inform selection of projects to implement including through grants and accepting mitigation.

6.1.2 Coordination and Collaboration

Implementation of the RCIS should leverage and expand coordination amongst various proponents including conservation partners, mitigating entities, resource agencies, transportation agencies, funders, decision-makers, and stakeholders. The following are some existing collaboratives that can facilitate implementation of the RCIS:

- **The Integrated Watershed Restoration Program (IWRP):** technical advisory committees and working groups of IWRP, facilitated by the RCD, are well positioned to identify and advance specific projects that support RCIS goals, objectives, and priority actions. Additional working groups could form around natural communities or other conservation elements that have not historically been active within IWRP, such as sandhills, karst caves, and habitat connectivity.
- **The Integrated Regional Water Management planning groups and Sustainable Groundwater Management Planning processes**: these groups could help identify and advance multi-benefit water resource projects including those that protect and enhance surface-groundwater interactions;
- **The Santa Cruz County Early Mitigation Partnership MOU group**: convened by the RCD and RTC, this collaborative between transportation and resource conservation agencies can be utilized for early identification of conservation opportunities that are aligned with mitigation needs.
- **The Living Landscape Initiative**: a collaboration of five land trusts working in Santa Cruz County [Land Trust of Santa Cruz County, The Nature Conservancy, Peninsula Open Space Trust (POST), Save the Redwoods League and Sempervirens Fund], to create and maintain vibrant and sustainable natural lands in the heart of coastal California.
- **The Santa Cruz Mountains Stewardship Network**: a region-wide and cross-sector collaboration of 21 organizations including local, state, and federal agencies, nonprofits, academia, business, community, and tribal groups, which manage 250,000 acres in the Santa Cruz Mountain and are committed to practicing effective stewardship on their own lands and coordinating their efforts with other land stewards to enhance stewardship on a regional level.
- **Santa Cruz County Weed Management Area**: A collaborative project to combat the destructive effects of non-native invasive plants on wildlands, parks, and farms.

Additional, focused working groups, and new collaborations could be forged to specifically implement the RCIS. Existing working groups that focus on amphibian recovery, coho salmon recovery, tidewater goby recovery, instream flow augmentation, and specific areas of conservation interest such as the Watsonville Sloughs can play a key role in advancing RCIS actions and priorities. This RCIS anticipates these existing groups and new groups playing key roles in advancing the myriad recommendations within this RCIS. These types of working groups are recommended to develop site-specific actions to implement many recovery plans (Section 2.3.1).

To enhance regional conservation, collaboratives seeking to coordinate implementation of the RCIS should coordinate with entities involved in carrying out RCISs for Santa Clara and Monterey counties. Such coordination will be especially critical to implementing strategies that cross RCIS Area boundaries, including:

- Maintaining landscape connectivity between the Santa Cruz Mountains and the adjacent Gabilan range and Diablo range mountains, where landscape linkages run through the three counties (as well as adjoining portions of San Benito County);
- Protecting, restoring, and enhancing riparian and riverine habitat and associated watershed lands in the Pajaro River Watershed; and
- Conserving narrowly endemic species that straddle counties, such as Santa Cruz long-toed salamander.

To coordinate between RCIS regions, working groups comprised of individuals implementing each RCIS Area should be formed and meet at appropriate intervals (e.g., annually) to discuss implementation of common strategies between the adjacent counties.

6.1.3 Resources for Implementation

The RCIS actions can be funded through a variety of existing mechanisms, including: mitigation, government grants and other public funds, private philanthropy, and tax incentives (e.g., for conservation easements). In addition, organizations implementing the RCIS could evaluate developing new funding programs to accelerate the pace and scale of implementation.

6.1.3.1 Grants and other Conservation Investments

The strategies in this RCIS can be implemented through conservation investments, including public and private grants, and conservation finance programs, such as local funding measures. Public agencies and private foundations seeking to invest in biodiversity and related conservation can use the RCIS as a screening tool for their grant making. Existing grant programs administered by the United States Fish and Wildlife Service, NOAA's Restoration Center, Wildlife Conservation Board, State Coastal Conservancy, California Department of Conservation, and Regional Water Quality Control Board, among other state and federal agencies, as well as funding programs provided by a host of private foundations, could prioritize

projects for funding that are identified in the RCIS or will otherwise achieve the goals and objectives of the RCIS.

These and other funders could also develop new funding programs dedicated to implementing the strategies in this RCIS and perhaps other approved RCISs. Such programs could be similar to the Department of Water Resources funding programs dedicated to implementation of Integrated Regional Water Management Plans. Dedicated state funding to implement RCISs could greatly enhance the ability of Santa Cruz County to contribute to California's statewide goal to conserve 30% of California land by 2030.

The RCIS, combined with the other local, community-supported conservation plans (e.g., Mackenzie et al. 2011, Schmidt et al. 2015), provides a strong foundation for building community and political support for local funding measures. Such a dedicated and sustained source of local conservation funding could be used to match state, federal, and private funding and greatly enhance the ability of conservation agencies and organizations working in the region to achieve the goals and objectives of the RCIS.

6.1.3.2 Mitigation

Mitigation can also be used to implement the RCIS, including through several existing mitigation tools: mitigation credit agreements, conservation banks, in-lieu-fee programs, and project-specific (permittee-responsible) mitigation. These programs, as well as perhaps new mitigation tools, could all facilitate achievement of the goals and objectives of the RCIS by implementing priority actions for the conservation strategy. The RCIS can be used:

- to site mitigation, by helping identify the lands that should be protected, restored, enhanced, or created (in the case of ponds and wetlands);
- identify quantitative objectives for mitigation projects; and
- inform long-term management and adaptive management plans for mitigation sites and protections, by identifying the pressures and stressors to species, communities, and other conservation elements, and identifying strategies to address them as well as maximize their resiliency to climate change.

The following sections briefly describe the mitigation mechanisms and their application to the RCIS. Mitigation for permanent and temporary impacts to waters, species, and upland habitats can be required by an array of state, federal and local regulatory agencies. Some of these agencies have overlapping jurisdictions; for example, the Army Corps of Engineers (Corps), Regional Water Quality Control Boards, and California Department of Fish and Wildlife all regulate rivers, streams, and certain types of wetlands. The various regulatory agencies differ in their mitigation requirements and approaches to mitigation. Whereas the Corps utilizes the 2008 Compensatory Mitigation for Losses of Aquatic Resources Rule (33 CFR, Part 332) and the Central Coast Regional Water Quality Control Board follows the 2021 State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State, other agencies have more fluid guidance for project specific impacts to natural resources. The Corps, USFWS,

NOAA, and CDFW all also have rules and guidance related to programmatic impacts and related programmatic mitigation mechanisms. These include Regional General Permits, HCPs, NCCPs, mitigation/conservation banks, in-lieu fee programs, and mitigation credit agreements. While each agency approaches mitigation slightly differently, there are a few guiding principles that are common across nearly all of the regulatory agencies and these include: the desire for mitigation sites to be in close proximity to the impact site; for mitigation sites to provide similar habitat characteristics to the areas impacted; and for mitigation to fully compensate for both temporary and permanent impacts.

6.1.3.2.1 Conservation and Mitigation Banks

The RCIS can be implemented through establishment of conservation or mitigation banks. Conservation banks are lands that are conserved and permanently managed for species that are endangered, threatened, candidates for listing, or are otherwise species-at-risk under the federal or state endangered species act (ESA and/or CESA). Mitigation banks are wetland, stream, or other aquatic resource areas that have been restored, established, enhanced, or (in certain circumstances) preserved for the purpose of providing compensation for unavoidable impacts to aquatic resources permitted under Section 404 of the Clean Water Act or a similar state or local aquatic resource regulation. In exchange for permanently protecting, restoring, and/or enhancing habitat for the listed species and and/or aquatic resources, the regulatory agencies that approve conservation and mitigation banks issue to the bank sponsor a specified number of mitigation credits. Bank sponsors can then sell the credits and transfer their offset value to project proponents who need to compensate for the unavoidable adverse impacts or otherwise mitigate their project impacts.

The RCIS Area features a single conservation bank located inside its boundary, which includes portions of the service area for three additional conservation banks as well as one mitigation bank (Section 2.2.6). These existing banks can provide mitigation for jurisdictional waters and eight listed species and two additional rare species in the region (Table 2-4; Section 2.2.6). Future conservation and mitigation banks could be established within the RCIS Area by implementing the conservation and habitat enhancement actions identified in the RCIS; doing so would meet additional mitigation needs while helping implement the conservation strategies. For example, mitigation banks could be created for riparian and riverine areas, grasslands, and other systems that are often impacted by public and private projects including infrastructure projects in the RCIS Area.

6.1.3.2.2 In-Lieu-Fee Programs

Under an in-lieu-fee programs (ILFP), mitigation sponsors collect funds from permittees in lieu of buying credits in a mitigation or conservation bank, or providing permittee-responsible mitigation; the mitigation sponsor uses the funds pooled from multiple permittees to implement actions after impacts have occurred. These actions are often restoration, enhancement, and creation of habitat, but can also include habitat protection, applied research, and other suitable mitigation actions as determined by the regulatory agency or

agencies that authorized the agreement with the ILFP sponsor, which is typically a public or non-profit natural resource management entity.

The RCD has an approved ILFP agreement with the US Fish and Wildlife Service to satisfy compensatory mitigation requirements for temporary and permanent impacts to Santa Cruz long-toed salamander, California red-legged frog, and tidewater goby. This ILFP can advance implementation of RCIS priority actions in support of these species and their associated communities; it could also be expanded to include additional FWS and NMFS species and communities, and wetlands and waters under the jurisdiction of the Corps. In addition, future ILFPs could be developed by program sponsors in the RCIS Area.

6.1.3.2.3 Mitigation Credit Agreements

A mitigation credit agreement (MCA) is an agreement developed in collaboration with CDFW to create mitigation credits by implementing the conservation or habitat enhancement actions identified within an approved RCIS. With the approval of CDFW, credits generated through MCAs can be used as compensatory mitigation for impacts under the California Environmental Quality Act (CEQA), the California Endangered Species Act (CESA), and the Lake and Streambed Alteration Program (LSA). Once credits have been approved, they can be used, sold, or otherwise transferred. Additional resource agencies could potentially elect to have credits generated through MCAs be applicable to compensatory mitigation needs under other local, state, or federal regulations.

The guidelines for development of MCA credits are currently being developed. Following approval of the RCIS and the CDFW MCA guidelines, proponents of projects can use the MCA program to receive mitigation credit by implementing conservation actions and enhancement actions identified in this RCIS.

6.1.3.2.4 Project-Specific/Permittee Responsible Mitigation

The RCIS can also be used to inform project-specific (or permittee-responsible) mitigation—projects that protect, restore, enhance, establish, or create, or otherwise benefit species or aquatic resources to compensate for unavoidable impacts to the resources as part of a specific project/permitting process. Such mitigation can be done on-site (where the project impacts occur) or at an off-site location. The RCIS conservation strategies can help maximize the regional benefit of such individual mitigation projects, by helping project proponents site, design, evaluate, and otherwise implement permittee-responsible mitigation that can benefit the regional strategies.

6.1.3.3 Overcoming Other Barriers to Implementation

In addition to overcoming funding limitations, steps should be taken to address additional barriers that could limit implementation of the strategies in the RCIS by landowners. These steps can include:

1. Facilitating permitting processes to reduce the time and costs to obtain permits for restoration and management; ;
2. Addressing barriers created by liability issues;
3. Increasing the availability of skilled labor and knowledge to implement projects;
4. Addressing financial impacts of conservation and management to working land owners including loss of productivity and profitability when conservation projects are not fully compatible with other land uses (e.g., for working lands).

The RCIS provides robust justification and incentive for addressing these additional barriers, and the process for developing and implementing the RCIS should strengthen relationships leading to more collaborative and creative solutions. The implementing partners, together with stakeholders, natural resource regulatory agencies, funders, and decision makers, should continue to work together to address these barriers. This work can be facilitated by broader efforts conducted as part of "Cutting Green Tape"—a statewide initiative focused on improving interagency coordination, partnerships and agency processes and policies to allow ecological restoration and stewardship to occur more quickly, simply, and cost-effectively (California Landscape Stewardship Network 2020).

6.1.4 Achieving Multiple Objective

Where possible, efforts should be made achieve multiple goals and objectives for the conservation elements. Such multiple-benefit projects can protect, restore, and/or manage land that benefits two or more of the conservation elements including focal species, non-focal species, natural communities, and other conservation elements, as well as other co-benefited species. For example, a habitat restoration project to eradicate exotic plants along a coho salmon and steelhead stream and adjacent oak woodlands could promote goals and objectives for these conservation elements (coho salmon, riparian and riverine, and oak woodland), benefit additional focal and non-focal species (e.g., California red-legged frog and Southwestern pond turtle), and restore habitat that is important for bats, mountain lions, and habitat connectivity (i.e., within an aquatic and/or terrestrial linkage). The maps and spatial database used to develop the RCIS can help site projects in areas that can achieve multiple objectives of the RCIS to enhance cost effectiveness of implementation.

6.2 Monitoring and Adaptive Management Strategy

Monitoring and adaptive management are designed to ensure that the conservation actions and habitat enhancement actions achieve the RCIS goals and objectives. In the adaptive management framework, monitoring is used to evaluate whether an action (or strategy) is achieving the goals and objectives; if not, the results of monitoring are used to inform adjustments to the action. Adaptive management processes can also enhance long-term effectiveness by integrating scientific information that is newly developed during the course of management.

Mitigation credit agreements implemented under the RCIS will be required to include a monitoring and adaptive management plan developed based on the CDFW adaptive management and monitoring plan template for MCAs (CDFW 2018), which is currently being developed as part of the CDFW MCA guidelines.

The following are guidelines for adaptive management and monitoring plans developed for MCAs under this RCIS.

1. Specific goals and objectives for the action, that are consistent with the goals and objectives for the conservation strategy in the RCIS;
2. A description of the specific strategies that will be used to achieve the goals and objectives;
3. Performance standards for evaluating the effectiveness of the action, which should utilize one or more of the metrics identified for this RCIS in order to facilitate reporting and tracking (Section 6.3.1);
4. Monitoring protocols to accurately and reliably measure the status of the action toward achieving the performance standards; and
5. Elements of a framework for adjusting the action, as needed and where feasible including by implementing remedial actions, based on the results of monitoring and also other relevant scientific information, to enhance its effectiveness at achieving the goals and objectives.

Ultimately, CDFW will review and approve MCAs including the adaptive management and monitoring plans.

To the extent feasible, proponents of non-MCA projects implementing the actions in this RCIS should develop and implement similar adaptive management and monitoring plans.

6.3 Evaluating Progress Toward the Goals and Objectives

Overall effectiveness of the conservation actions and habitat enhancement actions at achieving the goals and objectives for the conservation elements will also be evaluated, including by assessing the extent to which they offset the effects of identified pressures and stressors. This monitoring and reporting will be implemented by the RTC, as the RCIS proponent, unless and until the RTC transfers the requirement to another entity, as outlined in Section 6.3 of the RCIS Guidelines (CDFW 2018). This section identifies the metrics that will be used, and outlines the contents and process for preparing the reports, which are requisite to extending the RCIS every 10 years (CDFW 2018).

6.3.1 RCIS Metrics

Measurable objectives in this RCIS include metrics for tracking progress towards achieving the goals and objectives of the RCIS. In describing objectives, metrics are provided with the intent

of measuring, in a consistent way, the net change, from habitat restoration actions, on the habitat area and habitat quality. When implementing conservation actions and habitat enhancement actions that include habitat restoration, an MCA Sponsor shall select, and submit for CDFW's approval, an appropriate metric(s) from the metrics indicated in this RCIS to measure the net change in habitat area and habitat quality.

If the MCA Sponsor determines that an alternative metric, not listed in this RCIS, is more fitting for an action or objective, the MCA Sponsor may make a written request to the RCIS Proponent and CDFW to consider approving that alternative metric instead of, or in addition to, one or more metrics in this RCIS. CDFW will consider the proposed alternative metric and the RCIS Proponent's recommendation, if any, when determining whether to approve the alternative metric.

Once a metric(s) is designated and approved, it must be used for both the baseline and subsequent measurements of habitat area and habitat quality. If an approved metric turns out to be faulty or problematic, the MCA Sponsor may make a written request to the RCIS Proponent and CDFW to consider approving a different metric instead of, or in addition to, the approved metric(s), as set forth above. The determination to approve will be based, in part, on whether that new metric can be compared with the original baseline data in a reasonable way to compare the change in habitat area or habitat quality, as applicable.

MCA sponsors will report on relevant RCIS metrics for corresponding conservation actions and habitat enhancement actions implemented through an MCA. MCA sponsors may include additional measures and performance standards for assessing habitat quality in an MCA, consistent with the MCA Guidelines and with approval by CDFW.

The following metrics are acceptable in this RCIS for measuring the net change in habitat area and habitat quality resulting from habitat restoration actions:

- Acreage
- Linear feet
- Vigor index (health of plant on scale of 1-4)
- Percent cover (native vs. nonnative species)
- Native species diversity
- Number of individuals
- Number of populations
- Gene pool / genetic diversity
- Evidence of presence and abundance (presence/absence, number of nests, calls, scat, etc.)
- Habitat structure (number of canopy layers; percent cover; snags, etc.)

- Distribution of key resources (e.g., nesting trees, ponds, host plants) (number per acre)
- Inundation duration (consecutive days)
- Water depth (feet)
- Stream flow (cubic feet per second)
- Water temperature and chemical composition (dissolved oxygen, etc.)
- Stream substrate composition (percent cover; gravel size; etc.)
- Stream characterization (pool, riffle, run; length and width)

6.3.2 RCIS Reporting

A report will be submitted to CDFW at the end of the ten-year term of the RCIS (i.e., 10 years following its approval) or as part of a request to CDFW to renew the RCIS (CDFW 2018). The report will document the status of implementation of the RCIS and will contain the following:

- progress of conservation and habitat enhancement actions in achieving the RCIS' goals and objectives;
- The net change in selected metrics for the focal species and other conservation elements, including a summary of the progress of all MCAs in the RCIS Area based on readily available MCA information, which is assumed to be provided by CDFW directly or via a website; and
- A summary of other readily available information on conservation and/or habitat enhancement actions undertaken in the RCIS Area during the 10-year interval.

The report will be developed based on a summary of the progress of all MCAs in the RCIS Area based on readily available MCA information. To the extent feasible the RCIS report will also include a summary of other readily available information on conservation and/or habitat enhancement actions undertaken in the RCIS Area. For example, updates to the databases for California Protected Areas and California Conservation Easement (GIN 2021) could be used to identify new land protection projects, while restoration projects could be tracked through outreach to agencies and organizations and integrating information available through databases that document restoration, enhancement, and management in the RCIS Area. As resources allow, the RTC and RCD could develop and maintain a database to document implementation of projects in the RCIS Area.

6.4 Updating, Extending, and Amending the RCIS

The RCIS has a 10-year term, after which new MCAs cannot be approved by CDFW unless the RCIS term is extended. The RCIS can be updated during that term, to reflect new scientific information. It can also be amended to make other types of changes to the document. The

following sections summarize the processes for these changes, per the current RCIS guidelines (CDFW 2018).

6.4.1 Extending and Updating the RCIS

This RCIS has a 10-year term that begins within its approval date. After that period, CDFW cannot authorize new MCAs unless the RCIS term is extended. The term can be extended by CDFW for an additional period of up to 10 years provided the scientific information has been updated and the progress evaluation report has been submitted to CDFW.

The RTC and RCD, with support and input from the RCIS Steering Committee, Technical Advisory Committee, and Stakeholder Committee, will facilitate a 10-year evaluation of the RCIS, including assessment of its utilization for MCA creation and other conservation benefits. If the RCIS is fulfilling its intended value, and pending availability of necessary resources, the RTC and/or RCD, or other entity designated by the RTC, will complete the 10-year update of the RCIS.

The scientific information and data in this RCIS can be updated anytime during the 10-year term (CDFW 2018). A data update can occur through submission of new spatial data or minor changes to numbers or text in the document. It does not include updates or amendments to the geographic area, focal species, or other conservation elements.

6.4.2 Amending the RCIS

Changes to the RCIS within the 10-year term that go beyond updating scientific information require an amendment process as described in California Fish and Game Code 1854(a). Minor changes to the document (beyond data updates) are regarded as simple amendments, while substantive changes to the document such as changes to the geographic boundary (i.e., the RCIS Area) or adding or removing focal species or other conservation elements, are referred to as complex amendments; the latter are subject to the same noticing, review, and approval processes required for RCISs (CDFW 2018). Amendments can be submitted by the original RCIS proponent (i.e., RTC in this RCIS) or a third-party public agency, provided that the original proponent declines to amend the RCIS. The RCIS can also be amended by CDFW.

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Appendices

Appendix A Glossary

Table A- 1: Glossary

Term/Acronym/ Abbreviation	Definition[1]
AB – Assembly Bill	A draft of a proposed law introduced by a Member of the California Assembly. [2]
ACE—Areas of Conservation Emphasis	A project that provides data to help guide and inform conservation priorities in California launched by CDFW in 2010[3], or the latest update of that analysis.
adaptive management and monitoring strategy	A component of an RCIS that incorporates an adaptive management process that is informed by periodic monitoring of the implementation of both conservation actions and habitat enhancement actions.[4] Adaptive management means using the results of new information gathered through a monitoring program to adjust management strategies and practices to help provide for the conservation of focal species and their habitats. A monitoring strategy is the periodic evaluation of monitoring results to assess the adequacy of implementing a conservation action or habitat enhancement action and to provide information to direct adaptive management activities to determine the status of the focal species, their habitats, or other natural resources. [5]
administrative draft NCCP	A substantially complete draft of a Natural Community Conservation Plan (NCCP) that is released after January 1, 2016, to the general public, plan participants, and CDFW.
advance mitigation	Compensatory mitigation for impacts on ecological resources (species and their habitats) and other natural resources that is implemented prior to impacts occurring.
biodiversity	The full array of living things considered at all levels, from genetic variants of a single species to arrays of species and arrays of genera, families, and higher taxonomic levels; includes natural communities and ecosystems.

Term/Acronym/ Abbreviation	Definition[1]
CDFW – California Department of Fish and Wildlife	California Department of Fish and Wildlife
CEHC—California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California	A statewide assessment of essential habitat connectivity completed by consultants and commissioned by CDFW and Caltrans;[6] the assessment used the best available science, data sets, and spatial analysis and modeling techniques to identify large remaining blocks of intact habitat or natural landscape and model linkages between them that need to be maintained, particularly as corridors for wildlife.
CEQA – California Environmental Quality Act	California Environmental Quality Act (California Public Resources Code, sections 21000 - 21178, and Title 14 CCR, section 753, and Chapter 3, sections 15000 - 15387).
CESA – California Endangered Species Act	California Endangered Species Act (Fish and Game Code §2050-2115.5).
climate change vulnerability	Refers to the degree to which an ecological system, natural community, habitat, or individual species is likely to be adversely affected as a result of changes in climate and is often dependent on factors such as exposure, sensitivity, and adaptive capacity.
CNDDB – California Natural Diversity Database	California Natural Diversity Database is an inventory of the status and locations of rare plants and animals in California.[7]
co-benefited species	Term used in this RCIS to describe additional rare species (other than focal and non-focal species) that will benefit from the conservation strategy
compensatory mitigation	Actions taken to fulfill, in whole or in part, mitigation requirements under state or federal law or a court mandate.
conservation, conserve	The use of habitat and other natural resources in ways such that they may remain viable for future generations. This includes permanent protection of such resources. See “permanently protect.”

Term/Acronym/ Abbreviation	Definition[1]
conservation action	An action identified in an RCIS that, when implemented, would permanently protect, or restore, and perpetually manage, conservation elements, including focal species and their habitats, natural communities, ecological processes, and wildlife corridors. In contrast, a habitat enhancement action would have long-term durability but would not involve acquiring land or permanently protecting habitat – see habitat enhancement action. A conservation action is developed to achieve one or more conservation objectives. A conservation action may be implemented through a variety of conservation investments or MCAs. A conservation action that is implemented through an MCA would create conservation credits to be used as compensatory mitigation.
conservation easement	A perpetual conservation easement that complies with Chapter 4 (commencing with Section 815) of Title 2 of Part 2 of Division 2 of the Civil Code.[8]
conservation element	An element that is identified and analyzed in an RCIS that will benefit from conservation actions and habitat enhancement actions set forth in the RCIS. Conservation elements include focal species and their habitats, natural communities, biodiversity, habitat connectivity, ecosystem functions, water resources, and other natural resources. Conservation elements may benefit through both conservation investments and MCAs.
conservation goal	Broad, guiding principle that describes a desired future condition for a focal species, other species, or other conservation element. Each conservation goal is supported by one or more conservation objectives.
conservation investment	Conservation actions or habitat enhancement actions that are implemented under an approved RCIS, but the implementer does not create credits through an MCA with CDFW. Conservation investments are typically funded by public agencies and nonprofit or other philanthropic organizations.

Term/Acronym/ Abbreviation	Definition[1]
conservation priority	A conservation or habitat enhancement action (e.g., land acquisition, restoration, or habitat enhancement) that is identified based on its importance for benefiting and contributing to the conservation of focal species and their habitats, or other conservation elements within an RCIS area.
conservation purpose	Statement or statements in an RCIS that identify focal species and other conservation elements within the RCIS area and which outline conservation actions or habitat enhancement actions that, if implemented, will sustain and restore these resources.
creation (of natural community or focal species' habitat)	The creation of a specified resource condition where none existed before. See "establishment."
critical habitat	Habitat designated as critical[9] refers to specific areas occupied by a federally listed species at the time it is listed, and that are essential to the conservation of the species and that may require special management considerations or protection. Critical habitat also includes specific areas outside occupied habitat into which the species could spread and that are considered essential for recovery of the species.
CWHR—California Wildlife Habitat Relationships	System that contains the life history, geographic range, habitat relationships, and management information for over 700 regularly occurring species of amphibians, reptiles, birds, and mammals in the state; allows users to produce queries to generate lists of species by geographic location or habitat type and provides information on expert opinion–based habitat suitability ranks for each species within each habitat type.[10]
ecological function	Ecological function refers to the roles and relationships (e.g., predator and prey relationships) of organisms within an ecological system, and the processes (e.g., pollination, decomposition) that sustain an ecological system. See also, "ecosystem function."

Term/Acronym/ Abbreviation	Definition[1]
ecological resources	Species, habitats, biological resources, and natural resources identified in an RCA or RCIS. See "conservation element" and "natural resources."
ecoregion, sub-ecoregion	As used in this document, ecoregion means a USDA Section[11] and sub-ecoregion means a portion of the USDA Section or USGS Hydrological Units (assigned hydrological unit codes; HUC).[12] The U.S. Department of Agriculture (USDA) describes four geographic levels of detail in a hierarchy of regional ecosystems including domains, divisions, provinces, and sections. Sections are subdivisions of provinces based on major terrain features, such as a desert, plateau, valley, mountain range, or a combination thereof.
ecosystem	A natural unit defined by both its living and non-living components; a balanced system of the exchange of nutrients and energy. Compare with "habitat."
ecosystem function	The ecosystem processes involving interactions between physical, chemical, and biological components, such as dynamic river meander, floodplain dynamism, tidal flux, bank erosion, and other processes necessary to sustain the ecosystem and the species that depend on it.
ecosystem services	The beneficial outcomes to humans from ecosystem functions such as supplying of oxygen; sequestering of carbon; moderating climate change effects; supporting the food chain; harvesting of animals or plants; providing clean water; recharging groundwater; abating storm, fire, and flood damage; pollinating and fertilizing for agriculture; and providing scenic views.
endemic	A species, subspecies, or variety found only in a specified geographic region.
enhancement	A manipulation of an ecological resource or natural resource that improves a specific ecosystem function. An enhancement does not result in a gain in protected or conserved land, but it does result in an improvement in ecological or ecosystem function.

Term/Acronym/ Abbreviation	Definition[1]
essential connectivity areas	Those areas essential for ecological connectivity between natural landscape blocks, as depicted in the Essential Connectivity Map prepared as part of CEHC Project,[13] or other connectivity report, plan, or map approved by CDFW or that represents best available science.
establishment	The manipulation of the physical, chemical, or biological characteristics present on a site to develop an aquatic or terrestrial habitat resource for Focal Species. Establishment will result in a gain in resource area and/or function. See "creation."
focal species	Sensitive species that are identified and analyzed in an RCIS and will benefit from conservation actions and habitat enhancement actions set forth in the RCIS. Focal species may benefit through both conservation investments and MCAs. See also, "sensitive species", "special-status species", and "non-focal species".
Guidelines	Regional Conservation Investment Strategies Program Guidelines
habitat	An ecological or environmental area that is, or may be, inhabited by a species of animal, plant, or other type of organism. It is also the physical and biological environment that surrounds, influences, and is utilized by a species' population and is required to support its occupancy. See also, "CWHR—California Wildlife Habitat Relationships."
habitat connectivity	The capacity of habitat to facilitate the movement of species and ecological functions.
habitat enhancement action	An action identified in an RCIS that, when implemented, is intended to improve the quality of wildlife habitat, or to address risks or stressors to wildlife. A habitat enhancement action is developed to achieve one or more conservation objectives. A habitat enhancement action would have long-term durability but would not involve acquiring land or permanently protecting habitat. In contrast, a conservation action would permanently protect or restore, and perpetually manage, conservation elements – see Conservation Action. Examples of habitat

Term/Acronym/ Abbreviation	Definition[1]
	enhancement actions include improving in-stream flows to benefit fish species, enhancing habitat connectivity, and controlling or eradicating invasive species. A habitat enhancement action may be implemented through a variety of conservation investments or MCAs. A habitat enhancement action that is implemented through an MCA would create habitat enhancement credits intended for use as compensatory mitigation for temporary impacts.[14]
HCP – Habitat Conservation Plan	Habitat Conservation Plan. A planning document that is required as part of an application for an incidental take permit under the federal Endangered Species Act. HCPs provide for partnerships with non-federal parties to conserve the ecosystems upon which listed species depend, ultimately contributing to their recovery. HCPs describe the anticipated effects of the proposed taking, how those impacts will be minimized or mitigated, and how the HCP is to be funded.[15]
HUC – Hydrologic Unit Code	A code identifying a unique hydrologic unit.[16]
Implementing Entity	The organization designated in an NCCP and associated Implementing Agreement that is responsible for implementing the NCCP. Implementing Entities can be non-profit organizations, joint-powers authorities, local governments (such as cities or counties), or others.
invasive species	Invasive species means, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health.[17]
LSA – Lake and Streambed Alteration	Lake and Streambed Alteration Program (Fish and Game Code sections 1600-1617).[18]

Term/Acronym/ Abbreviation	Definition[1]
MCA—Mitigation Credit Agreement	An agreement between CDFW and one or more persons or entities that identifies the types and numbers of credits the person(s) or entity(ies) proposes to create by implementing one or more conservation actions or habitat enhancement actions. An MCA includes the terms and conditions under which those credits may be used. The person or entity may create and use, sell, or otherwise transfer the credits upon CDFW's approval that the credits have been created in accordance with the MCA. To enter into an MCA with CDFW, a person or entity shall submit a draft MCA to CDFW for its review, revision, and approval. An MCA may only be created within an area where an RCIS has been approved.
metric	The indicator (e.g., area, habitat quality, known or estimated population size, etc.) by which the net change can be measured, using existing technology, from implementation of the proposed conservation actions or habitat enhancement actions relative to performance standards, to determine achievement of the RCIS's objectives.
natural community	A group of organisms living together and linked together by their effects on one another and their responses to the environment they share.[19] A general term often used synonymously with vegetation community and aquatic community.
natural resources	Biological and ecological resources including species and their habitats, Waters of the State, Waters of the United States, wetlands, and natural communities. See "ecological resources" and "conservation element."
NCCP—Natural Community Conservation Plan	A plan developed pursuant to the Natural Community Conservation Planning Act (Fish and Game Code sections 2800-2835) which identifies and provides for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity.[20] An NCCP allows for take of species listed under CESA, as well as other, non-listed species.

Term/Acronym/ Abbreviation	Definition[1]
NCCPA – Natural Community Conservation Planning Act	Natural Community Conservation Planning Act (Fish and Game Code sections 2800-2835).
NEPA – National Environmental Policy Act	The National Environmental Policy Act requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions.[21]
NMFS – National Marine Fisheries Service	National Marine Fisheries Service, or the National Oceanic and Atmospheric Administration (NOAA) Fisheries, is the federal agency responsible for the stewardship of the nation's living marine resources and their habitat.
non-focal species	Species that are not "focal species", as defined in these Guidelines, but which are associated with a focal species or other conservation element and will benefit from conservation actions and habitat enhancement actions set forth in the RCIS. Non-focal species may benefit through both conservation investments and MCAs. See also, "focal species", "sensitive species", and "special-status species".
objective	A concise, measurable statement of what is to be achieved and that supports a conservation goal. The objective should be based on the best available scientific information to conserve the focal species or other conservation elements for which the conservation goal and objective is developed. It should be measurable by using a standard metric or scale (i.e., number, percent), in a region (e.g., county, watershed, jurisdictional area) over a period of time (e.g., years).
permanently protect	Permanent protection means: (1) recording a conservation easement and (2) providing secure, perpetual funding for management of the land, monitoring, legal enforcement, and defense.
population	The number of individuals of a particular taxon inhabiting a defined geographic area.
pressure	See "stressor, pressure."

Term/Acronym/ Abbreviation	Definition[1]
RCA—Regional Conservation Assessment	An assessment that provides information and analyses that document the ecosystems, ecosystem functions, species, habitat, protected and conserved areas, and habitat linkages within an ecoregion to provide the appropriate context for nonbinding, voluntary conservation strategies and actions. These assessments include information for the identification of areas with the greatest probability for long-term ecosystem conservation success incorporating co-benefits of ecosystem services, such as carbon cycling, water quality, and agricultural benefits. An RCA may be used to provide context at an ecoregional or sub-ecoregional scale to assist with the development of an RCIS. RCAs are intended to provide scientific information for the consideration of public agencies and their preparation is voluntary.
RCA or RCIS Area	The geographic area encompassed by an RCA or RCIS.
RCA or RCIS proponent	The public agency or group of public agencies developing an RCA or RCIS for review and approval by CDFW and who is responsible for the technical and administrative updates of an RCA or RCIS.
RCIS—Regional Conservation Investment Strategy	Information and analyses to inform nonbinding and voluntary conservation actions and habitat enhancement actions that would advance the conservation of focal species and their habitats, natural communities, and other conservation elements. The RCIS provides nonbinding, voluntary guidance for the identification of conservation priorities, investments in ecological resource conservation, or identification of priority locations for compensatory mitigation for impacts on species and natural resources. RCISs are intended to provide scientific information for the consideration of public agencies and are voluntary. RCISs do not create, modify, or impose regulatory requirements or standards, regulate the use of land, establish land use designations, or affect the land use authority of, or exercise of discretion by, any public agency. RCISs are required if MCAs are to be developed.

Term/Acronym/ Abbreviation	Definition[1]
recovery	The process by which the decline of an endangered or threatened species is halted or reversed or threats to its survival are neutralized, so that its long-term survival in nature can be ensured. Recovery entails actions to achieve the conservation and survival of a species,[22] including actions to prevent any further erosion of a population's viability and genetic integrity. Recovery also includes actions to restore or establish environmental conditions that enable a species to persist (i.e., the long- term occurrence of a species through the full range of environmental variation).
recovery plan	A document published by USFWS, NMFS, or CDFW that lists the status of a listed species and the actions necessary to remove the species from the endangered species list.
rehabilitation	Manipulation of a piece of land with the goal of repairing natural or historic ecosystem functions to degraded habitat or natural resources. This results in an improvement in ecological or ecosystem functions, but it does not result in a gain in area.
restore, restoration	Manipulation of a site with the goal of returning species, habitat, and ecological and ecosystem functions to a site that historically supported such species, habitat, and functions, but which no longer supports them due to the loss of one or more required ecological factors or as a result of past disturbance. Compare with "conservation," "preserve," and "rehabilitation."
sensitive species	Any special-status species identified by a state or federal agency. See also, "focal species" and "special-status species".
SCV – Survey of California Vegetation	The Survey of California Vegetation is the vegetation mapping standard developed and maintained for the state by CDFW (Fish and Game Code 1940).[23]
special-status species	For the purpose of the Program, a species identified as endangered, threatened, or candidate under state or federal law; as rare or fully protected under state law; or otherwise identified by CDFW through the approval of an RCIS. See also, "focal species" and "sensitive species".

Term/Acronym/ Abbreviation	Definition[1]
SGCN – Species of Greatest Conservation Need	Species of Greatest Conservation Need are selected, for each state, to indicate the status of biological diversity in the state, specifying at-risk species that have the greatest need for conservation. The latest SGCN list for the state of California is found in the California State Wildlife Action Plan 2015 Update.[24]
SSC – Species of Special Concern	Species of Special Concern[25] is an administrative designation and carries no formal legal status. The intent of designating SSCs is to: 1) focus attention on animals considered potentially at conservation risk by CDFW, other state, local and federal governmental entities, regulators, land managers, planners, consulting biologists, and others; 2) stimulate research on poorly known species; and 3) achieve conservation and recovery of these animals before they meet CESA criteria for listing as threatened or endangered.
stressor, pressure	Stressor is a degraded ecological condition of a focal species or other conservation element that resulted directly or indirectly from a negative impact of pressures such as habitat fragmentation. A pressure is an anthropogenic (human-induced) or natural driver that could result in changing the ecological conditions of a focal species or other conservation element. Pressures can be positive or negative depending on intensity, timing, and duration. Negative or positive, the influence of a pressure to the target focal species or other conservation elements is likely to be significant.
sub-ecoregion	See “ecoregion, sub-ecoregion.”
SWAP– California State Wildlife Action Plan	The California State Wildlife Action Plan (SWAP) is a CDFW publication developed to address the highest conservation priorities of the state, providing a blueprint for actions necessary to sustain the integrity of California’s diverse ecosystems.[26] CDFW also created companion plans to support SWAP 2015[27] implementation through collaboration with partner agencies and organizations. The companion plans identify shared priorities among partner organizations to conserve natural resources in nine sectors that are experiencing significant pressures affecting natural resources.[28]

Term/Acronym/ Abbreviation	Definition[1]
USDA – U.S. Department of Agriculture	U.S. Department of Agriculture, the federal agency providing leadership on food, agriculture, natural resources, rural development, nutrition, and related issues based on public policy, the best available science, and effective management.
USFWS – U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service, the federal agency responsible for conserving, protecting, and enhancing fish, wildlife and plants and their habitats.
USGS – U.S. Geological Survey	U.S. Geological Survey, the federal agency that provides science about natural hazards and natural resources.
VegCAMP – Vegetation Classification and Mapping Program	The Vegetation Classification and Mapping Program develops and maintains California's expression of the National Vegetation Classification System.[29]
watershed	An area or ridge of land that contains a common set of streams and rivers that all drain into one location such as a marsh, stream, river, lake, or ocean.
working land	An area where people live and work in a way that allows ecosystems or ecosystem functions to be sustained (e.g., farms, ranches). Human activities are done in a way that minimizes disturbance on native plants and animals while still retaining the working nature of the landscape.

[1] Unless cited otherwise, all definitions are excerpted or modified from AB 2087 or are modified from the State
Wildlife Action Plan.

[2] California State Legislature Glossary of Legislative Terms, definition of "Bill." Accessed at: http://www.legislature.ca.gov/quicklinks/glossary.html.

[3] https://www.wildlife.ca.gov/Data/Analysis/Ace

[4] Fish & G. Code, § 1856, subdivisions (b)(1) and (f)(14)

[5] Adapted from Fish & G. Code, § 2805, subdivisions (a) and (g)

[6] California Essential Habitat Connectivity Project. Accessed at:https://www.wildlife.ca.gov/conservation/planning/connectivity/CEHC.

[7] https://www.wildlife.ca.gov/Data/CNDDB

[8] "Conservation easement" includes a conservation easement as defined in Civil Code section 815.1 and an agricultural conservation easement as defined in Pub. Resources Code, § 10211.

[9] 16 U.S.C. § 1532(5)(a)

[10] https://www.wildlife.ca.gov/Data/CWHR

[11] Goudey, C.B., and D.W. Smith, eds. 1994. Ecoregions California07_3. McClellan, CA. Remote Sensing Lab. Updated with ECOMAP 2007: Cleland, D.T.; Freeouf, J.A.; Keys, J.E., Jr.; Nowacki, G.J.; Carpenter, C; McNab, W.H. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States [1:3,500,000] [CD-ROM]. Sloan, A.M., cartog. Gen. Tech. Report WO-76. Washington, DC: U.S. Department of Agriculture, Forest Service. Miles and Goudey 1997. Ecological Subregions of California. Technical Report R5-EM-TP-005, USDA Forest Service, Pacific Southwest Region, San Francisco, CA.

[12] The United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), the United States Geological Survey (USGS), and the Environmental Protection Agency (EPA). The Watershed Boundary Dataset (WBD) was created from a variety of sources from each state and aggregated into a standard national layer for use in strategic planning and accountability. Accessed at: http://datagateway.nrcs.usda.gov.

[13] *California Essential Habitat Connectivity Project*. Accessed at: https://www.wildlife.ca.gov/conservation/planning/connectivity/CEHC

[14] Fish & G. Code, § 1856, subdivision (d) states that "…the habitat enhancement action shall remain in effect at least until the site of the environmental impact is returned to pre-impact ecological conditions."

[15] https://www.fws.gov/endangered/esa-library/pdf/hcp.pdf

[16] The United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), the United States Geological Survey (USGS), and the Environmental Protection Agency (EPA). The Watershed Boundary Dataset (WBD) was created from a variety of sources from each state and aggregated into a standard national layer for use in strategic planning and accountability. Accessed at: http://datagateway.nrcs.usda.gov.

[17] Obama, Barack – the White House, Executive Order -- Safeguarding the Nation from the Impacts of Invasive Species. December 5, 2016. Accessed at: https://obamawhitehouse.archives.gov/the-press-office/2016/12/05/executive-order-safeguarding-nation-impacts-invasive-species.

[18] Fish & G. Code, §§ 1600 – 1617

[19] Sawyer, J.O., T. Keeler-Wolf, and J.E. Evens. 2009. *A Manual of California Vegetation*. Second Edition. Sacramento, CA: California Native Plant Society.

[20] Fish & G. Code, §§ 2800 – 2835

[21] Pub. L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, § 4(b), Sept. 13, 1982.

[22] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. *Recovery Plan for Upland Species of the San Joaquin Valley, California*. Portland, OR: Region 1.

[23] https://www.wildlife.ca.gov/Data/VegCAMP/Mapping-Standards

[24] California Department of Fish and Wildlife. 2015. *California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians. Appendix C: Species of Greatest Conservation Need*. Accessed at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109224&inline.

[25] https://www.wildlife.ca.gov/Conservation/SSC

[26] https://www.wildlife.ca.gov/SWAP/Final

[27] California Department of Fish and Wildlife. 2015. *California State Wildlife Action Plan, 2015 Update: A Conservation Legacy for Californians*. Edited by Armand G. Gonzales and Junko Hoshi. Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA. Accessed at: https://www.wildlife.ca.gov/SWAP.

[28] https://www.wildlife.ca.gov/SWAP/Final/Companion-Plans

[29] https://www.wildlife.ca.gov/Data/VegCAMP

Appendix B Geographic Information Systems Data Sources

Table B-1 provides a list of the geographic information systems (GIS) data sources that were used to develop the RCIS. Table B-2 outlines the specific data used to develop the vegetation and land cover dataset, which was synthesized using the best available data. Due to the scale of the planning, however, it was not feasible to incorporate property-specific vegetation data.

The RCIS was developed using available information for the planning area, which oftentimes included regional spatial data (Appendix B). While these data are appropriate for planning purposes, they may not always accurately depict conditions at the site level, where additional assessments and planning may be required during implementation of the RCIS. Notably, wetlands were largely mapped through vegetation mapping, which is conducted through aerial image analysis; as a result, these features are often not completely mapped. Additional wetlands, including one-parameter wetlands, likely occur within the RCIS Area.

Table B- 1: GIS Data Sources

Theme and Dataset	Reference	Sources
Base Reference (included on most figures)		
RCIS Area	prepared for this RCIS	BAOSC 2019
Drop Shadow and Mask	prepared for this RCIS	
Coast Fade	prepared for this RCIS	
County Boundaries	BAOSC 2019	
City Limits	County of Santa Cruz 2020a	
Streams	Mackenzie et al. 2011	USGS 2010
Waterbodies	Mackenzie et al. 2011, BAOSC 2019	USGS 2010
Highways	USCB2000	
Major Roads	BAOSC 2019, USCB 2000	
30m Digital Elevation Model	BAOSC 2021	
California Hillshade	Mackenzie et al. 2011	
California Urban	Mackenzie et al. 2011	DOC 2008
World Terrain Base	ESRI 2020	
Land Use		
General Land Use	Prepared for this RCIS	County of Santa Cruz 2020a, City of Santa Cruz 2020a, AMBAG 2018

Theme and Dataset	Reference	Sources
Coastal Zone	County of Santa Cruz 2020a	
Infrastructure		
Water Management Agencies	DWR 2019	
Electric Transmission Lines	CEC 2020	
Substations	CEC 2020	
Power Generating Facilities	CEC 2020	
Natural Gas Transmission Mainlines	OES 2020	
Regional Planned Transportation Projects	RTC 2020	
State Planned Transportation Projects	Caltrans 2017	
Protected Lands		
Protected Lands (Ownership and Gap Status)	Prepared for this RCIS	GIN 2021, USGS 2018, L. McLendon pers. comm. 2020
Conservation and Mitigation Banks		
Conservation and Mitigation Banks Service Areas	RIBITS 2020, McGraw 2007c	
Conservation Bank Location	CDFW 2020b	
Ecoregions		
Ecological Provinces	Prepared for this RCIS	McNab et al. 2007
Ecological Sections	Prepared for this RCIS	McNab et al. 2007
Ecological Subsections	Prepared for this RCIS	McNab et al. 2007
Aquatic Resources		
Watershed Regions	Prepared for this RCIS	Mackenzie et al. 2011
Priority Sub-watersheds	Mackenzie et al. 2011	
Water and Wetlands	Prepared for this RCIS	Mackenzie et al 2011, County of Santa Cruz 2020a, SFEI 2017, AIS 2007, SMGWA 2021
Priority Fish Streams	Mackenzie et al. 2011	
Pond	Prepared for this RCIS	Mackenzie et al. 2011, SMGWA 2021, SFEI 2017

Theme and Dataset	Reference	Sources
Seep or Spring	Prepared for this RCIS	Mackenzie et al. 2011, Nolan Associates 2016
Land Cover		
Natural Communities and other Land Cover	Prepared for this RCIS	Mackenzie et al. 2011, DOC 2016, County of Santa Cruz 2020a, SFEI 2017, AIS 2007, McGraw 2007c, McGraw 2015a, SMGWA 2021, Mendonca and Smith 2017
Habitat Connectivity		
Habitat Patches	Mackenzie et al. 2011	Merenlender and Feirer 2011
Significant Habitat Patches and Complexes	Mackenzie et al. 2011	Merenlender and Feirer 2011
Ben Lomond Mountain Patch Complex	Mackenzie et al. 2011	Merenlender and Feirer 2011
Critical Areas to Maintain Landscape Permeability	Mackenzie et al. 2011	
Critical Landscape Linkages	Mackenzie et al. 2011	
Large Landscape Blocks	Penrod et al. 2013	
Linkage Designs	Penrod et al. 2013	
Key Riparian Corridors	Penrod et al. 2013	
Riparian Buffer Zones	Penrod et al. 2013	
Working Lands		
Cultivated	Prepared for this RCIS	DOC 2016, Mackenzie et al. 2011
Rangelands	DOC 2016	
Urban and Built-up Land	DOC 2016	
Agricultural Resource Protection Area	County of Santa Cruz 2020a	
Williamson Act	BAOSC 2019	
Timber Harvests (2010-2019)	CalFire 2020	
Timber Production Zones (TPZ)	Mackenzie et al. 2011	
Other Conservation Elements		
Fire Perimeters	CalFire 2021	

Theme and Dataset	Reference	Sources
Stream Valleys	BAOSC 2021	
Sea Level Rise 8-Ft Scenario	NOAA 2017	
Fish Bearing Streams	County of Santa Cruz2021	
Fish Passage Barriers	County of Santa Cruz 2021	
Other Streams	County of Santa Cruz 2020a	
Marble Outcrops	Nolan Associates 2016	
Karst Springs	Nolan Associates 2016	
Well Records	Nolan Associates 2016	
Critical Habitat (polygon)	USFWS 2020a	
Critical Habitat (line)	NOAA 2020	
Documented Occurrences (CNDDB)	CDFW 2019d	
Santa Cruz Long-toed Salamander Population Boundaries	USFWS 2004b	
Santa Cruz Long-toed Salamander Range	CDFW 2020a	
Mountain Lion Range	CDFW 2020a	
Coho Priority Restoration Areas	NOAA 2021	
Marbled Murrelet Important Areas	Singer 2012b	CDFW 2008a,b, CDFW 2011, Singer 2012b, TNC 2002b, USFWS 2011
Marbled Murrelet Nest Range	Singer 2012b	CDFW 2008a,b, CDFW 2011,

Table B- 2: Vegetation Compilation Sources and Priorities

Vegetation and Land Cover Data	Priority Level[1]	Source	Area	Description
These layers and adjustments were used to create a composite vegetation and land cover dataset				
Conservation Blueprint Vegetation	Low (although sensitive communities remained High)	Mackenzie et al. 2011	Entire County	CALVEG (1997-2001) with the following changes to geometry and typing: 1)sandhills (McGraw 2005), 2) sand parkland (McGraw 2005), 3) Santa Cruz cypress (McGraw 2007c), and 4) cultivated and built up (DOC 2008) Additionally, some type changes made including coyote brush scrub reclassified as maritime chaparral in many places.
Urban and Cultivated	Medium- Low	DOC 2016	Entire County	Updated the Urban and Cultivated areas in Conservation Blueprint Vegetation Layer per changes since 2008. Cultivated included these categories: Prime farmland, Farmland of Statewide Importance, Unique Farmland, Farmland of Local Importance; Urban included: Urban and Built-up Land. Sandhills habitat and other important natural communities were retained when bringing in urban and cultivated areas, due to the latter's importance
Riparian Woodlands	Medium	County of Santa Cruz 1994	Entire County	The riparian areas mapped in the Conservation Blueprint Vegetation layer were supplemented by this map, which was not allowed to override other sensitive communities due to its coarser level of mapping.

Vegetation and Land Cover Data	Priority Level[1]	Source	Area	Description
CARI Wetlands	Medium	SFEI 2017	Entire County	A combination of the attribute fields was used to select wetlands (vegetated), and water (non-vegetated), and identify saline influenced or freshwater, using this layer, which integrates the National Hydrographic Dataset (NHD) and the National Wetlands Inventory (NWI). Linear stream features classified as "Freshwater Forested Shrub/Wetland" were not included to avoid redundancy with the linear stream layer used as an overlay (i.e., streams were not integrated into the land cover data).
MROSD	High	AIS 2007	~2,500 acres on the northern border	This layer has been accepted by VegCAMP staff to meet the Survey of California Vegetation standards, and therefore was not superseded by any other layers. The attribute was cross walked to the Conservation Blueprint Vegetation Types.
Sandhills and Sand Parkland Adjustment	High	McGraw 2020		Sandhills and sand parkland geometry were adjusted to reflect updates since 2011.
Santa Cruz Cypress Adjustment	High	McGraw 2015a	Bracken Brae patch	Recovery plan data were replaced with more precise mapping for the Bracken Brae stand.
Ponds and Wetlands	High	SMGA 2021	Santa Margarita Groundwater Basin	Ponds and wetlands were added that were mapped as part of the Groundwater Dependent Ecosystems in the draft Groundwater Sustainability Plan.
Estuarine Complex Adjustment	High	Mendonca and Smith 2017	Coast	Estuarine, Coastal Salt Marsh and adjacent Freshwater Wetlands were adjusted to reflect more accurate conditions using aerial imagery and the Mendonca and Smith 2017 report.

Vegetation and Land Cover Data	Priority Level[1]	Source	Area	Description
The following layers were not integrated into the vegetation layer, but instead, were used as overlays to estimate the areal extent of these features.				
Old Growth/Older Second Growth	Overlay	SRL 2008, Singer 2012a		These layers will be used to identify old-growth and older second growth forests
Streams	Overlay	County of Santa Cruz 2020a	Entire County	This layer mapped from several sources including the 2003 and 2007 ortho-imagery and was deemed more accurate than NHD. It was not integrated into vegetation layer and instead used as overlay.

[1] Available GIS data were incorporated in a stepwise fashion and decision rules were developed to control which layers were given priority in areas of overlap so that more accurate and/or more biologically relevant information was reflected in the final map and table. Lower priority layers were superseded by higher priority layers that featured more accurate and/or more important data.

Appendix C Letter of Support

This appendix contains the letter provided by the California Department of Transportation (Caltrans) requesting approval of the RCIS.

STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY GAVIN NEWSOM, Governor

DEPARTMENT OF TRANSPORTATION
CALTRANS DISTRICT 5
50 HIGUERA STREET
SAN LUIS OBISPO, CA 93401-5415
PHONE (805) 549-3101
FAX (805) 549-3329
TTY 711
www.dot.ca.gov

Making Conservation a California Way of Life.

March 30, 2022

Mr. Charlton H. Bonham
Director
California Department of Fish and Wildlife
1416 9th Street, 12th Floor
Sacramento, CA 94244-2090

Dear Mr. Bonham:

In accordance with California Fish and Game Code (FGC) Section 1852(a) the California Department of Transportation (Caltrans) District 5, a state transportation infrastructure agency, requests that the California Department of Fish and Wildlife (CDFW) approve the Santa Cruz County Regional Conservation Investment Strategy (SCr RCIS). The proposed SCr RCIS encompasses a portion of District 5 and has been developed by a collaborative group of state and local agencies and non-profits through a steering committee to help achieve improved conservation and public infrastructure outcomes in the region.

Caltrans believes that a successfully implemented SCr RCIS could significantly further the State's public infrastructure goals and regional conservation objectives. By using a science-based approach to identify areas of high conservation value in the County, the SCr RCIS will also help agencies avoid and minimize project impacts and identify priority conservation actions for compensatory mitigation, including as part of advance mitigation programs. Caltrans anticipates construction of several transportation projects over the next 10 years in Santa Cruz County, some of which will require compensatory mitigation and may benefit from advanced mitigation guided by the SCr RCIS.

In accordance with California Streets and Highway Code (CSHC)Section 8000.6(j), Caltrans is requesting approval of the SCr RCIS in part to facilitate mitigation for transportation infrastructure projects. As such, the SCr RCIS, if approved by the CDFW, shall not count against the limit on the number of regional conservation investment strategies set in Section 1861 of the CFGC.

Caltrans understands that this letter and support for the SCr RCIS does not obligate Caltrans to implement any part of the RCIS. However, Caltrans continues to maintain support for development of a robust RCIS and future Mitigation Credit Agreements, to implement the conservation goals of the SCr RCIS.

Thank you for your consideration. Should you have any questions, please do not hesitate to contact me at (805) 549-3127 or tim.gubbins@dot.ca.gov.

Sincerely,

TIMOTHY M. GUBBINS
District Director

c: Karen Weiss, Landscape Conservation Planning Program Manager, California Department of Fish and Wildlife

Melinda Molnar, Office Chief of Strategic Biological Planning, Advance Mitigation, and Innovation, Division of Environmental Analysis, California Department of Transportation

Appendix D Public Participation, Notifications, and Comments

D.1 Public Participation

Involvement and input from stakeholders, technical advisors, and the public was integral to development of the RCIS. As described in Section 1.7, outreach occurred through a variety of methods, including presentations and meetings held in person and via teleconferences (e.g., Zoom), the RCIS website, email notifications providing documents for review, and one-on-one outreach. Input was requested from tribal entities, federal, State, and local agencies with land use authority, including the cities and counties in and adjacent to the RCIS area, resource districts, conservation organizations, other non-governmental organizations, and from the public. Specifically, RTC representatives met with representatives of the following municipalities to discuss transportation and other major infrastructure and development projects:

- City of Santa Cruz Public Works (January 23, 2020);
- City of Watsonville Public Works (January 28, 2020); and
- City of Capitola Public Works and Planning (March 13, 2020).

Additionally, RTC staff corresponded with the following entities via email between May and July 2020, to obtain additional project information:

- County of Santa Cruz Public Works Department;
- County of Santa Cruz Planning Department;
- City of Santa Cruz Water Department;
- City of Santa Cruz Planning Department;
- City of Watsonville Planning Department; and
- Pajaro Valley Water Management Agency.

Presentations were provided to the public via meetings of the following: Santa Cruz County Regional Transportation Commission (RTC), Board of Directors of the Resource Conservation District of Santa Cruz (RCD), the Santa Cruz County Commission on the Environment, and the Santa Cruz County Fish and Wildlife Advisory Commission. Additionally, the RTC presented on the RCIS to the RTC Interagency Technical Advisory Committee in March 2019, August 2020, and December 2020.

Table D-1 lists the meetings, presentations, and other outreach that has taken place to date in the RCIS development process. This table will be updated as the RCIS is further developed.

Table D- 1: Public Outreach and Notifications for the RCIS

Dates	Activity
January 24, 2020	First Steering Committee Meeting
April 28, 2020	First Stakeholder Meeting via Zoom
June 2, 2020	Second Steering Committee Meeting via Zoom
June 25, 2020	First Technical Advisor Committee (TAC) Meeting
September 23, 2020	Presentation to the Santa Cruz County Commission on the Environment
October 8, 2020	Third Steering Committee Meeting via Zoom
December 4, 2020	Second Stakeholder Group Meeting via Zoom
December 22, 2020	Notice of Public Meeting
January 11 - February 19, 2021	Santa Cruz County RCIS Virtual Workshop (Website providing information and requesting input about the RCIS)
January 19, 2021	Notice of Intent filed with the County of Santa Cruz Clerk of the Board
January 21, 2021	Public Meeting #1: Introduction to the Santa Cruz County RCIS
January 27, 2021	Notice of Intent filed with the State Clearinghouse
February 10, 2021	Presentation on the RCIS to the Resource Conservation District of Santa Cruz County Board of Directors
June 3, 2021	Presentation to the County of Santa Cruz Fish and Wildlife Advisory Commission
July 13, 2021	Second TAC Meeting

Representatives of the agencies and organizations provided input on the RCIS by participating in one or more of the RCIS groups (steering committee, stakeholder, and/or technical advisor), and/or participating in the public meeting.

Local

- Association of Monterey Bay Area Governments
- City of Santa Cruz
- County of Santa Cruz
- Resource Conservation District of Santa Cruz County
- Transportation Agency of Monterey County

State

- California Coastal Commission
- California Department of Fish and Wildlife
- California Department of Transportation
- California State Coastal Conservancy
- California State Parks
- CalPoly Swanton Pacific Ranch
- Central Coast Regional Water Quality Control Board
- San Jose State University
- University of California, Santa Cruz

Federal

- National Oceanic and Atmospheric Administration' National Marine Fisheries Service
- National Oceanic and Atmospheric Administration's Southwest Fisheries Science Center
- National Oceanic and Atmospheric Administration's Restoration Center
- United States Fish and Wildlife Service
-

Private Organizations

- Big Creek Lumber
- California Academy of Sciences
- Central Coast Wetlands Group
- Coastal Watershed Council
- Ecology Action
- Land Trust of Santa Cruz County
- Peninsula Open Space Trust
- The Nature Conservancy
- Trust for Public Land
- Watsonville Wetlands Watch

Individuals

- Mark Allaback
- Tara Cornelisse
- Jackman Eschenroeder
- Jeff Hagar
- Ken Kellman

- Dylan Neubauer
- Mike Podlech
- Dawn Reis
- Jerry Smith

D.2 Notices

Three public notices were issued regarding the RCIS:

1. On January 27, 2021, a Notice of Intent was filed with the County of Santa Cruz, the California Governor's Office of Planning and Research, and California Department of Fish and Wildlife, and which was sent to each local public agency with land use authority;
2. On December 22, 2020, a Notice of Public Meeting was published to advertise the January 21, 2021, virtual public meeting to provide an overview and receive public input on the Santa Cruz County RCIS; and
3. On *DATE <to be inserted.*, a Notice of Public Meeting was published advertising the public meeting to receive public input of the draft Santa Cruz County RCIS document.

The following page provides the notice for the initial public meeting that was filed with the state clearinghouse, which was the same as the noticed filed with the County.

Governor's Office of Planning & Research

Jan 27 2021

STATE CLEARINGHOUSE

SCCRTC

SANTA CRUZ COUNTY REGIONAL TRANSPORTATION COMMISSION

1523 Pacific Ave., Santa Cruz, CA 95060-3911 • (831) 460-3200 FAX (831) 460-3215 EMAIL info@sccrtc.org

January 19, 2021

NOTICE OF INTENT TO PREPARE SANTA CRUZ COUNTY REGIONAL CONSERVATION INVESTMENT STRATEGY

The Santa Cruz County Regional Transportation Commission (RTC), in coordination with the Resource Conservation District of Santa Cruz County (RCD) is preparing a Regional Conservation Investment Strategy (RCIS) for Santa Cruz County. The RCIS area extends to the jurisdictional boundaries of Santa Cruz County and is being developed with input from the public and stakeholders including community-based organizations, federal, state, and local agencies, and non-governmental organizations.

A new California State law passed in 2016, AB 2087, establishing a conservation planning tool called a Regional Conservation Investment Strategy (RCIS) to promote the conservation of species, habitats, and other natural resources.

RTC, in coordination with the RCD, is developing the RCIS to promote regional habitat conservation and advance mitigation planning through the development of Mitigation Credit Agreements (see below). Funding for the development of the RCIS was provided by the Wildlife Conservation Board, and Santa Cruz County Measure D.

The Santa Cruz County RCIS:

- Provides a voluntary, non-binding, non-regulatory conservation assessment.
- Provides a regional conservation strategy of conservation elements, including, but not limited to, focal species and sensitive habitats through strategic, scientifically grounded actions and investments.
- Establishes conservation and enhancement goals, objectives, and priorities.
- Describes and promotes methods of conservation investment that will contribute to species and habitat conservation, including, but not limited to: land acquisition and protection, habitat preservation, enhancement, creation, and restoration, creek and river restoration, corridor and linkage enhancement, development of Mitigation Credit Agreements (see below).
- Must be approved by CDFW.

Mitigation Credit Agreements (MCAs) are developed under an approved RCIS; approved by CDFW; and:

- Create mitigation credits by implementing conservation actions identified in the RCIS.
- Must be within the boundary of an approved RCIS.
- May be used as compensatory mitigation for impacts under:
- California Environmental Quality Act
- California Endangered Species Act
- Lake and Streambed Alteration Program.
- Anyone can enter into an MCA with CDFW, with their own resources for their own projects.

Once finalized, the RCIS may facilitate advance mitigation planning where environmental mitigation for impacts can be conducted in advance, which can result in conservation projects that have greater benefit, while also expediting delivery of infrastructure projects.

Please visit www.sccrtc.org/rcis or contact rcis_santacruzcounty@sccrtc.org for more information about the Santa Cruz County RCIS.

D.3 Responses to Public Comments

This section documents comments during the first public meeting which was held by videoconference (Zoom) on January 21, 2021. Following the presentation, participants were invited to ask questions by using the "raise hand" feature and/or provide written comments through to the RCIS email address. Oral Comments are shown in Table D-2 while written comments are included in Table D-3.

D.3.1 Oral Comments

Table D- 2: Oral Comments and Responses from the January 21, 2021, RCIS Public Meeting

Comment	Response
Can you give some examples of how the Regional Conservation Investment Strategy (RCIS) might apply to private lands with focal species? And are all focal species equal (e.g., tricolor blackbird or western pond turtle)?	A RCIS is an entirely voluntary program that will identify goals, actions, and priorities throughout the landscape and it can apply to existing protected, public, and private lands. Project sponsors working in private lands can choose to participate in the RCIS either independently or in collaboration with conservation agencies and organizations that are participating in the implementation of a RCIS. The RCIS provides a menu of opportunities based on a strategic approach, but it is up to landowners and others who might partner with them to determine what they would like to do to address mitigation requirements. In the Santa Cruz County RCIS (SCCRCIS), the Southwestern pond turtle is a focal species, so it will have more of an in-depth analysis of its individual ecological needs than the tricolor blackbird, is a non-focal species. However, this is where the natural communities approach, being pioneered by this RCIS is advantageous. The conservation strategies for ponds, freshwater wetlands, and working lands will also promote tricolor blackbird even though it is not a focal species.
Is it correct that Assembly Bill (AB) 2087 sets a limit of 8 RCISs that can be completed in the state and a program sunset date of January 1, 2020?	Yes, AB 2087 included that language. However, on July 21, 2017, the Governor Brown signed Senate Bill (SB) 103 which makes two changes to Assembly Bill 2087: 1) it removes the January 1, 2020 "sunset" provision; and 2) it allows a RCIS to be exempt from the limit of eight RCISs that may be approved by the California Department of Fish and Wildlife (CDFW) if a state water or transportation infrastructure agency requests approval of the RCIS.
Why is the Santa Cruz County Regional Transportation	An analysis of opportunities for regional mitigation have been a requirement of regional transportation plans since the early 2000s. Additionally, transportation agencies have been interested in early

Comment	Response
Commission (RTC) involved in this effort?	and advance mitigation opportunities as a tool for project delivery and so have partnered with regional conservation agencies and organizations to develop the RCIS to investigate such opportunities. Caltrans has been leading the way with an advance mitigation program and other local agencies across the state have adopted transportation sales tax measures with dedicated funding for advanced mitigation.
Have you selected a contractor to prepare the RCIS, such as AECOM or ICF?	The Resource Conservation District of Santa Cruz County (RCD) is conducting the technical analysis with a team of local consultants with expertise in the RCIS Area: Alnus Ecological, Camera Environmental Consulting, Jodi McGraw Consulting.
How will you integrate/interface/align with the Monterey County RCIS?	The Transportation Agency for Monterey County (TAMC) staff involved in the Monterey County RCIS are members of the RCIS Stakeholder Group, so there is an exchange of information and lessons learned. There has also been a robust effort by the Nature Conservancy to bring folks who are working on RCISs together and share information, so that is an area in which there has been coordination with the various agencies across the state working on RCISs.
Is this presentation about how the RTC is working with the RCD to identify potential impacts and mitigation measures related to RTC projects?	Primary focus of this presentation is on the resource conservation strategy that is being developed by the RCD in partnership with the RTC. The RCIS itself is focused on conservation priorities and does not have a transportation component. However, as a parallel effort, RTC has set up a process to evaluate potential mitigation of transportation projects in the regional transportation plan. It is a very high-level look at planned transportation projects through 2046 and it is not specific to a scoping transportation project, not a transportation alternative to any specific transportation project.
Is the RCD working on large, proposed projects in Santa Cruz County, i.e., University of California, Santa Cruz Long Range Development Plan Draft Environmental Impact Report?	More information would be needed about that project to answer that question. RCD is involved in a variety of different conservation projects/ voluntary conservation projects with landowners across the county in different capacities.
How will both agencies prioritize transportation projects to take	The first step is identifying if there is a need for advance mitigation, and a high-level assessment of potential of which future planned transportation and other major infrastructure projects may benefit

Comment	Response
advantage of these mitigation efforts? Will having advanced mitigation projects in the queue or completed speed up approval of RTC's projects?	from advanced mitigation by providing an indication of whether there may be impacts to certain species or habitats. Additionally, the results of this analysis will likely show that more than one project will have a particular type of impact that will result in scoping for advanced mitigation. As such the RTC has been having internal discussions to use the scoping of the advance mitigation as a driver to determine project prioritization, so that an advance mitigation project is applicable to a number of projects and not necessarily limited to a RTC project. The primary interest of RTC is seeking efficiencies to deliver projects.
Does the term "investment strategy" refer to RCD budgetary allocation?	In the context of the RCIS, "investment strategy" refers to how we, as a society, are investing in conservation, whether through state or local grants, private funding or donations, or mitigation. But there are many different tools for investing in mitigation and the RCIS will provide a roadmap to guide investments to those high conservation priorities.
If someone wanted to explore whether the RCIS would be applicable to particular project, how do you explore that further?	Send an email to rcsi_santacruzcounty@sccrtc.org and the RCIS Core team will follow up with you.
Could you provide further information regarding the mitigation banking discussed and how it is consistent with the CDFW banking program? Does that mean that if there is a conservation project, a large project, it could be used for mitigation for a number of other projects? And would the projects requiring mitigation have to be in the local area of the conservation work, or can they be in other areas of the county or state?	Mitigation Credit Agreements (MCAs) are a way to help implement the RCIS strategies. Draft MCA guidelines are under development and are still subject to review and finalization. Currently, the idea is to structure MCAs similarly to mitigation and conservation banks, which have been developed through a long period of time with multiple agency review and coordination. As such the intent behind the MCAs is not to alter or change the way mitigation gets done, but rather use existing programs as a framework. In developing an MCA, the sponsor must identify a service area. For example, if a sponsor conducts a project that improves habitat connectivity in the region, the MCA would identify the geographic area in which the credits would be available. But ultimately, it is up to the agencies who would approve use of mitigation to determine if that mitigation is applicable and appropriate for a given project.

Comment	Response
Which agencies would determine if use of an MCA is appropriate?	Currently, it is the CDFW, as the RCIS and MCA are under their program. There are a lot of efforts under way to have other agencies with jurisdictions for similar resources, including the US Fish and Wildlife Service, Regional Water Quality Control Board, and the Army Corps of Engineers, sign onto MCAs.
Is a RCIS only good for 10 years? Can an RCIS be extended and updated?	Yes, the RCIS program sets a 10-year timeframe the strategies. After 10 years, in order for future MCAs to be developed, the RCIS would need to be updated. The intent is not to have it terminate after 10 years, but rather to ensure that the RCIS remains current.
Would the RCD fund projects included in the RCIS? Please discuss how adopted projects in the RCIS would be funded.	The idea of the RCIS is to direct conservation investments from a variety of different sources and to have the RCIS be implemented through a variety of different partners. The RCD could be one entity bringing forth conversation projects that would be fulfilling goals and priorities laid out in the RCIS, a number of additional entities could also bring forth conservation projects guided by the RCIS. These other entities could fund the conservation projects using a variety of different funding sources, such as grant programs, advanced mitigation, or other mitigation funds directed through MCAs made possible by the existence of the RCIS. One goal of the RCIS is to create attract additional resources to our community as a result of going through this planning process and putting forth a conservation investment strategy. Mitigation is not the sole investment strategy, and the RCD is a key partner to bring the different players to do this sort of regional-scale planning. The RCD also facilitates projects on the ground, but it is not alone in doing that. Part of our desire here is creating the means to lifting all boats and bringing players to bear to help move projects forward and achieve the goals that we are collectively setting out in this RCIS.
During the presentation, a slide showed connectivity between Aptos and Loch Lomond, are those areas in between going to be examined for potential conservation areas? Is that what the idea of connectivity is about there?	The data shown was obtained from the Conservation Blueprint for Santa Cruz County, which was developed about 10 years ago. Those specific arrows referred to the sort of conceptual linkages that we would like to be able to maintain so that animals, plants, and ecological processes are able to move between these large patches. The brown patches are basically contiguous areas of relatively intact habitat areas. These areas are largely roadless and considered ‘core habitat areas’ that can support large populations. The purple arrows illustrate linkages necessary for some populations to persist in Santa Cruz County. Maintaining opportunities for movement between those patches and between the Santa Cruz Mountains and adjacent ranges is important for many reasons, including to allow for genetic exchange, populations dispersal, and climate change adaptation.

Comment	Response
Habitat connectivity seems to be more in line with larger animals such as mountain lions, are there other species that connectivity addresses?	The mountain lion is an iconic species for why connectivity is important, because of its large home range. However, when considering larger and longer timescales, even species with smaller home ranges need to be able to move between these areas. Otherwise, if connectivity is not maintained, such as along the Highway 17 corridor, there is the potential to fragment the western and eastern parts of our county. It is important for all species and ecological processes in the short and long-term.
Is there a built-in incentive in the SCCRCIS for project applicants whose projects do a lot of environmental damage?	The SCCRCIS does not have built-in incentives that would influence a project sponsor in determining whether or not they would mitigate. Having a regional plan that identifies conservation priorities that could be supported by resource agencies would give project sponsors more options; however, mitigation is still subject to the permitting agencies' approval and most agencies require project proponents to follow the mitigation hierarchy: avoid, minimize, then mitigate.
Will information on the Santa Cruz County RCIS be available on the RCD website?	The RTC is hosting the RCIS on its website and we are trying to keep all information related to this effort in one place to facilitate access for interested parties. RCD is currently updating its website and will include a link to the RTC's project page.

D.3.2 Written Comments

D.3.2.1 List of Commentors

Table D-3 lists the written comments received for the January 21, 2021, public meeting.

Table D-3: Authors of written comments provided for the first public meeting

Date	Letter	Author
1/7/21	1	Ami Olson, CDFW, RCIS Program Coordinator
1/11/21	2	Monica Oey, CDFW – Bay Delta Region
1/30/21	3	Sandra Baron, Santa Cruz Co. Fish and Wildlife Advisory Commissioner
2/12/21	4	Sean Cochran, CDFW
2/18/21	5	Jennifer Moonjian, Caltrans District 5
2/18/21	6	Tiffany Yap, Center for Biological Diversity
2/19/21	7	Andrew Johnson, Defenders of Wildlife

D.3.2.2 Comment Summary and Responses

Table D-4 provides written responses to the summarized comments, which are provided in Section D.3.2.3.

Table D- 4: Written comments provided following the January 21, 2021, meeting.

Commenter	Comment #	Comment Summary	Actions/Responses
Ami Olson	1.1	Ensure Caltrans has been consulted regarding list of proposed major infrastructure projects	Caltrans reviewed the Regional Setting including Section 2.2.4.
Ami Olson	1.2	My understanding is that GIN updates may be delayed. How does the info in GIN compare to CPAD, CCED, and NCED (see Guidelines Section 4.2.9.7)?	The RCIS incorporates the most recent and comprehensive protected lands data available including CPAD and the CCED (GIN 2021 references both of databases) as well as additional data obtained through outreach to stakeholders (McLendon 2020).
Ami Olson	1.3	Please note that Guidelines Section 4.2.4.2 requires a consistency comparison and, if applicable, and inconsistency explanation for recovery plans and small, non-regional HCPs	The consistency evaluation is provided in Section 5.4.
Ami Olson	1.4	Does not appear to represent the 18 principal watersheds indicated for this reference	The reference to the 18 principal watersheds was eliminated.
Ami Olson	1.5	Ensure tables and tags are compliant with CDFW's accessibility requirements	The RCIS team obtained ADA accessibility guidance from CDFW and will work to achieve compliance with ADA when preparing the final document.
Monica Oey	2.1	Federal status of the monarch butterfly needs to be updated	The status for monarch was updated to candidate for federal listing in Table 3-4
Sandra Baron	3.1	A fine-scale vegetation map is also needed for South County	The RCIS was revised to state that the map will cover all of Santa Cruz County rather than just the Santa Cruz Mountains portion.
Sandra Baron	3.2	Total acreage of habitat types is not a good measure for fragmented types like oak forest and maritime chaparral. It may look like there's plenty, when in reality it is more threatened and the largest patches should be a high priority for	The referenced section of the RCIS acknowledges that the natural communities occur amidst other land cover types, including urban and cultivated lands. The conservation strategies prioritize protecting intact habitat.

Commenter	Comment #	Comment Summary	Actions/Responses
		protection.	
Sandra Baron	3.3	Dusky-footed woodrat habitats include oak forests	The list of habitats occupied by this species was expanded to include Oak Woodlands and Forests.
Sandra Baron	3.4	Should be corrected to show that a slice of the county near Aptos (and inland) needs more conservation credits than other areas	Table 2-4 includes a caption explaining the secondary service area and implications for credits.
Sean Cochran	4.1	I am concerned that not having CCC and SCCC steelhead as a focal species will funnel bulk of stream restoration work to subset of the county's watersheds, mainly in the north, while watersheds in the south, and in particular the Pajaro/Corralitos where there are no Coho Salmon will get overlooked as far as restoration and mitigation projects	The way the RCIS has been structures, CCC and SCCC steelhead are covered under 2 different conservation elements, Riparian and Riverine and Bar-Built Estuaries and CCC steelhead are also a non-focal species covered under CCC coho salmon. The Riparian and Riverine and BBE communities includes the entire county and specifically call out actions and priorities for SCCC steelhead.
Sean Cochran	4.2	Consider including the Monterey Hitch and Sacramento Blackfish to co-benefitted species	Monterey hitch was added to the list of co-benefited species. Sacramento Blackfish are not native to the Pajaro Watershed but occur there.
Jennifer Moonjian	5.1	At least one crevice-roosting bat species should be included to the non-focal list as transportation projects often involve bridges or large culverts	Bat Habitat was added as a conservation element to address the specialized needs of this guild.
Tiffany Yap	6.1	RCIS should be revised to provide a more historically and ecologically accurate depiction of the fire ecology, regimes, and its effects on the landscapes within the planning area	Additional background information on pre-historical fire regimes provided by the letter writer was included in the Section 2.4.3 of the RCIS.

Commenter	Comment #	Comment Summary	Actions/Responses
Tiffany Yap	6.1	American badger, and other species that are important as ecosystem engineers, should be included as a focal species	The community-based conservation elements including the Sandhills/Sand Parkland and Grassland elements address the importance of ecosystem engineers and other keystone species.
Tiffany Yap	6.11	Insufficient evidence is provided to substantiate claim that logging redwoods can be considered a conservation strategy nor goal	The RCIS cites several published papers in its discussion of the values of sustainable timber harvest and restoration forestry. It acknowledges that there are aspects of timber harvest that are not currently compatible with biological resources conservation while recognizing the importance of working forests as part of the regional conservation strategy.
Tiffany Yap	6.12	Logging should not be considered as an appropriate replacement for cultural burning	The RCIS section on working lands discusses the role of sustainable timber harvest and restoration forestry practices. It does not propose logging as an alternative to cultural burning, which will be discussed as part of the conservation strategy for fire-adapted and fire-dependent communities. The RCIS discusses fire management/cultural burning as part of the conservation strategy for fire-adapted and fire-dependent communities.
Tiffany Yap	6.2	The document should clearly state that the RCIS planning area encompasses unceded territories of the Ramaytush, Muwekma, Tamyen, Ohlone, Awaswas, and Amah Mutsun indigenous communities	A land acknowledgement recommended by the Amah Mutsun Tribal Band was added to Section 1.3 of the RCIS.

Commenter	Comment #	Comment Summary	Actions/Responses
Tiffany Yap	6.3	Riparian woodlands and wetlands should be categorized as fire-adapted	The RCIS was revised to reflect riparian communities are fire adapted
Tiffany Yap	6.4	Also consider these studies to inform conservation action: a. Study conducted by US Geological Survey biologists, Research to inform Caltrans Best Management Practices (Brehme and Fisher 2020) and b. The UC Davis Road Ecology Center's California Roadkill Observation System (CROS)	The RCIS conservation strategy for connectivity integrates these resources, which are very helpful.
Tiffany Yap	6.5	RCIS should conserve existing and enhance regional connectivity	The Habitat Connectivity conservation strategy (Section 5.3.21) addresses existing barriers and discusses methods to make them more permeable.
Tiffany Yap	6.6	RCIS should account for the value of wildlife corridor redundancy and functional connectivity to facilitate wildfire movement throughout the RCIS area	The Habitat Connectivity conservation strategy (Section 5.3.21) includes providing alternative pathways and redundancy.
Tiffany Yap	6.7	Conservation needs of special-status species in the RCIS area are not sufficiently addressed	As outlined in Section 3.2, this RCIS focuses on natural communities to a create a comprehensive, cohesive, and connected regional conservation outcome with enhanced adaptation to pressures and stressors. It provides conservation strategies to address 13 natural communities, bat habitat, habitat connectivity, and working lands and connectivity. The RCIS also identifies focal species based on the RCIS guidelines (2018), which require RCISs to identify focal species that

Commenter	Comment #	Comment Summary	Actions/Responses
			include: 1) listed species, 2) wide-ranging species, c) climate-vulnerable species, and d) taxonomic representation (CDFW 2018).
Tiffany Yap	6.8	Include reasoning for why the selected focal species will result in the most comprehensive conservation outcomes	Section 3.2 was expanded to clarify why the community-based approach to conservation elements will provide for a comprehensive conservation strategy and how the focal species were selected to complement the community-based strategies.
Tiffany Yap	6.9	Most of the non-focal species should be included as focal species to ensure diverse species' life histories and conservation needs are adequately addressed	The approach to including 13 communities, 7 focal species, and three other conservation elements was designed to address the non-focal species in this RCIS as illustrated in the conservation strategies (Section 5.3) and tabulated in Table 5-2. Due to the requirements analyses and strategies, it weas not feasible with the resources available to prepare this RCIS to address the 30 additional non-focal species as focal species.
Andrew Johnson	7.1	The list of focal species in the draft Conservation Elements section is deficient and lacks representation of imperiled and vulnerable species and communities. More species that can serve as indicators of ecosystem health in the county should be included.	The response to comment 6.7 also addresses this comment.
	7.2	Relying on seven focal species to represent the diversity, distribution and conservation needs of other conservation elements within the RCIS area will not meet the objectives of the SCCRCIS	

Commenter	Comment #	Comment Summary	Actions/Responses
Andrew Johnson	7.1	The view that strategies for focal species and natural communities will fully address the conservation needs of non-focal species does not align the with RCIS guidelines	The SCCRCIS team consulted with CDFW in developing the approach to selecting conservation elements for the RCIS. The RCIS does not claim to fully address the conservation needs of focal species nor is that a requirement of the RCIS guidelines. Rather, the RCIS identifies conservation strategy elements that will facilitate non-focal species based on their common ecological requirements with focal species, natural communities, and other conservation elements.
Andrew Johnson	7.10	SCCRCIS should include mechanisms to guide future updates	Section 6.4 outlines how the RCIS can be updated to remain relevant over time.
Andrew Johnson	7.11	Consider using a SMART-based criteria to develop conservation goals and biodiversity targets	The conservation strategies in Section 5.3 use the “SMART” objectives and targets, where feasible.
Andrew Johnson	7.12	A map overlay of the various infrastructure projects would further illuminate areas of potential conflict and inform the generation of conservation actions	Comprehensive spatial data were not available to map all of the infrastructure projects in the area. The RCIS team utilized available spatial data as well as non-spatial information sources when developing conservation actions to limit conflicts with development.
Andrew Johnson	7.13	The SCCRTC and the SCCRCD should consider targets in line with the Global Deal for Nature, which advocates for maintaining and restoring at least 50% of the Earth’s land area as intact natural ecosystems by 2050 (Dinerstein et al. 2019). The SCCRCIS would benefit from a vision that sets	The RCIS habitat protection targets outlined in Section 5.2 meet or exceed the 50% target recommend.

Commenter	Comment #	Comment Summary	Actions/Responses
		ambitious conservation targets beyond 2030 in its gap analysis and planning	
Andrew Johnson	7.3	Additional species should be elevated to focal species by prioritizing keystone, umbrella, indicator, and flagship species	As noted in response to comment 6-7, the conservation strategies for the 13 natural communities and three other conservation elements provide the coverage that could be achieved by including the additional types of focal species listed.
Andrew Johnson	7.4	Focal species list should include species that inhabit nearshore waters and enter harbor and estuary zones; the southern sea otter should be included as a focal species	The RCIS conservation elements for Bar-Built Estuaries and Riparian and Riverine communities address habitat conditions and water quality in these communities, which will also promote habitat conditions nearshore environment inhabited by sea otter.
Andrew Johnson	7.5	Focal species list should include species that inhabit areas not represented by animals on the focal species list; the eelgrass should be included as a focal species	As noted above, the SCCRCIS will address estuaries as well as water quality in ways that will benefit the nearshore environment.
Andrew Johnson	7.6	Central California Coast steelhead would serve as a better flagship for resource protection services	The response to comment 4.1 also addresses this comment.
Andrew Johnson	7.8	A broad consortium of stakeholders should be enlisted to ensure that the assemblage of support documents current and relevant	The SCCRCIS stakeholder group included representatives from conservation agencies and organizations as well as those involved in regional land use and transportation. In addition, the SCCRCIS has engaged numerous technical advisors to assist with development and review of the RCIS.

D.3.2.1 Written Comments

1. From: Wildlife RCIS <RCIS@wildlife.ca.gov>

Sent: Thursday, January 7, 2021 3:31 PM
To: Jim Robins <jrobins@alnus-eco.com>; Oey, Monica@Wildlife <Monica.Oey@wildlife.ca.gov>
Cc: Jodi M. McGraw <jodi@jodimcgrawconsulting.com>; Kelli Camara <kcamara@rcdsantacruz.org>; Lisa Lurie <llurie@rcdsantacruz.org>; Grace Blakeslee <gblakeslee@sccrtc.org>; Fernanda Pini <fpini@sccrtc.org>
Subject: RE: CDFW Comments on Santa Cruz RCIS Setting

Hi Jim,

I skimmed through mainly looking for high-level issues with RCIS requirements that could be time-consuming to fix. After a more thorough review I may have additional comments, but they should be relatively minor. Of course, region may also have additional comments. My current comments are as follows:

- 1.1 Section 2.2.1.3.1 – The first sentence says "The RTC worked with local jurisdictions to identify major planned…" If Caltrans was not consulted about planned projects, you may want to in order to avoid having them make these types of comments during the public comment period.
- 1.2 Section 2.2.2., page 12 – GIN 2020 reference – My understanding is that GIN updates may be delayed. How does the info in GIN compare to CPAD, CCED, and NCED (see Guidelines Section 4.2.9.7)? You may also want to verify with local conservation land stewards that their lands are included in the RCIS info. This was an issue with the East Bay RCIS that drew a lot of attention during the public comment period.
- 1.3 Section 2.3.1 and 2.3.2 – Please note that Guidelines Section 4.2.4.2 requires a consistency comparison and, if applicable, and inconsistency explanation for recovery plans and small, non-regional HCPs. These consistency comparisons do not need to be extensive, but they are required. The Guidelines also identify additional requirements for regional HCPs.

- 1.4 Section 2.4.4 – The figure 2-7 reference in the first paragraph – Was there meant to be another figure? Figure 2-7 does not appear to represent the 18 principal watersheds indicated for this reference.
- 1.5 Please be aware that fixing many accessibility (ADA/508) compliance issues after the document is completed may be more difficult than using accessible formatting from the beginning. I didn't do an accessibility check on this document, but just skimming it appears that the tables would not pass CDFW's accessibility compliance review since there are multiple heading rows and merged or blank fields. So far, most issues with RCIS accessibility compliance have been with tables. The second biggest issues has been with appropriate and correctly ordered tags. Please be aware that the document will need to pass CDFW accessibility compliance review before we will be able to post it for public review.

Hope these comments help.

Ami Olson
RCIS Program Coordinator
California Department of Fish and Wildlife
Office: (916) 376-8668
Cell: (916) 531-4570 (current telework number)

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2. **From:** Oey, Monica@Wildlife <Monica.Oey@wildlife.ca.gov>
Sent: Monday, January 11, 2021 9:51 AM
To: Wildlife RCIS <RCIS@wildlife.ca.gov>; Jim Robins <jrobins@alnus-eco.com>
Cc: Jodi M. McGraw <jodi@jodimcgrawconsulting.com>; Kelli Camara <kcamara@rcdsantacruz.org>; Lisa Lurie <llurie@rcdsantacruz.org>; Grace Blakeslee <gblakeslee@sccrtc.org>; Fernanda Pini <fpini@sccrtc.org>
Subject: RE: CDFW Comments on Santa Cruz RCIS Setting

2.1 Hi All,

In addition to Ami's comments, please update the federal status of the monarch butterfly (PDF page 65 and 66). Otherwise the document looks good to me.

Thank you,
Monica Oey
Environmental Scientist
California Department of Fish and Wildlife – Bay Delta Region
2825 Cordelia Road, Suite 100, Fairfield, CA 94534
Phone: (707) 428-2088 | Email: monica.oey@wildlife.ca.gov

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3. From: Sandra Baron

Sent: Saturday, January 30, 2021 10:22 AM
To: rcis_santacruzcounty@sccrtc.org
Subject: Input on Setting and Conservation Elements

3.1

- The report says that The SCMSN is developing a fine-scale vegetation map for the Santa Cruz Mountains, this is also needed for the south county (Fig. 2-8).
- 3.2 Total acreage of habitat types (Table 2-7 Natural Communities and other land cover) is not a good measure for fragmented habitat types like oak forests and maritime chaparral. It may look like there's plenty, when in reality it is more threatened and the largest patches should be a high priority for protection.

3.3

- Dusky-footed woodrat habitats include oak forests (Table 2-15).

- 3.4 As I mentioned in a prior email, the East Austin Creek Conservation Bank covers a large part of our county, but only a part of it isn't also covered by a local conservation bank. This means a slice of the county near Aptos (and inland) needs more conservation credits than other areas. This should be corrected (Fig. 2-5).

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4. **From:** Mary Olswang
Sent: Friday, February 12, 2021 3:35 PM

To: rcis_santacruzcounty@sccrtc.org
Subject: Comments from Sean Cochran, CDFW – Station 1: Environmental Setting

- 4.1 4.2 I like the ecosystems and landscape based conservation approach. I am concerned that not having CCC and SCCC steelhead as a focal species will funnel bulk of stream restoration work to subset of the county's watersheds, mainly in the north, while watersheds in the south, and in particular the Pajaro/Corralitos where there are no Coho Salmon will get overlooked as far as restoration and mitigation projects.
- Should consider adding Monterey Hitch and Sacramento Blackfish to co-benefit species.

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5. **From:** Jennifer Moonjian
Sent: Thursday, February 18, 2021 9:05 PM
To: rcis_santacruzcounty@sccrtc.org
Subject: Station 2: Conservation Elements

- 5.1 There is only one mammal on the non-focal species (ring-tail) and in my opinion is rarely mitigated for. Transportation agencies have to mitigate for bat species regularly particularly if there are bridges or large culverts involved in the project. I would recommend including at least one crevice-roosting bat species (I recommend pallid bat) to your non-focal list.

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6. **From:** Tiffany Yap <TYap@biologicaldiversity.org>
Sent: Thursday, February 18, 2021 10:54 PM
To: Regional Transportation Commission <rcis_santacruzcounty@sccrtc.org>
Subject: Santa Cruz County Regional Conservation Investment Strategy draft environmental setting, conservation elements, and priorities for conservation strategies – comments

Re: Comments on the Santa Cruz County Regional Conservation Investment Strategy draft environmental setting, conservation elements, and priorities for conservation strategies

To whom it may concern,

These comments are submitted on behalf of the Center for Biological Diversity (the "Center") regarding the Santa Cruz County Regional Conservation Investment Strategy

Draft Environmental Setting and Conservation Elements (the "RCIS"). The Center appreciates the work of the Santa Cruz County Regional Transportation Agency (SCCRTC) in developing the RCIS. We believe the RCIS process provides an opportunity to help craft a vision for long-term regional conservation, and we are supportive of that process moving forward in Santa Cruz County. However, as detailed below in these comments, we have concerns about how effective the RCIS will be in promoting biodiversity and habitat conservation without (1) including more focal species that encompass a wider range of life histories and habitat needs, or (2) considering appropriate historical fire regimes and drivers of habitat degradation.

The Center for Biological Diversity ("Center") is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center has over 1.7 million members and online activists throughout California and the United States. The Center and its members have worked for many years to protect imperiled plants and wildlife, open space, air and water quality, and overall quality of life for people in Santa Cruz County and the greater San Francisco Bay Area.

I. ***The RCIS should accurately describe the fire ecology and historical fire regimes of diverse habitats.***

6.1 & 6.2

California's landscapes have complex wildfire histories and fire ecologies. Wildfire is a natural and necessary ecological process in many of California's native ecosystems. Fires have occurred in these landscapes for thousands of years. Prior to the arrival of humans, large wildfires caused by lightning strikes likely occurred infrequently on the landscape (Sugihara et al. 2018). However, when humans arrived about 12,000 years ago, indigenous burning and lightning strikes drove fire regimes that varied by habitat, frequency, size, extent, and seasonality (Kimmerer and Lake 2001; Anderson 2018). It is speculated that this combination of fire management by indigenous communities and lightning fires may have led to higher levels of biodiversity (Anderson 2018). But contemporary wildfires have been more damaging and destructive to human communities and some ecosystems. In the 200 years since European colonization, indigenous communities and cultures have been erased and the shift in land stewardship and land use has resulted in the dramatic alteration of the varied fire regimes the state's habitats have evolved with. The RCIS should be revised to provide a more historically and ecologically accurate depiction of fire and the effects of fire on the landscapes within the planning area. The document should also clearly state that the

RCIS planning area encompasses unceded territories of the Ramaytush, Muwekma, Tamyen, Ohlone, Awaswas, and Amah Mutsun indigenous communities.

The influence of cultural burns varied spatially depending on where Native Americans lived and frequented. Indigenous burning was regularly and intensively applied in many habitats at low- and mid-elevation, including in coastal redwoods, coastal prairies, and open woodlands and forests (Anderson and Carpenter 1991; Stephens and Fry 2005; Swetnam et al. 2009; Lightfoot et al. 2013; Crawford et al. 2015; Long et al. 2015; Cuthrell et al. 2016; Anderson 2018). Explorers, missionaries, and colonizers have documented "smoky air" throughout the state, including in coastal redwoods, tule marshes, oak woodlands, mixed-conifer forests, chaparral, and northern hazelnut flats since 1542 (Anderson 2018). The Central Coast had relatively low lightning-ignited fires, and many of the habitats' fire regimes were driven by cultural burning (Cuthrell 2013; Lightfoot et al. 2013; Cuthrell et al. 2016).

6.3

In Table 2-8, riparian woodlands and wetlands are categorized as "fire sensitive," which is defined as "[d]ominated by plant species that are killed by, and do not regenerate well following, fire, which is not an important component of the natural disturbance regime" (RCIS at 40-43). This categorization is inaccurate and needs to be corrected. Evidence suggests that riparian areas and wetlands are fire-adapted and burned relatively frequently prior to European colonization (Dwire and Kauffman 2003; Kobziar and McBride 2006; Stephens et al. 2007; John Muir Project 2017; Anderson 2018). This should be accurately reflected in the RCIS.

II. The RCIS should place greater emphasis on habitat connectivity as a conservation element.

6.4

The Center is encouraged to see that habitat connectivity is one of the conservation elements in the RCIS. In addition to using the Santa Cruz Mountains Bioregion habitat Connectivity Study (Merenlender and Feirer 2011) and the Bay Area Critical Linkages Study (Penrod et al. 2013) to inform conservation action, the RCIS should also include a study conducted by US Geological Survey biologists, Research to inform Caltrans Best Management Practices for reptile and amphibian road crossings (Brehme and Fisher 2020). This study identifies state highways in areas where vulnerable reptiles and amphibians have high and very-high risk of negative road impacts. In addition, the UC Davis Road Ecology Center has a California Roadkill Observation System (CROS) that can

be used to identify roadkill hotspots where connectivity needs to be improved, and the RCIS should incorporate this tool as well.

6.5 Identifying roads and development that are existing barriers to wildlife movement and habitat connectivity is critical for the preservation of biodiversity and ecosystem health. These impediments to wildlife passage can be made more permeable by protecting habitat on both sides of the road and implementing wildlife crossings (*e.g.*, wildlife bridges, elevated road segments, upgraded culverts) and wildlife crossing infrastructure (*e.g.*, directional fencing, light and sound berms). The RCIS should conserve existing natural linkages while enhancing regional connectivity for the wide variety of species that occur throughout the county.

6.6 In addition, it is crucial to include corridor redundancy (*i.e.,*the availability of alternative/redundant pathways for wildlife movement) in regional connectivity plans because it allows for improved functional connectivity and resilience. Compared to a single pathway, multiple connections between habitat patches that account for the different movement needs of multiple species increase the probability of movement across landscapes by a wider variety of species, and they provide more habitat for low-mobility species while still allowing for their dispersal (Mcrae et al. 2012, Olson and Burnett 2008, Pinto and Keitt 2008). Corridor redundancy also enhances species' resilience in the face of uncertainty, the effects of climate change, and extreme events like flooding or wildfires, by providing alternate escape routes or refugia for animals seeking safety (Cushman et al. 2013, Mcrae et al. 2008, Mcrae et al. 2012, Olson and Burnett 2008, Pinto and Keitt 2008). The RCIS should account for the value of corridor redundancy and functional connectivity to facilitate wildlife movement throughout the RCIS area.

III. The RCIS's list of focal species should be more expansive and include other vulnerable species that occur or may occur in the planning area

6.7 6.8 The Center is encouraged to see species like the mountain lion, Santa Cruz long-toed salamander, and Mt. Hermon June beetle included as focal species in the RCIS. However, having just one representative each for plants, insects, fishes, amphibians, reptiles, birds, and mammals is grossly insufficient to cover the vast biodiversity of species in the county. There are high levels of diversity within taxonomic

groups in terms of individual species' life history, habitat requirements, and behaviors. The extremely limited focal species of the RCIS do not sufficiently encompass the conservation needs of the numerous special-status species that occur or have the potential to occur in the RCIS area. The RCIS also fails to justify how the particular focal species that it has chosen will result in the best overall conservation outcomes.

6.9

The RCIS should include as focal species most, if not all, of the non-focal species it passed over. For example, conservation actions relating to the southwestern pond turtle and Santa Cruz long-toed salamander may not be adequate for, or even address the needs of, other herpetofauna that occur or potentially occur in the RCIS planning area. Western pond turtles are known to migrate over 3,280 feet (1 km) between aquatic and upland habitats (Holland 1994, Zaragoza et al. 2015), while long-toed salamanders have been found to migrate up to 1969 ft (0.6km) (Lannoo 2005). Meanwhile, California red-legged frogs have been found to roam over 4,500 feet (1.4 km) from the water (Fellers and Kleeman 2007) and California tiger salamanders have been reported to migrate up to 1.3 miles (2.1 km) and are capable of migrating up to 1.5 miles (2.4 km) (USFWS 2017a). Even if all habitat and life history requirements were equal among these species (which they are not), conservation actions that accommodate focal species (i.e., southwestern pond turtle and Santa Cruz long-toed salamander) that migrate shorter distances would not meet the conservation needs of non-focal special-status species (i.e., California red-legged frog and California tiger salamander) that migrate longer distances. Accommodating the more long-range dispersers is vital for continued survival of species populations, recolonization following a local extinction, and adaptation to climate change (Semlitsch and Bodie 2003, Heller and Zavaleta 2009, Warren et al. 2011, Cushman et al. 2013). Similarly, conservation actions focused on the needs of marbled murrelets as a focal species will not address the needs of, for example, western snowy plovers. Although both are marine birds, marbled murrelets nest in coastal coniferous forests while snowy plovers nest on sandy beaches. The list of focal species should be expanded significantly and the RCIS should justify with evidence the reasons the selected focal species can be expected to result in conservation actions that are adequately protective of other, non-focal species.

6.10

American badgers, which are a species of special concern, should also be included in the RCIS as a focal species. Their burrows are often used by other species, including California red-legged frogs and California tiger salamanders. Open space and habitat connectivity are critical for their long-term survival.

Species that do not have special status but are important as ecosystem engineers should also be included as focal species. For example, California ground squirrels create burrows that several special-status species, including California tiger salamanders,

burrowing owls, and Santa Cruz long-toed salamanders, rely on. Prioritizing habitats occupied by California ground squirrels could help provide habitat for other special-status species. In addition, California newts are sensitive species that have been found to migrate up to two miles between breeding ponds and upland habitats (Trenham 1998). Although they do not have special status in Santa Cruz County, they are a species of special concern in nearby Monterey County and are exceptionally vulnerable to impacts of roads and climate change (Brehme et al. 2018, Bucciarelli et al. 2020). California newts are often the first to disappear in fragmented landscapes (Brehme and Fisher 2020); therefore, they should be included as a focal species in the RCIS to protect biodiversity and overall ecosystem function.

IV. Timberlands within the RCIS planning area should not be a conservation strategy within the Working Lands Conservation Element.

In 1997, California's old-growth coastal redwood forests had been reduced by 85-96%, with much of the remnant stands on private land (USFWS 2019d). California's remaining remnant patches of coastal old-growth redwoods are of great significance in terms of their importance to California's plant and wildlife communities, including, but not limited to, rare and endangered species. For example, the endangered marbled murrelet requires old-growth forests close to the coast, like coastal redwoods, for nesting. Loss of nesting habitat is a major cause of the species' decline; therefore, protection of known and potential nesting habitat is essential for their recovery (USFWS 2019d).

6.11

Logging remaining redwood forests is not a conservation strategy or conservation goal, and should not be identified as such in the RCIS. Although the RCIS claims that logging redwoods can promote biodiversity, conservation, and forest health, it supplies insufficient evidence to support these claims. In fact, logging in redwood forests has been found to cause extensive environmental damage that harms wildlife *(e.g.,* Bury 1983, Mazurek and Zielinski 2004). The RCIS's claims that logging redwood forests increases "the resiliency of the entire forest to drought, fire, pests, pathogens, or other indirect effects of climate change, while limiting the impacts of the treatments on natural resources" (RCIS at 58) are unsubstantiated and significantly undermine the RCIS's effectiveness and credibility as a conservation strategy document.

6.12

As mentioned previously, coast redwood stands in the Santa Cruz Mountains have been found to have burned frequently, with most fires being ignited by Native Americans for various resource purposes (Stephens and Fry 2005, Stephens et al. 2007). Native Americans had over 70 documented uses of fire, including enhancing productivity of plants used for food, medicines, and building materials; increasing water

resources; maintaining travel corridors; combatting insects and diseases; managing game and wildlife; and reducing the chances of severe fire (Kimmerer and Lake 2001; Anderson 2018). The RCIS's apparent assumption that logging (as a replacement for cultural burning) can "reduce fuel loads and promote forest health…given the widespread practice of fire exclusion" (RCIS at 58) is grossly inaccurate. Logging often degrades ecosystems by creating hotter, drier conditions and/or promoting the spread of highly flammable invasive grasses; the most heavily logged areas in forests of the western U.S. experience the most intense fires (Bradley et al. 2016). Logging and fire suppression in the past 200 years since European colonization have altered the fire regime of coast redwood forests and degraded these ecosystems. Continued logging of redwoods will not promote conservation of these habitats or the species that rely on them.

V. Conclusion

Thank you for the opportunity to submit comments on the Santa Cruz County RCIS Draft Environmental Setting and Conservation Elements. The Center urges the SCCRTC to strengthen the RCIS to promote biodiversity and habitat conservation that considers appropriate historical fire regimes, wildlife connectivity, diverse species' life histories and conservation needs, and climate change. Please add the Center to the notice list for this project. Please do not hesitate to contact the Center with any questions at the number or email listed below.

Sincerely,

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CBD Comments References - Santa Cruz County RCIS Environmental Setting and Conservation Elements

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7. **From:** Andrew Johnson <ajohnson@defenders.org>
Sent: Friday, February 19, 2021 8:53 PM
To: rcis_santacruzcounty@sccrtc.org
Cc: gblakeslee@sccrtc.org
Subject: SCCRCIS Draft Environmental Setting and Conservation Elements

RE: Santa Cruz County Regional Conservation Investment Strategy Draft Environmental Setting and Conservation Elements

To Involved Planning Entities:

Defenders of Wildlife (Defenders) thanks the Santa Cruz County Regional Transportation Commission (SCCRTC) and the Resource Conservation District of Santa Cruz County (SCCRCD) for initiating the Santa Cruz County Regional Conservation Investment Strategy (SCCRCIS) process. We appreciate the opportunity to comment on the draft Environmental Setting and Conservation Elements document. The draft document is well-researched and thorough. We fully support the RCIS process as a means to protect natural resources, maintain or enhance habitat connectivity and contribute to the climate resiliency of Santa Cruz County's transportation infrastructure. We ask the SCCRTC and the SCCRCD to consider and integrate our comments into subsequent phases of the SCCRCIS planning effort.

Defenders is a national, non-profit conservation organization dedicated to protecting all wild animals and plants in their natural communities. To this end, we employ science, public education and participation, media, legislative advocacy, litigation and proactive on-the-ground solutions to impede accelerating rates of extinction, the associated loss of biological diversity, and habitat loss. We offer the following comments on behalf of our 1.8 million members and supporters in the United States, approximately 279,000 of whom reside in California.

Focal Species, Non-focal Species, Co-benefited Species and Other Conservation Elements

Section 4.2.5 of the California Department of Fish and Wildlife (CDFW) Regional Conservation Investment Strategies Program Guidelines (RCIS Guidelines), headed "Focal Species and Other Species Information and Analysis," states:

> "The final focal species list and list of other conservation elements shall be representative of all major and unique natural communities and ecosystem functions that characterize the conservation needs in the RCIS area such that the RCIS results in a comprehensive, cohesive, and connected regional conservation

outcome with enhanced adaptation to pressures and stressors."[9]

7.1

7.3 7.2 Given that, the list of focal species in the draft Conservation Elements section is deficient and lacks representation of imperiled and vulnerable species and communities, especially when compared to other completed or near-completed RCISs. For example, the Monterey County RCIS whittled its list of candidates to 28 focal species; the Santa Clara County RCIS includes 18 focal species. By generating a list of just seven focal species, the SCCRCIS process has limited its ability to set comprehensive conservation priorities and goals. Defenders believes that relying on seven focal species to represent the diversity, distribution and conservation needs of other conservation elements within the RCIS area will not meet the objectives of the SCCRCIS. As Fort (2020) states, "It is crucial to note that the focal species that are the best indicators may well be common species that have not been identified as a priority by ranking schemes or in decline by monitoring programs."[10] Because an RCIS is nonbinding by definition, the document must include a more expansive list of focal species to ensure "identification of conservation priorities, investments in ecological resource conservation, or identification of priority locations for compensatory mitigation for impacts on species and natural resources" (CDFW 2018).[11]

Section 4.2.5.1.d of the RCIS Guidelines refers to the selection of taxonomic group representatives as focal species:

> "One or more focal species should represent each of the following major taxonomic groups: plants, invertebrates, fish, amphibians, reptiles, birds and mammals."[12]

7.1 revisited The draft Environmental Setting and Conservation Elements document takes

[9] California Department of Fish and Wildlife. 2018. Regional Conservation Investment Strategies Program Guidelines. September 14. Sacramento, CA, p.4-9. Accessed at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=161193&inline on February 16, 2021.

[10] Fort, H. 2020. Making quantitative predictions on the yield of a species immersed in a multispecies community: The focal species method. *Ecological Modeling, 430,* 109108. https://doi.org/10.1016/j.ecolmodel.2020.109108.

[11] California Department of Fish and Wildlife. 2018. Regional Conservation Investment Strategies Program Guidelines. September 14. Sacramento, CA, p. 2-10. Accessed at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=161193&inline on February 16, 2021.

[12] CDFW, 2018 RCIS Guidelines, p. 4-11.

this guidance to the extreme by selecting single (and not more) representatives from each taxonomic group. Because of this, the list of focal species does not fully represent the habitats, systems, species interactions and species impacts throughout the RCIS range. The focal species list comes across as exclusive rather than representative. Defenders urges the SCCRTC and the SCCRCD to include more species that can serve as indicators of ecosystem health in Santa Cruz County.

7.4

Defenders believes that the SCCRCIS should elevate additional species to the focal species list by prioritizing keystone, umbrella, indicator and flagship species. For example, the SCCRCIS should grant greater consideration to rare keystone species, such as the critically imperiled Santa Cruz kangaroo rat (Dipodomys venustus venustus), which inhabits fragmented sandhills (i.e., silverleaf manzanita chaparral) in the SCCRCIS region. While the Mount Hermon June beetle (Polyphylla barbata) is represented in numerous habitat conservation plans and is designated as a focal species in the draft Environmental Setting and Conservation Elements document, the kangaroo rat might offer more compelling representation for protecting and restoring sandhills habitat in the SCCRCIS area. Defenders supports the inclusion of multiple species of different taxonomic groups on the SCCRCIS focal species list.

7.5

The SCCRCIS list of focal species does not consider marine species that inhabit nearshore waters and enter harbor and estuary zones. Although the "Final Revised Recovery Plan for the Southern Sea Otter (Enhydra lutris nereis)" is entered in Table 2-4 as one of the Recovery Plans in the SCCRCIS Area, the SCCRCIS does not include southern sea otters on its focal, non-focal or co-benefited species lists. This keystone species inhabits nearshore ecosystems—kelp forest, rocky intertidal, estuarine—and confers a range of ecosystem services that benefit many species. Sea otters suffer downstream impacts from the mismanagement and pollution of watersheds.[13] Defenders believes that sea otters should be on the focal species list to help support conservation actions that will protect marine and coastal habitats within the SCCRCIS area.

[13] Miller, M. A., Kudela, R. M., Mekebri, A., Crane, D., Oates, S. C., Tinker, M. T., Staedler, M., Miller, W. A., Toy-Choutka, S., Dominik, C., Hardin, D., Langlois, G., Murray, M., Ward, K., & Jessup, D. A. 2010. Evidence for a Novel Marine Harmful Algal Bloom: Cyanotoxin (Microcystin) Transfer from Land to Sea Otters. PLOS One, 5(9), e12576. https://doi.org/10.1371/journal.pone.0012576.

7.6

We suggest upgrading listed species that inhabit areas not represented by animals on the focal species list, such as the western snowy plover (Charadrius alexandrinus nivosus), which is struggling to reestablish a foothold in Santa Cruz County and is highly susceptible to anthropogenic disturbance.

We believe that the SCCRTC and the SCCRCD should consider species such as eelgrass (Zoster marina), which suffer from agricultural runoff and watershed inputs to river mouths, lagoons and sloughs, for the focal species list. Eelgrass beds support a high biodiversity of species by providing food and shelter for numerous juvenile animals, and they absorb carbon from the atmosphere and stabilize sediment and shorelines. Anthropogenic activities cause immense harm to eelgrass, to the detriment of valuable nearshore systems. Defenders encourages the SCCRTC and the SCCRCD to expand its focal species list to include eelgrass.

7.7

The Central California Coast steelhead Distinct Population Segment (Oncorhynchus mykiss irideus), which has a broader distribution in Santa Cruz County than coho salmon (Oncorhynchus kisutch), should receive focal species status. As a focal species, steelhead would serve as a better flagship for resource protection objectives within the region, encourage stronger conservation actions (e.g., improving aquatic habitat connectivity and estuary restoration, removing fill and infrastructure, developing alternative methods of flood control), and guide urban planning.

7.8

7.1 revisited

The view that strategies for focal species and natural communities will fully address the conservation needs of non-focal species does not align with the RCIS Guidelines. Non-local species must be "associated with a focal species or other conservation element and will benefit from conservation actions and habitat enhancement actions set forth in the RCIS."[14] It seems unlikely that the long list of non-focal and cobenefited species will necessarily benefit from conservation actions taken on behalf of the few proposed focal species. Conservation actions for the marbled murrelet may not achieve any benefit for the range of resident and migratory avian

[14] CDFW, 2018 RCIS Guidelines, p.2-9

species within the SCCRCIS area. Conservation actions for the Santa Cruz tarplant cannot represent the conservation needs of all plants or ensure the appropriate protection of critical habitat areas and non-focal species within the RCIS area. The protection of natural communities and other conservation elements within the RCIS area will have a profound effect on the persistence of species that depend on those communities; however, Defenders suggests that the SCCRTC and the SCCRCD should revise and reapply their criteria for prioritizing species to increase the number of plants and animals on the focal species list.

Environmental Setting

7.9

We note that the Environmental Setting section relies, to a degree, on studies of habitat connectivity and climate change vulnerability conducted more than a decade ago (e.g., Griggs and Haddad 2011; Mackenzie et al. 2011; Merenlender and Feirer 2011; Penrod et al. 2013). Similarly, many habitat conservation plans, natural community conservation plans, recovery plans, area protection plans, enhancement plans and other documents aimed at conserving species and habitat are out of date or will fall out of date over time. The California Ocean Protection Council[15] and other groups generate and update planning and guidance documents that address climate change, sea-level rise and other challenges that will affect habitat and species throughout California. The groups working on the SCCRCIS should enlist a broad consortium of stakeholders to keep the assemblage of support documents current and relevant.

The RCIS Guidelines describe an RCIS *proponent* as:

> "The public agency or group of public agencies developing an…RCIS for review and approval by CDFW and who is responsible for the technical and administrative updates of an…RCIS."[16]

7.10

Defenders encourages the SCCRTC and the SCCRCD to build mechanisms within the final SCCRCIS that will guide proponents in updating the regional strategy over time. As agencies revise conservation documents and establish mitigation measures and credit

[15] State of California Natural Resources Agency, Ocean Protection Council. 2018. State of California Sea-Level Rise Guidance. Accessed at https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidancerd3.pdf on February 16, 2021.

[16] CDFW, 2018, RCIS Guidelines, p.2-10.

agreements, the guidance value of the SCCRCIS must remain intact.

Section 1.2 of the RCIS Guidelines states:

> "[T]he conservation document informs and facilitates ecosystem conservation outcomes that are ecologically integrated and sustainable, with sufficiently large and connected conservation areas and redundancies in the types of habitats conserved to help ensure that species populations and natural communities are protected against the unanticipated damages and losses to any single location."[17]

7.11

To achieve these kinds of outcomes, Defenders advocate using a SMART-based framework in developing conservation goals and biodiversity targets. SMART criteria (i.e., Specific, Measurable, Achievable, Realistic and Time-bound) can help create integrated biodiversity-conservation strategies like an RCIS. Green et al. (2019) offer additional criteria—Comprehensive, Unambiguous and Scalable—that can further refine the development of conservation actions and adaptive management strategies.[18]

7.12

We appreciate the inclusion of the Infrastructure Plans and Projects List in Appendix F of the draft Environmental Setting and Conservation Elements document. This list of Measure D-funded projects, anticipated transportation projects, water and energy infrastructure projects and projects to develop and redevelop residential, commercial and mixed-used properties in unincorporated Santa Cruz County helps indicate the scope and scale of potential conflicts between conservation elements and development in Santa Cruz County. As the SCCRCIS process progresses, the SCCRTC, the SCCRCD, and the SCCRCIS stakeholder committees and groups will develop conservation actions to protect species and habitat in the face of intensive development. We suggest that overlaying a map of the various infrastructure projects would further illuminate areas of potential conflict and inform the generation of conservation actions.

[17] CDFW, 2018, RCIS Guidelines, p.1-3.

[18] Green, E. J., Buchanan, G. M., Butchart, S. H. M., Chandler, G. M., Burgess, N. D., Hill, S. L. L., & Gregory, R. D. 2019. Relating characteristics of global biodiversity targets to reported progress. Conservation Biology, 33(6), 1360–1369. https://doi.org/10.1111/cobi.13322

7.13 We appreciate that the draft Environmental Setting and Conservation Elements document incorporates Governor Newsom's executive order N-82-20, which directs the State to combat the biodiversity and climate crises by conserving at least 30 percent of California's land and coastal waters by 2030. However, the SCCRTC and the SCCRCD should not accept that the SCCRCIS area is "outpacing the state-wide goal" with respect to its protected lands. Instead, the SCCRCIS should target loftier objectives that will reflect impending and long-range climate change impacts (e.g., sea-level rise), climate adaptation priorities and species conservation objectives
. In particular, the document should anticipate habitat resiliency and connectivity needs in the face of intensive development activities over longer time scales. The 2040 Santa Cruz County Regional Transportation Plan and the draft 2045 Regional Transportation Plan project list require an RCIS that can help overcome the pressures that anticipated development will impose over decades.

To that end, the SCCRTC and the SCCRCD should consider targets in line with the Global Deal for Nature, which advocates for maintaining and restoring at least 50% of the Earth's land area as intact natural ecosystems by 2050 (Dinerstein et al. 2019).[19] The SCCRCIS would benefit from a vision that sets ambitious conservation targets beyond 2030 in its gap analysis and planning. The SCCRCIS Steering Committee, Stakeholder Group and Technical Advisory Groups have the latitude to project the influence of the SCCRCIS far into the future and give planners and agency managers the guidance they need to protect the natural resources of Santa Cruz County for generations.

Defenders looks forward to working with the Santa Cruz County Regional Transportation Commission and the Resource Conservation District of Santa Cruz County as the SCCRCIS process continues. Again, thank you for your work in developing a collaborative conservation investment plan for Santa Cruz County and for your consideration of these comments.

Respectfully,

Andrew B. Johnson, California Representative
Defenders of Wildlife
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Appendix E Infrastructure Plans and Projects

This section provides additional information about the infrastructure plans and capital improvement programs and the local agencies that developed them. It was created to provide context for the RCIS assessment of Infrastructure Plan (Section 2.2.4).

E.1 Transportation Plans and Programs

Transportation projects account for a significant number of the anticipated infrastructure projects in Santa Cruz County. Transportation projects are sponsored by local jurisdictions (City of Capitola, City of Santa Cruz, City of Scotts Valley, City of Watsonville, and County of Santa Cruz), California Department of Transportation (Caltrans), Santa Cruz Metropolitan Transit District, and the Santa Cruz County Regional Transportation Commission.

E.1.1 Regional Transportation Plan and Metropolitan Transportation Plan

The RCIS considers foreseeable transportation projects through 2040 based on the 2040 Santa Cruz County Regional Transportation Plan (RTC 2018) and Capital Improvement Programs. The 2040 Santa Cruz County Regional Transportation Plan (2040 RTP) is a state-mandated plan that identifies transportation needs and a financially constrained priority list of projects in Santa Cruz County over the next twenty-plus years. Projects identified in the 2040 RTP include maintenance of and improvements to local roadways, highways, bicycle and pedestrian facilities, transit service, rail, specialized transportation for seniors and people with disabilities, and transportation demand management programs (RTC 2018). Individual projects listed in the RTP must still undergo separate design and environmental processes, and can only be implemented as local, state, and federal funds become available.

While the 2040 RTP and 2040 MTP/SCS provide a roadmap for accommodating projected household and employment growth in Santa Cruz County, as well as a transportation investment strategy, the MTP/SCS 2040 provides no regional authority over cities and counties to decide how and where land is developed or preserved; instead, local governments are encouraged to utilize MTP/SCS as a tool to inform land use and development decisions in the Monterey Bay Area, including Santa Cruz County.

E.1.2 Measure D

In 2016, Santa Cruz votes approved Measure D, a sales tax increase to fund transportation projects. Measure D is a comprehensive and inclusive package of transportation improvements. This ½-cent sales tax guarantees every city and the county within Santa Cruz County a steady, direct source of local funding for local streets and road maintenance, bicycle and pedestrian projects (especially near schools), safety projects, transit and paratransit service, and numerous essential transportation projects and programs throughout the county as outlined in the Expenditure Plan and Strategic Implementation Plan for Measure D. The Strategic Implementation Plan serves as the guiding policy and programming document for the

implementation of regional Measure D projects. A list of major infrastructure projects funded by Measure D are listed below. Table E-1 lists all transportation projects that are anticipated to have off-pavement disturbance (Figure 2-3).

- **Monterey Bay Sanctuary Scenic Trail Network (Coastal Rail Trail):** The Monterey Bay Sanctuary Scenic Trail Network (MBSST) is an RTC-proposed, 50-mile bicycle and pedestrian trail project. The spine of the trail network will be the 32-mile Coastal Rail Trail from Davenport to Watsonville, to be built within or adjacent to the RTC-owned Santa Cruz Branch Rail Line right-of-way.
- **Highway 1 41st Avenue to Soquel Drive/Avenue Auxiliary Lane, Bus-on-Shoulder, and Chanticleer Bike/Ped Overcrossing Project:** This project extends approximately 1.4 miles along Highway 1 between 41st Avenue in Capitola and Soquel Drive in Live Oak, proposes to add northbound and southbound auxiliary lanes and bus-on-shoulder improvements between the two interchanges and to construct a new bicycle and pedestrian overcrossing at Chanticleer Avenue.
- **Highway 1 Bay Avenue/Porter Street to State Park Drive Auxiliary Lane, Bus-on-Shoulder, and Mar Vista Bike/Ped Overcrossing Project**: This project will construct northbound and southbound auxiliary lanes and bus-on-shoulder improvements between the Bay Avenue/Porter Street and State Park Drive interchanges and replace the existing Capitola Avenue local roadway overcrossing. This project also includes a new bicycle and pedestrian overcrossing at Mar Vista Drive.
- **Highway 1 State Park Drive to Freedom Boulevard Auxiliary Lane, Bus-on-Shoulder, and Coastal Rail Trail Segment 12 Project**: This project will construct northbound and southbound auxiliary lanes and bus-on-shoulder improvements between State Park Drive–and Freedom Boulevard interchanges, replace two existing railroad bridges between the State Park Drive and Rio del Mar interchanges, and widen the Highway 1 bridge over Aptos Creek and Spreckels Drive.
- **Santa Cruz Branch Rail Line Maintenance and Repairs**: The RTC acquired the Santa Cruz Branch Line (SCBRL) in 2012 to expand transportation options and alternatives to driving, and plan for the future mobility needs of Santa Cruz County residents and visitors. The 135-year-old rail corridor spans 32-miles from Davenport to Watsonville and connects to regional and state rail lines. Inspections and repairs to the 30 railroad bridges, as well as repairs and upgrades to railroad signals, grade crossings, and the railbed are planned to meet the Federal Railroad Administration (FRA) Requirements for a short-line railroad.

Santa Cruz Metropolitan Transit District (METRO)

The METRO operates in Santa Cruz County with connections to transit in neighboring counties, providing both fixed route local and express bus service, and paratransit as mandated by the

Americans with Disabilities Act. In FY19/20, fixed-route public transit operations required a maximum fleet of 76 buses serving 26 routes throughout Santa Cruz County, including the Highway 17 Express AMTRAK feeder service between Santa Cruz and San Jose (Diridon Station). ParaCruz, METRO's complementary paratransit service, operates 32 accessible vans in demand-response service for persons who, due to disability, cannot access the fixed-route system. METRO has the following major infrastructure improvements planned.

- Bus and Paratransit Vehicle Replacements;
- Pacific Station Redesign; and,
- Paratransit Operations Center.

California Department of Transportation (Caltrans)

Santa Cruz County is in Caltrans District 5, which is headquartered in San Luis Obispo and covers five counties. Caltrans is the state agency responsible for highway, bridge, and rail transportation planning, construction, and maintenance including Highway 17, Highway 9, Highway 236, Highway 1, Highway 152, and Highway 129 in Santa Cruz County. Together, these highways makeup 123 centerline miles. Caltrans receives funding through the State Highway Operating Program (SHOPP) for maintenance and operations and the State Transportation Improvement Program (STIP) for operational and capacity improvements. As the owner and operator of the state highway system in Santa Cruz County, Caltrans is working closely with RTC to construct Measure D-funded improvements to Highway 1 and Highway 9.

Table E-1: Anticipated transportation projects with off-pavement disturbance in the RCIS Area

Project Name	Project ID	Project Description
RTC		
MBSST Construction	RTC 27a	Design, environmental clearance, and construction of the 32-mile rail component of the 50+ mile network of bicycle and pedestrian facilities on or near the coast, with the rail trail as the spine and additional spur trails to connect to key destinations. (Funded segments listed individually.)
Rail Maintenance	RTC P03	Operating expenses for rail line oversight.
Highway 1 Improvements	RTC 24e	Hwy 1 Auxiliary Lanes: State Park Dr- Park Ave and Park Ave-Bay/Porter
Highway 1 Improvements	RTC 24o	Hwy 1: Reconstruction of 2 Railroad Crossings in Aptos
Highway 1 Improvements	RTC 24p	Hwy 1: Auxiliary Lanes from Rio Del Mar Blvd to State Park Dr Including Bridge over Aptos Creek
Highway 1 Improvements	RTC 24q	Hwy 1: Auxiliary Lanes from Freedom Blvd to Rio Del Mar Blvd
Highway 1 Improvements	RTC 24r	Hwy 1: Northbound Auxiliary Lane from San Andreas Rd/Larkin Valley Rd to Freedom Blvd
City of Capitola		
Stockton Ave bridge rehabilitation	CAP-P07p	Replace bridge with wider facility that includes standard bike lanes and sidewalks
Capitola Village Multimodal enhancements	CAP-P04b	Multimodal enhancement in Capitola Village.
Bay Ave Traffic Calming and bike/ped enhancements	CAP-P29	Traffic calming features along Bay Avenue from Highway 1 to Monterey Avenue, including left turn pocket, buffered pedestrian facilities and bicycle treatments.

Project Name	Project ID	Project Description
Upper Pacific Cove parking lot pedestrian trail depot park metro development	CAP 17	Construct 4-foot-wide pedestrian pathway along City owned upper Cover Parking lot adjacent to the rail line. Includes new signal for ped crossing over Monterey Avenue and new Metro shelter.
Cliff Drive Improvements	CAP-P05	Installation of sidewalks, pedestrian crossing and slope stabilization of embankment including seawall.
Porter St and Highway 1 I/S Improvements	CAP-P55	Additional dedicated right turn lane on Porter Street to northbound on ramp.
City of Santa Cruz		
Hwy1/San Lorenzo River Bridge Replacement	SC 38	Replace the Highway 1 bridge over San Lorenzo River.
Murray Street Bridge Retrofit	SC 37	Seismic retrofit of existing bridge over Woods Lagoon at harbor and associated approach roadway improvements and placement of barrier rail. Includes wider bike lanes and sidewalk on ocean side and access path to harbor if feasible.
Shaffer Road Widening and Railroad Crossing	SC-P91	Construction of new crossing of the Railroad line at Shaffer Rd, and widening of the southern leg of Shaffer in conjunction with development.
Segments 8 & 9	TRL 8-9a	Rail Trail Design, Environmental and Construction along the rail corridor between Pacific Avenue and 17th Avenue.
City of Watsonville		
Pajaro Valley Connector Trail	WAT-P42	Install bicycle/pedestrian trail (this trail connects Pajaro Valley Highway School to Airport Boulevard.
Upper Watsonville Slough Trail	WAT-P43	Install bicycle/pedestrian trail.
Lee Road Trail		Install bicycle/pedestrian trail.

Project Name	Project ID	Project Description
County of Santa Cruz		
Empire Grade: City of SC to end (17.07 mi)	CO-P10	Road rehab and maintenance, left turn pocket at Felton Empire Road, add bike lanes, transit facilities, some sidewalks, landscaping. Drainage improvements, merge lanes, and intersection improvements may also be needed.
Freedom Blvd, from Bonita Dr to city limits (8.52 miles)	CO-P11	Add bike lanes, sidewalks on some segments, transit turnouts, signalization. Left turn pockets at Bowker, Day Valley, White Rd, and Corralitos Rd. Also includes merge lanes, intersection improvements, landscaping, major rehabilitation and maintenance, drainage improvements.
Graham Hill Rd, from City of SC to State Hwy 9 (5.73 miles).	CO-P12	Bike lanes, sidewalks, transit turnouts, left turn pockets, merge lanes, traffic signals. Major rehabilitation and maintenance. Drainage improvements. Signal upgrade at SR9.
La Madrona Dr, from El Rancho Dr to City of Scotts Valley (2.1mi).	CO-P14	Bike lanes, sidewalks, transit turnouts, left turn pockets at Sims Road, Highway 17, and El Rancho Road), merge lanes, and intersection improvements. Also includes major rehabilitation, drainage, and maintenance.
Sims Road from Graham Hill Rd to La Madrona Dr (.59mi)	CO-P17	Road rehab and maintenance, drainage, intersection improvements, landscaping, add bike, ped, and transit facilities.
Airport Blvd, from City of Watsonville to Green Valley Rd. (.57 mi)	CO-P02	Major rehab, addition of bike lanes, transit facilities, merge lanes, intersection improvements, sidewalks, drainage, and landscaping.
Lockwood Lane Improvements (Graham Hill Rd to SV limits)	CO-P24	Major road rehab, add bicycle lanes, sidewalks, some transit facilities, landscaping, and intersection improvements.
Mt Hermon Rd. (Lockwood Ln to Felton Empire Grade)	CO-P26q	Roadway and roadside improvements including bike lanes, sidewalks, transit turnouts, left turn pockets, merge lanes and intersection improvements.

Project Name	Project ID	Project Description
Mt View Rd (Branciforte Dr to Rodeo Gulch Rd)	CO-P27g	Roadway and roadside improvements including bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvement.
Paulsen Rd (Green Valley Rd to Casserly Rd)	CO-P27h	Roadway and roadside improvements including bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvement.
Glen Arbor Rd.(State Hwy 9 to State Hwy 9)	CO-P30f	Improvements of roadways and roadsides including addition of bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvements. Roadwork includes major rehabilitation and maintenance of the road and roadsides.
Granite Creek Rd.(Branciforte Dr to City of Scotts Valley)	CO-P30h	Improvements of roadways and roadsides including addition of bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvements. Roadwork includes major rehabilitation and maintenance of the road and roadsides.
Lompico Rd Improvements (E Zayante Rd. to end)	CO-P30k	Improvements of roadways and roadsides including addition of bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvements. Roadwork includes major rehabilitation and maintenance of the road and roadsides.
Lockhart Gulch Improvements (Scotts Valley City limits to end)	CO-P31e	Roadway and roadside improvements including bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvements.
South & North Rodeo Gulch Rd. (Hwy 1 to Mt. View/Laurel Glen Rd)	CO-P31i	Roadway and roadside improvements including bike lanes, transit turnouts, left turn pockets, merge lanes and intersection improvements.
Harkins Slough Rd. (entire length-Buena Vista Dr to State Hwy 1)	CO-P32c	Road rehabilitation and maintenance. Roadside improvements: left lane pockets, sidewalks, bike lanes and transit turnouts.

Project Name	Project ID	Project Description
Quail Hollow Rd. (entire length- East Zayante to Glen Arbor Rd)	CO-P32f	Road rehabilitation and maintenance. Roadside improvements: left lane pockets, sidewalks, bike lanes and transit turnouts.
Murphy Crossing, from Highway 129 to Monterey County line.	CO-P39	Bikeway on Murphy Crossing (Hwy 129 to Monterey Co line), major rehabilitation and maintenance of road, drainage improvements may also be needed.
San Lorenzo River Valley Trail	CO-P46	15 mile, paved multi-use path for bicyclists and pedestrians from Boulder Creek to Santa Cruz.
Quail Hollow Rd Bridge Replacement Project	CO-P82	The project will consist of completely replacing the existing two-lane structure and roadway approaches with a two-lane clear span concrete bridge and standard bridge approaches.
San Lorenzo Way Bridge Replacement Project	CO-P83	The project will consist of completely replacing the existing one lane structure and roadway approaches with a two-lane clear span bridge and standard bridge approaches.
Green Valley Rd Bridge Replacement Project	CO-P85	The project will consist of completely replacing the existing two-lane structure and roadway approaches with a two-lane clear span concrete slab bridge and standard bridge approaches.
Forest Hill Dr @ Bear Creek Bridge Replacement Project	CO-P86	The Project will consist of completely replacing existing steel girder bridge crossing Bear Creek with a new precast concrete voided slab bridge.
Rancho Rio Ave @ Newell Creek Bridge Replacement Project	CO-P87	The project will consist of completely replacing the existing one lane structure and roadway approaches with a two-lane clear span concrete slab bridge and standard bridge approaches.
Either Way Ln Bridge Replacement Project	CO-P88	The project will consist of completely replacing the existing narrow one lane structure and roadway approaches with a two-lane clear span precast voided concrete slab bridge and standard bridge approaches.

Project Name	Project ID	Project Description
Fern Dr @ San Lorenzo River Bridge Replacement Project	CO-P90	The project will consist of completely replacing the existing three span single lane structure and roadway approaches with a new two-lane clear span reinforced concrete box girder bridge and standard bridge approaches.
Larkspur Bridge @San Lorenzo River	CO-P91	The project will consist of completely replacing the existing narrow one lane structure and roadway approaches with a two-lane bridge and standard bridge approaches.
Swanton Rd Bridge Replacement	CO-P94	The project will consist of replacing existing 3 span steel girder bridge with a single span concrete box girder bridge
Lompico Rd Bridge Replacement	CO-P95	The project will consist of replacing existing steel stringer bridge with a reinforced concrete slab bridge

E.2 Water Infrastructure

Four primary water districts serve Santa Cruz County: San Lorenzo Valley Water District, the Scotts Valley Water District, the Soquel Creek Water District, and the Central Water District. Along with the water departments within the four cities, these districts manage and operate a complex and integrated water supply and flood management infrastructure network. With a significant portion of the water infrastructure approaching 40 to 50 years of age, water districts and water departments are carrying out major capital improvement projects to ensure each facility functions as intended. Some of the major capital improvement projects include the following pipeline installation and replacement, diversion rehabilitation and retrofit, pump station rehabilitation.

The County also helps manage streams to provide flood protection, including the Pajaro River to protect the Watsonville area of Santa Cruz County.

E.2.1 City of Santa Cruz Water Department

- Laguna Creek Diversion Retrofit Project
- North Coast System Majors Diversion Rehab
- Tait Diversion Rehab/Replacement
- Coast Pump Station Rehab/Replacement
- Felton Diversion and Pump Station Assessment
- North Coast System Repair and Replacement Project - Laguna/Liddell to Scaroni
- North Coast System Repair and Replacement Project – Majors
- North Coast System Repair and Replacement Project - Detail D Dimeo lane to town
- Newell Creek Pipeline Rehab/Replacement
- Coast Pump Station 20-inch Pipeline Replacement
- Water Supply Augmentation
- Recycled Water Feasibility Study
- Aquifer Store and Recovery in Purisima
- Aquifer Store and Recovery in Santa Margarita GW Basin (SMGB)
- Pipe Loop Study
- In-Lieu Water Transfers and/or Exchanges
- Graham Hill WTP Tube Settlers Replacement
- Graham Hill WTP Flocculator Rehab/Replacement

- Graham Hill WTP Concrete Tanks Project
- Graham Hill WTP Upgrades
- River Bank Filtration Study
- Source Water Data Collection and Management
- Main Replacement Model Development
- University Tank No. 4 Rehab/Replacement

E.2.2 Pajaro Valley Water Management Agency

The following are anticipated as well as prospective but not planned projects (listed in italics) of the Pajaro Valley Water Management Agency, which manages water supplies in the Pajaro Valley.

- College Lake Integrated Resources Management Project
- Recycled Water Facility Improvements Phase III (additional disinfection and 0.5-million-gallon storage tank)
- Expanded College Lake, Pinto Lake, Corralitos Creek, Watsonville Slough, and Aquifer Storage and Recovery
- Murphy Crossing with Recharge Basins
- Coastal Distribution System Expansion
- Winter Recycled Water Deep Aquifer Storage
- River Conveyance of Water for Recharge at Murphy Crossing
- San Benito County Groundwater Demineralization at Watsonville WWTP
- Seawater Desalination
- Bolsa de San Cayetano with Pajaro River Diversion

E.2.3 San Lorenzo Valley Water District

- 2020 Pipeline Project: Boulder Creek at Big Basin Highway (236), Sequoia Avenue, and Hillside Drive.
- Ben Lomond at California Drive and Quail Hollow Road Lyon Slide Repair Project
- Lompico Tanks Replacement Project
- Felton Heights Tank Replacement Project
- Redwood Park Tank Replacement Project

- Glen Arbor Bridge Pipeline Replacement Project
- Quail Hollow Well
- Quail Hollow Pipeline Replacement
- Olympia Well
- Fall Creek Fish Ladder Improvement Project
- 5-Mile Pipeline Replacement Project

E.3 Energy

Energy infrastructure in the RCIS Area is currently primarily limited to gas and electricity transmission and distribution facilities, and small-scale power plants and substations operated by Pacific Gas and Electric (PG&E). Central Coast Community Energy, a community choice energy agency that procures energy for Santa Cruz as well as Monterey and San Benito counties, distributes electricity generated outside of the RCIS Area to the region. There are no known new large-scale energy development projects planned for the RCIS Area.

As part of its *Multiple Region Operation and Maintenance Habitat Conservation Plan* (PG&E 2020), PG&E will maintain facilities within its parcels and right of way (ROW) including transmission and distribution infrastructure and maintain access routes to its infrastructure. The HCP also covers some new gas pipeline or electric line extensions, management of PG&E's fee-owned lands or lands subject to PG&E easements for the new infrastructure, and activities in offsite areas where mitigation parcels would be acquired to offset permanent and temporary impacts to species and habitat.

E.4 Development

The following lists the planned new development and redevelopment residential, commercial, and mixed-used development in unincorporated Santa Cruz County as well as the three cities based on information gathered during development of the RCIS.

New Development

- Atkinson Lane Residential Development (County of Santa Cruz)
- Aptos Village (County of Santa Cruz)
- Delaware Addition (City of Santa Cruz)
- Harbor Landing Visitor Accommodations (County of Santa Cruz)
- Fairfield Inn- West Beach Street (City of Watsonville)
- Sunshine Gardens Residential Development- Ohlone Parkway (City of Watsonville)

Redevelopment

- Mid-Peninsula Housing and Mixed-Use Project- (County of Santa Cruz)
- East Cliff Village Center (County of Santa Cruz)
- Interlight Assisted Living Facility (County of Santa Cruz)
- Dominican Hospital Surgery Center & Parking (County of Santa Cruz)
- Medical Office Building on Soquel Avenue (County of Santa Cruz)
- Riverfront Project Mixed Use Project (City of Santa Cruz)
- Library Mixed Use Project (City of Santa Cruz)
- Pacific Station South Mixed-Use Project (City of Santa Cruz)
- 190 West Cliff Mixed Use Project (City of Santa Cruz)
- 908 Ocean Street Mixed Use Project (City of Santa Cruz)
- 126 Eucalyptus Avenue Housing Project (City of Santa Cruz)
- 101 Felix Avenue Housing Project (City of Santa Cruz)
- 119 Coral Street Housing Project (City of Santa Cruz)
- City of Watsonville Downtown Specific Plan (City of Watsonville)
- Capitola Mall Redevelopment (City of Capitola)

Appendix F Species Database Compilation

This appendix outlines the resources consulted and steps taken to compile a list of special status and other rare species in the RCIS Area based on review of literature and databases, and input from the RCIS Steering Committee, Stakeholders, and Technical Advisory Groups.

1. **Compile initial list**: An initial list of special-status species and other rare species that occur currently or historically within the RCIS Area was compiled based on prior lists for Santa Cruz County including the *Conservation Blueprint* (Mackenzie et al. 2011) and the RCD's Partners in Restoration Program (County of Santa Cruz 2004).
2. **Review and Update List:** The technical team used literature and web-based research to update the list to include additional species, evaluate species ranges, update taxonomy (nomenclature) and update listing status since the prior lists were compiled. The following sources, which include those identified in the RCIS guidelines (CDFW 2018), were used:
    A. California Natural Diversity Database (CDFW 2019d): A spatial query of special plant and special animal occurrence records within a 5-mile radius of the RCIS Area as conducted. The radius was chosen to consider occurrences of low spatial accuracy, wide-ranging, or migratory species. The list indicated if a record was in the 5-mile buffer only, within 2-miles, or actually within the RCIS Area. Records outside of the RCIS Area were evaluated against other sources (e.g., the Santa Cruz County Bird List [Suddjian 2016] to verify the species occurs in the RCIS Area.
    B. State Wildlife Action Plan (CDFW 2015): The plan was used to identify the following:
        i. Species of Greatest Conservation Need (SGCN); and
        ii. Climate-vulnerable species.
    C. Special Animals List (CDFW 2019b): This list was used to obtain the following status information for animal species:
        i. Plant and animal species that are listed under the federal Endangered Species Act, or are proposed for listing or are a candidate for listing as endangered or threatened
        ii. Plant or animal species that are listed under CESA as endangered or threatened or are candidates for listing
        iii. CDFW Animal species of special concern (SSC)
        iv. California Fully Protected Animals
        v. NatureServe Element Ranking
            a. Global Rank (G-rank) - describing the rank for a given taxon over its entire distribution

b. State Rank (S-rank) - describing the rank for the taxon over its state distribution

vi. Species formally listed by the US Forest Service as a Sensitive Species or a Management Indicator Species

vii. Species formally listed by the US Fish and Wildlife Service as a Bird of Conservation Concern

viii. Animal and plant species listed by the US Bureau of Land Management as sensitive

ix. Other species identified by a state or federal agency as having special status

D. Other CDFW Resources: The following were reviewed to evaluate additional species for inclusion in the species list:

i. Species specially protected under the California Wildlife Protection Act of 1990 (mountain lion)

ii. The Complete List of Amphibian, Reptile, Bird, and Mammal Species in California

iii. Native game species managed under CDFW's Game Management Program

iv. Lists of terrestrial vertebrates can be generated by queries of the California Wildlife Habitat Relationships (CWHR) Program

E. Natural Community Conservation Plans: List and maps of current or pending NCCPs in California (CDFW 2019a), none of which overlap the RCIS area.

F. Other available state, local, or regional resources within the RCIS area: The following additional databases were used to identify rare and special-status species occurring in the RCIS Area.

i. NatureServe spatial query for the Number of Species of Conservation Concern within Santa Cruz County (NatureServe 2020)

ii. California Native Plant Society (CNPS 2020) rare plant inventory website query for Santa Cruz County; including information on California Rare Plant Rank (CRPR), endemic status, and notes

iii. Checklist of the Birds of Santa Cruz County, California (Suddjian 2016)

iv. Western Bat Species list, including distribution and conservation status (WBWG 2020)

v. Calflora species profiles (Calflora 2020), geographical range maps, nomenclature, status

vi. California Herps Guide (Nafis 2020), geographical range maps of various species

3. **Review with RCIS Participants:** The species lists was reviewed with the RCIS Steering Committee, Stakeholder Group, and Technical Advisory Groups, to obtain feedback. The input of these individuals was primarily used to indicate whether the species currently occurs in the RCIS Area, including to note species that have not been observed in a consideration amount of time and are believed to be currently extirpated.

4**. Identify Natural Communities and Land Cover Types Associated with each Species**: The database was annotated to identify the natural community or other land cover types of rare species occurring in the RCIS Area.

Appendix G RCIS Required Components

To approve a Regional Conservation Investment Strategy, CDFW must determine that it meets all of the requirements in the California Fish and Game Code (CFGC) for an RCIS. To assist CDFW with this determination, the following table lists the requirements in the order they appear in CFGC; for each, it identifies where in this RCIS the required element is found.

Table G-1: Sections of the RCIS addressing required elements in the Fish and Game Code

Fish and Game Code	Required Element	Relevant RCIS Section(s)
1852(c)(5)	A summary of historic, current, and projected future stressors and pressures in the RCIS area, including climate change vulnerability, on the focal species, habitat, and other natural resources, as identified in the best available scientific information, including, but not limited to, the State Wildlife Action Plan.	Chapter 4, Section 5.3
1852(c)(6)	Consideration of major water, transportation and transmission infrastructure facilities, urban development areas, and city, county, and city and county general plan designations that accounts for reasonably foreseeable development of major infrastructure facilities, including, but not limited to, renewable energy and housing in the RCIS area.	Section 2.2.4, Appendix E
1852(c)(7)	Provisions ensuring that the strategy will be in compliance with all applicable state and local requirements and does not preempt the authority of local agencies to implement infrastructure and urban development in local general plans.	Section 1.5.6
1852(c)(8)	Conservation goals and measurable objectives for the focal species and important conservation elements identified in the strategy that address or respond to the identified stressors and pressures on focal species.	Section 5.3
1852(c)(9)	Conservation actions, including a description of the general amounts and types of habitat that, if preserved or restored and permanently protected, could achieve the conservation goals and objectives, and a description of how the conservation actions and habitat enhancement actions were prioritized and selected in relation to the conservation goals and objectives.	Section 5.2, Section 5.3
1852(c)(10)	Provisions ensuring that the strategy is consistent with and complements any administrative draft natural community conservation plan, approved natural	Section 5.4.2

Fish and Game Code	Required Element	Relevant RCIS Section(s)
	community conservation plan, or federal habitat conservation plan that overlaps with the RCIS area.	
1852(c)(11)	An explanation of whether and to what extent the strategy is consistent with any previously approved strategy or amended strategy, state or federal recovery plan, or other state or federal approved conservation strategy that overlaps with the RCIS area.	Section 5.4.1
1852(c)(12)	A summary of mitigation banks and conservation banks approved by the department or the U.S. Fish and Wildlife Service that are located within the RCIS area or whose service area overlaps with the RCIS area	Section 2.2.6
1852(c)(13)	A description of how the strategy's conservation goals and objectives provide for adaptation opportunities against the effects of climate change for the strategy's focal species.	Section 5.3
1852(c)(17)	Incorporation and reliance on, and citation of, the best available scientific information regarding the strategy area and the surrounding ecoregion, including a brief description of gaps in relevant scientific information, and use of standard or prevalent vegetation classifications and standard ecoregional classifications for terrestrial and aquatic data to enable and promote consistency among regional conservation investment strategies throughout California.	Section 2, Appendix B
1852(d)	A regional conservation investment strategy shall compile input and summary priority data in a consistent format that could be uploaded for interactive use in an Internet Web portal and that would allow stakeholders to generate queries of regional conservation values within the RCIS area.	*TBD*
1852(e)	In addition to considering the potential to advance the conservation of focal species, regional conservation investment strategies shall consider all of the following: (1) The conservation benefits of preserving working lands for agricultural uses. (2) Reasonably foreseeable development of infrastructure facilities. (3) Reasonably foreseeable projects in the RCIS area, including, but not limited to, housing.	(1) Sections 2.2.3 and 5.3.23 (2) Sections 2.2.4.1 and E.1 – E.3 (3) Sections 2.2.4.2 (4) Section E.4

Fish and Game Code	Required Element	Relevant RCIS Section(s)
	(4) Reasonably foreseeable development for the production of renewable energy. (5) Draft natural community conservation plans within the area of the applicable regional conservation investment strategy.	(5) Section 5.4.2
1854(a)	The department may prepare or approve a regional conservation investment strategy, or approve an amended strategy, for an initial period of up to 10 years after finding that the strategy meets the requirements of Section 1852.	Section 6.4
1854(c)(1)	A public agency shall publish notice of its intent to create a regional conservation investment strategy. This notice shall be filed with the Governor's Office of Planning and Research and the county clerk of each county in which the regional conservation investment strategy is found in part or in whole. If preparation of a regional conservation investment strategy was initiated before January 1, 2017, this notice shall not be required.	Section 1.6.3 and Section D.2
1854(c)(3)(*A*)	A public agency proposing a strategy or amended strategy shall hold a public meeting to allow interested persons and entities to receive information about the draft regional conservation investment strategy or amended strategy early in the process of preparing it and to have an adequate opportunity to provide written and oral comments.	Sections 1.6.3 and Appendix D