# VEGETATION MANAGEMENT PLAN: BUTTE CREEK AND BIG CHICO CREEK ECOLOGICAL RESERVE COMPLEX

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A Project

Presented

to the Faculty of

California State University, Chico

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In Partial Fulfillment

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in

Geography:

Environmental Policy and Planning

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by

Abigail R. Rizzo

Spring 2012

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ABSTRACT

VEGETATION MANAGEMENT PLAN: BUTTE CREEK AND

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The California State University, Chico Research Foundation (the Foundation) owns and manages the Butte Creek Ecological Preserve (BCEP) and the Big Chico Creek Ecological Reserve (BCCER) Complex, herein known as “the Reserves”. BCEP is located approximately five miles southeast of Chico, and BCCER is located approximately ten miles northeast of Chico, California. The Reserves both contain riparian corridors, oak woodlands, and other sensitive habitats for species native to the area. Prudent vegetation management of the Reserves can lead to increased floral and faunal biodiversity, as well as maintaining the sites for optimal educational, recreational, and

research uses. Appendix A contains a Vegetation Management Plan for the Butte Creek and Big Chico Creek Ecological Reserve Complex, the culmination of this project.

Proper management of the Reserves requires a plan outlining the existing conditions of vegetation within the Reserves as well as a vegetation management plan to guide future action. The vegetation management plan written for this project lays out a framework for management. This plan will operate under a set of guiding principles to attain measurable objectives. Potentially it will alleviate competing interests, conflicts in strategy, and misunderstandings. Additionally, a plan also lends credibility to the implementation process, along with ensuring consistency of actions. When actions have been carried out consistently, they may be monitored to inform future land management decisions. This plan seeks to provide all of those aspects as well as an adaptive management monitoring plan, which can be updated periodically. These steps will provide an information feedback mechanism, which will allow management decisions to adapt to changing times.

# CHAPTER I

# INTRODUCTION

## Objectives

The objective for this project was to produce a vegetation management plan, which would provide a framework for future action on the Butte Creek and Big Chico Creek Ecological Reserve Complex. Appendix A contains a copy of the developed vegetation management plan. This plan addresses the restoration of natural habitats of the Reserves, and has the potential to be used to obtain funding and reduce regulatory review for future projects. A major result of this project will be to generate measurable objectives (*i.e.,* discrete and implementable), such as weed control strategies which can be planned by season and realistic projections about cost. Timely implementation of the measurable objectives might indicate a thoughtfully considered plan and timeline for action. Additionally, a comprehensive background on existing vegetation conditions as well as proposed management strategies will be available for use by Reserve management and all stakeholders. Management strategies from research conducted by faculty and students will be included in the plan updates periodically. These updates will primarily occur in the Management Decision Matrix (Appendix E).

# Planning for Habitat Management

Most successful ventures begin with proper preparation and planning. Many times this planning can be informal, but frequently it involves the organization and preparation of a formalized long-range guideline for action. This can be particularly useful for natural resources management and land-use planning where many different actors are involved over a long period of time. Due to the ambiguity of appropriate habitat management techniques for each piece of land over a given segment of time, regulations can arrest progress where a more flexible policy would better fit the needs of the particular habitat. Thus, this vegetation management plan *guides* actions rather than *regulating* them. Developing a plan lends credibility to the implementation process, along with ensuring consistency of actions (Tear et al. 2005, 839). The plan should thus become “a set of standards that can serve as guiding principles to establish scientific credibility, methodological rigor, and consistency for comparative and regional analyses in support of conservation actions” (The Nature Conservancy and World Wildlife Fund 2006, 2). In this manner, land managers will not need to continuously justify their actions, and in the absence of these managers the same strategies will continue. Reserve management requires continuity and consistency, as “a comprehensive vision is the definition of conservation success” (The Nature Conservancy and World Wildlife Fund 2006, 7).

## Study Area: The Reserves

Ecological reserves, preserves, restoration areas, sanctuaries, and other habitat protection areas provide services dependent on connectivity at all levels-- from global regions, to local landscapes, to single biotic communities. The Reserves contribute to this corridor of protected lands throughout Butte County, California (see Appendices C and D for lists of potentially-occurring threatened and endangered species at each of the Reserves). A conserved lands map of the region highlights the connectivity of the Reserves to other important protected lands in the area (California Protected Areas Database 2011). This map reveals general habitat connectivity, while the red highlighted portions of the map indicate the two Reserves project sites. The highlighted portion to the north shows Big Chico Creek Ecological Reserve, and the one to the south indicates Butte Creek Ecological Preserve.

The Foundation owns and manages the Reserves. The Foundation is affiliated with, but not owned, by California State University, Chico; the Foundation is a non-profit organization, so the Reserves are effectively under private ownership. Both reserves are largely undeveloped and rural. The Butte Creek Ecological Preserve (BCEP) is located approximately five miles southeast of Chico, California and the Big Chico Creek Ecological Preserve (BCCER) is located about ten miles north of Chico. BCCER occupies 3,950 acres and BCEP occupies 93 acres; both have mixed habitat including riparian corridors, oak woodlands, pine forests, chaparral, and other sensitive habitats which are home to species endemic to the area.

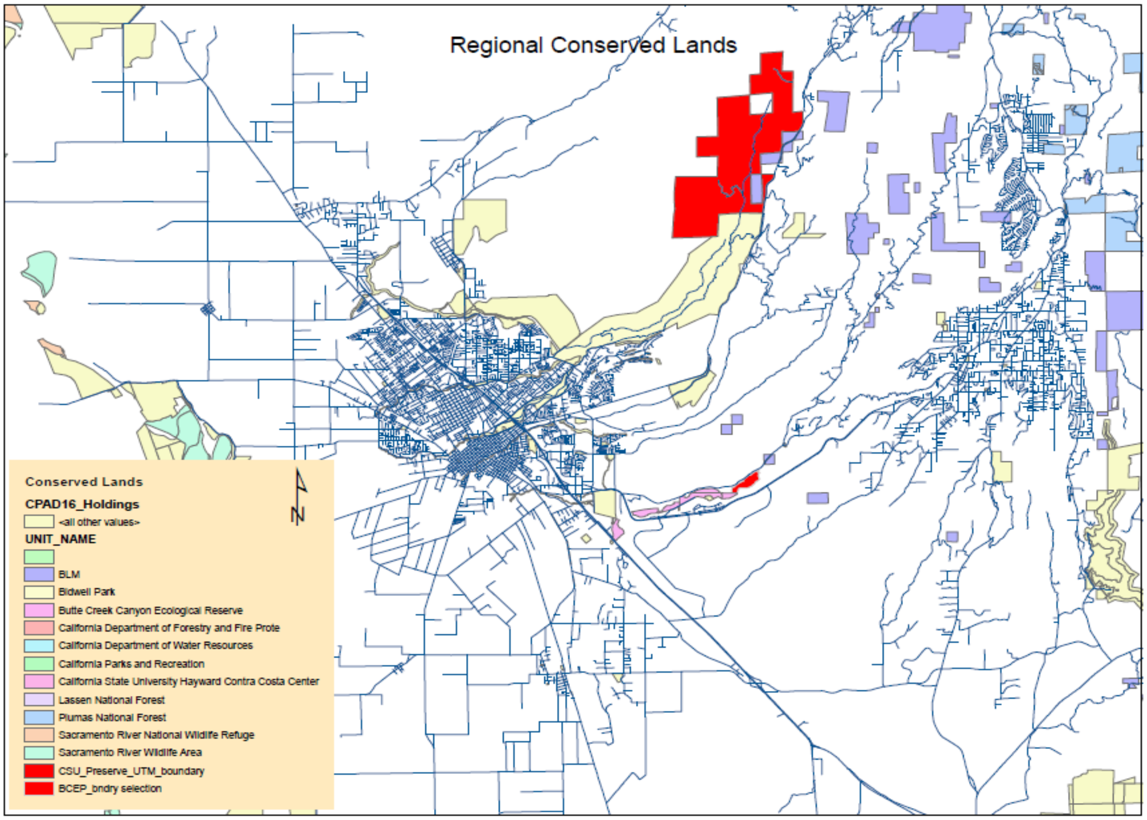


Figure 1. Regional conserved lands map In Butte County, Including CSU, Chico Reserves.

Source**:** Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

Figure 2 lists the vegetation communities (California Native Plant Society 2011) of the two Reserves and a list of specific targeted and other species can be found in Appendix B. The term “native” will be used for in this document to refer to all historically native and naturalized plants in the project area. “Naturalized” refers to plants which do not naturally exist in a particular range, but have established successfully in the wild without human assistance. Additionally, the term “exotic” will be used to refer to all non-native species within the project area.

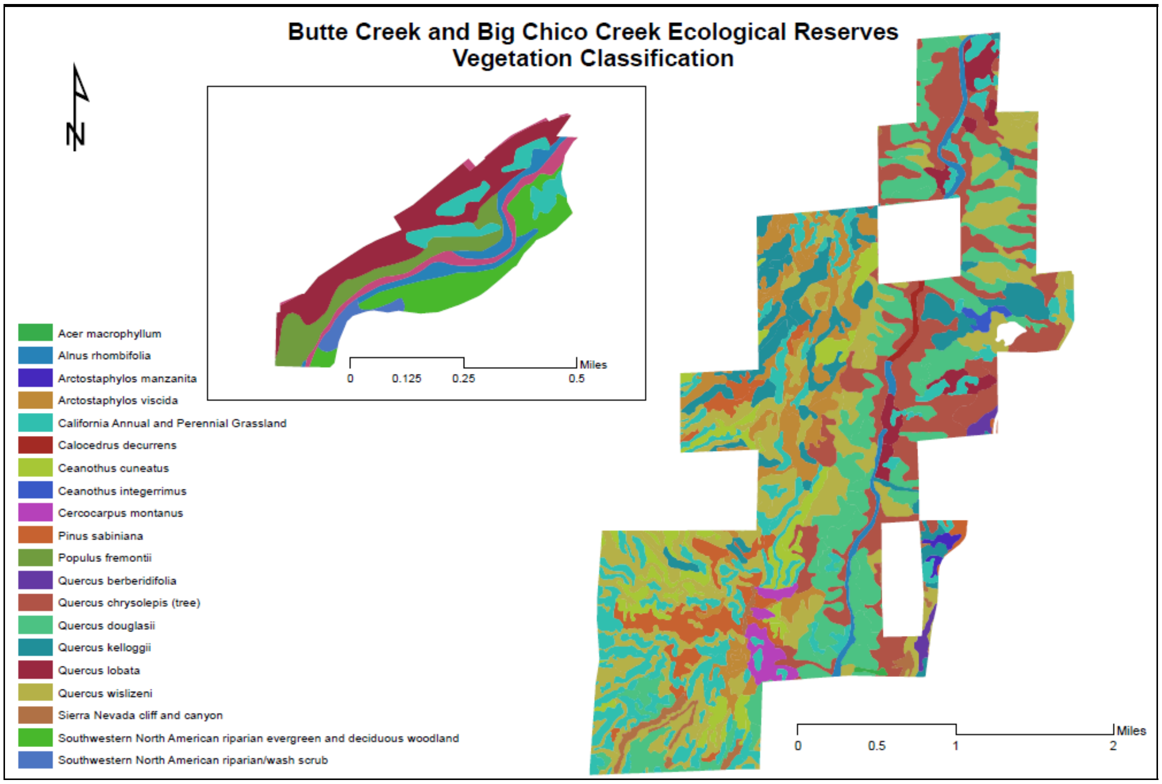


Figure 2. Butte Creek and Big Chico Creek Ecological Reserve vegetation communities.

Source: Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

## Forces Affecting the Landscape

BCCER

Historically, cattle grazed on this Reserve after European settlement. Goats, sheep, and cattle grazed this property intensively in the early 1900's. Sheep and goats had year-round access, while cattle were limited to spring and summer grazing. Land managers removed cattle in 2002; however, grazing c0ontinued from 2001-2005 on Musty Buck Ridge. Grazing has had the effect of reducing cover and forage, which was certainly the case with the high-intensity grazing in the early 1900's. More recently, the limited cattle grazing negatively affected the ecological services of BCCER not by overgrazing, but instead by eroding stream banks and increasing sedimentation in Big Chico Creek. Additionally, cattle selectively chose palatable plants over unpalatable plants, which has been a contributing factor to the increase in noxious weeds. Finally, the high weight/area of hooves have compacted the soils, which led to increases in surface runoff and erosion.

Along with grazing, fire has greatly affected this Reserve. Naturally-started and human-started fires have been an important ecological process for the foothill vegetation communities of the BCCER. Seasonal variations in precipitation have promoted long dry periods and abundant fuels, which have led to wildfires. Lightning provides the catalyst for these naturally-occurring burns. Portions of the property burned in 1961, 1978, 1983, 1993, and 1999 with the 1961 fire burning the most acreage on the Reserve. Figure 3 illustrates a regional fire history (California Department of Forestry and Fire Protection 2010). In 1999, the majority of the Reserve west of Big Chico Creek burned in the Musty Buck Fire.

Old fire scars and multiple-trunked trees attest to numerous earlier fires. Research on the Maidu people managing ecosystems with fire coupled with archeological evidence suggest that people set fires in the BCCER area for thousands of years. Historically, the Native Americans burned grasslands and oak woodlands annually or semi-annually (Greenlee and Moldenke 1982). Later, oak woodlands burned at intervals of 8-15 years (Sampson 1944 18), while the entire foothill zone burned at a

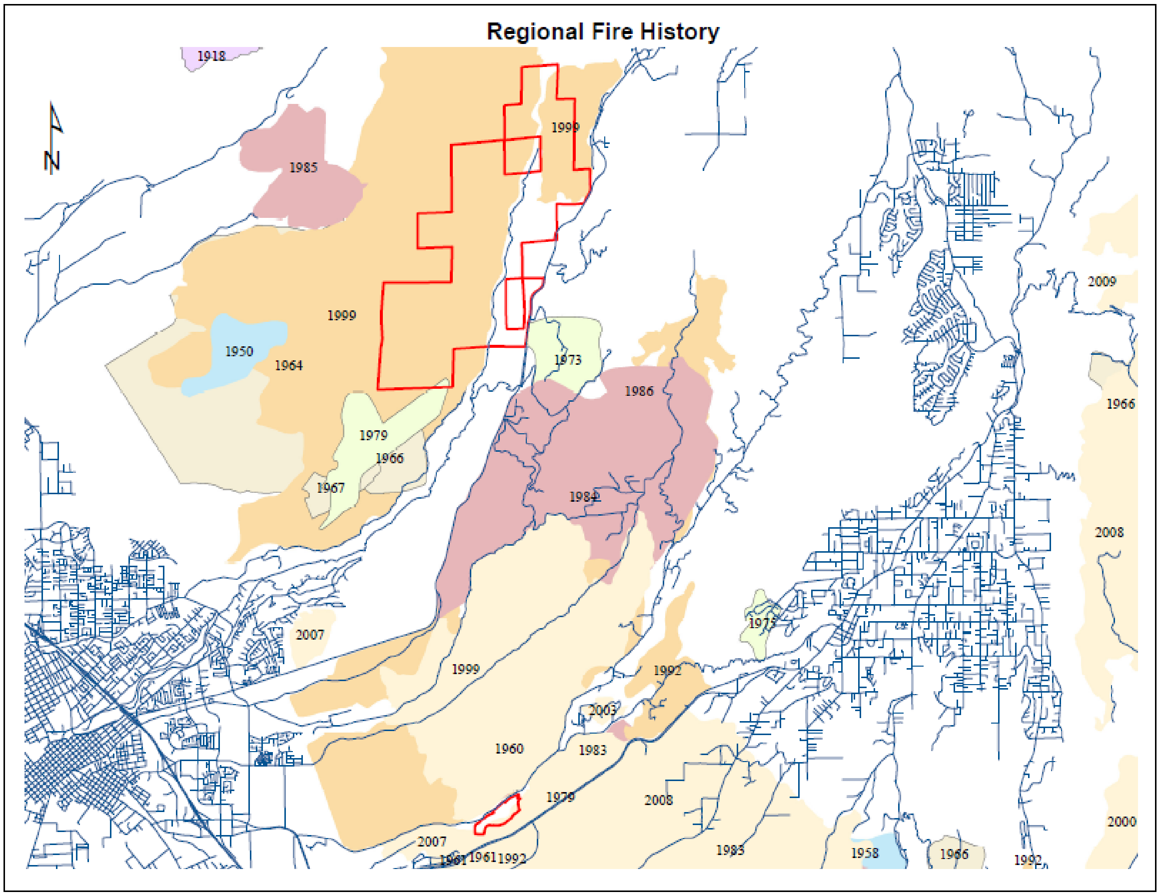


Figure 3. Big Chico Creek Ecological Reserve regional fire history map.

Source: Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

median frequency of less than 20 years (McKelvey et al. 1996, 1033). Beyond post-European settlement and subsequent actions, it is important to recognize that indigenous landscape management in this region was at one time a significant component, which shaped the landscape and possibly the evolutionary histories of vegetation (Keeley 2002, 310). Reserve ecosystems should be considered to be adapted for periodic fire and expected to change character in its absence.

BCEP

Less than optimal soil conditions exist at the Preserve due to historical gold, sand, and gravel mining. Mining has stripped the topsoil, leaving degraded conditions which hinder native plant growth and restoration (Behnke 1990, 4). This lack of organic soil hinders native vegetation growth, particularly for annual grassland-dominated areas (Hankins 2007). Additionally, the highly permeable nature of the soils on this property leads to conditions which encourage water to undercut the bank. The bank along the riparian corridor drops sharply into Butte Creek, thus jeopardizing riparian growth.

Fire is another factor influencing the Butte Creek Ecological Preserve. Recent fire-related changes to the landscape have been the Honey Fire of 2007, which burned through the southwest portion of the preserve (approximately five acres). Furthermore, the Humboldt Fire of 2008 burned through the site roughly parallel to the areas burned by the Honey Fire. Wildfire affected approximately 40 acres of riparian forest and floodplain grassland. Burn area rehabilitation is currently focused on 15 of the 40 acres burned by the Humboldt Fire.

The management plan for the Reserves includes prescribed burns as a way to establish the historical and beneficial role of fire in vegetation management especially that of invasive plants such as yellow star- thistle. The project also emphasizes the broader, interactive, and diverse approach to landscape ecology which assumes that the reserve is part of a mosaic of historic and current land use as well as complex soil geographies, geology, and topography. In the next section, I will review literature on the management of reserves that considers reserves as part of a wider landscape but that also acknowledges the financial limits to what is referred to as “adaptive” management.

# CHAPTER II

# LITERATURE REVIEW

## The Need for Vegetation Management

The overall consensus of research today is that the goal of vegetation management is to maintain and enhance natural plant communities, remove and reduce the spread of exotic species, and duplicate historic disturbance processes to the extent possible (Griggs 2009, 26). The research suggests that this will enhance ecosystem services such as clean air and water, which will support biodiversity (Banzhaf 2010, 592). Lost ecosystem services will not return to their natural setting without assistance from land managers (Noss 1996, 777) and current and historical anthropogenic effects upon landscapes necessitate management of these areas (Manning, Lindenmayer, and Fischer 2006, 487). Lands such as these, with histories of grazing and mining, require restoration to return to hospitable environments that will favor native species. Increasing organic matter in the soil after mining or stabilizing banks after erosion from cattle grazing at stream banks will reduce time (perhaps hundreds of years) it would take for the ecosystem to perform these functions. Factors affecting the landscape include altered vegetation growth patterns, altered natural disturbance to the landscape, and altered hydrology (Griggs 2009, 9). Land managers must control the landscape for some period of time to restore the landscape to its historical function. These landscapes include preserved lands and developed lands.

Although land management has much potential to benefit ecosystem services, defining success poses an additional challenge. For example, some research points to creation of habitat as a success indicator (Tang and Brody 2009, 532), while other studies indicate that success is only achieved when targeted species begin to inhabit that area (Griggs 2009, 16). Priorities must be established when it comes to measuring the success of vegetation management. The Society of Ecological Restoration International, an organization well-respected and typically a leader in vegetation management studies, provides the following definition of success in ecosystem management:

> Ecosystems should have the following attributes: (1) similar diversity and community structure in comparison with reference sites; (2) presence of indigenous species; (3) presence of functional groups necessary for long-term stability; (4) capacity of the physical environment to sustain reproducing populations; (5) normal functioning; (6) integration with the landscape; (7) elimination of potential threats; (8) resilience to natural disturbances; and (9) self-sustainability. (Ruiz-Jaen and Aide 2005, 569)

An important aspect of planning for optimal ecosystem functioning includes an understanding of sites which possess similar characteristics to the one which is being managed or restored. Additionally, native species must be encouraged and non-natives or other potential threats discouraged. Furthermore, quantitative indicators of success, such as adequate population numbers and adequate space and resources for populations to remain in a dynamic equilibrium, can be accounted for. Finally, resilience and self-sustainability of an ecosystem or landscape mark a truly successful management scheme. Planning restoration carefully and monitoring its establishment will help meet restoration success criteria, regardless of the setting.

## Defining the Reserve

This project is concerned with landscape management of vegetation on two ecological reserves. To successfully consider all aspects of planning for these landscapes, it is important to understand the conceptual framework of a reserve, including its opportunities and limitations. A reserve usually encompasses parcels of interconnected land, which are set aside for maintaining critical habitat for endangered, endemic, and common floral and faunal species (Noss 1996, 777). The most essential characteristic goal of these reserves is their connectivity. Many times, a reserve will promote native plant propagation and ecosystem health if connectivity is enhanced along the appropriate biological corridor (Schlotterbeck 2003, 958). Many times conservationists see reserves as distinct areas of land that protect declining species from encroachment from humans' increasing demands for space and resources (Margules and Pressey 2000, 243). However, conducting conservation on a closed piece of land may become impossible given the interactive processes that are essential to its functioning.

Instead, the research points to the concept of an open landscape model where habitat has no defined boundaries. In line with this thinking, Everett and Lehmkuhl (1997, 575) examined the spatial needs of a reserve and found that reserves require a landscape approach to ecosystems. They concluded that the concept of a core reserve may not meet the spatial requirements of conservation and restoration and that a reserve may be difficult to define when there is disagreement about its scalar requirements. A crucial component of habitat restoration planning is therefore that “all ecosystem restoration should be approached with a spatially explicit landscape perspective, in order to ensure the suitability of flows, interactions and exchanges with contiguous ecosystems” (Society for Ecological Restoration International 2004, 5). The literature suggests that successful restoration occurs at a number of interconnected spatial scales. However, research also indicates that projects spanning large amounts of acreage (watershed or landscape scale, for example) require often unrealistic financial commitments (Noss 1991, 225).

## Vegetation Management: Methods And Theory

A vegetation management plan has among its objectives the minimization of non-native, invasive species and the restoration of beneficial native plants. The outcome of management should be greater diversity-related ecosystem services restored to a landscape. The plan must address many variables, including soil quality and function (Montgomery and Eames 2008, 626), native seed dispersal (Garcia, Zamora, and Amico 2010, 1077), and fire as a natural disturbance driver of historical landscape processes (Rodríguez-Trejo and Myers 2010, 305).

Mechanical, biological and chemical means can satisfy many of these priorities in a reserve setting. Mechanical techniques include using hand and power tools such as chainsaws and back hoes, constructing waterbars and other methods of erosion control, conducting seed propagation, and performing invasive species removal. The advantages of these techniques are that they can be done over relatively large areas and with semi-skilled labor. The disadvantages of these methods include lack of targeted eradication of propagating seeds and roots many times.

On the other hand, biological techniques include using native or non-native grazers to control non-native naturalized species, enhancing soil nutrients by encouraging carbon breakdown in deficient soils, and doing prescribed burning. The advantages to these methods can include restoring natural disturbance regimes, which is good for landscape resilience and self-sustainability. Alternately, disadvantages can include heavy erosion or potential landscape scarring from grazing, as well as air quality concerns from prescribed burning.

Finally, chemical techniques include the use of herbicides and natural growth inhibitors (e.g., plant competitors or by-products). These methods have the advantage of targeting specific invasive species in the case of herbicides; however, without an application strategy, these chemicals can contribute to water quality issues. Finally, the last vegetation management tool involves increasing awareness of the reserve user's role in restoration opportunities and costs. This can include tools such as educating the user about the need to remove non-native grass seeds from the treads of their shoes before entering the restoration site where managers are trying to control non-natives. These methods are varied, and no one prescription can meet the needs of a particular landscape. Informed combinations of these techniques are clearly experimental many times.

Given the wide range of options, a multi-method approach to vegetation management has been shown to be the most effective (Young and Claassen 2008, 357). However, burning, grazing, and herbicides usually should not all be undertaken at once and thus require coordination (Hatcher and Melander 2003, 307). Not only should the method(s) be considered, but the seasonality of vegetation control techniques reveals the complexities of this type of management. For example, studies indicate that controlled burning during certain seasons leads to higher success rates for yellow star-thistle (*Centaurea solstitialis* L.) eradication. DiTomaso suggests summer burning (Kyser and DiTomaso 2002, 648), but fall burning has proven to be an effective tool at the Reserves. Star-thistle is an aggressive non-native species, which possesses a fire-vulnerable seasonal seed bank (Keeley 2006, 380; Kyser and DiTomaso 2002, 648). Timing not only includes considerations such as season and frequency of prescribed burns, but also focuses on the life histories of individual species when planning the timing and frequency of burns.

Prescribed burning can enhance native flora growth by removing surface fuel build-up which diminishes recruitment and puts mineral nutrients back into the soil base. This recruitment occurs due to minimized light filtering and increased soil temperatures (Lesica and Martin 2003, 516). The literature today is in agreement that introducing multiple management techniques increases the complexity of planning, but it also increases the chances of success.

## Importance of Contextual Setting and Adaptive Management

No single model or plan can be used to manage all reserves. Every reserve is unique and needs must be assessed for each set of requirements and objectives (Fleming 1999, 25). Noss (2003, 1271) echoes the same sentiment, but takes it a step further in referring to aspects of the landscape that may differ between reserve systems, including ecology, land use, and disturbance regimes. Continuously monitoring implementation strategies and adjusting for evolving conditions will make the plan more dynamically effective (Tang and Brody 2009, 534; Margules and Pressey 2000, 250; Marshall, Blackstock, and Dunglinson 2010, 68; Noss 2003, 1271; Tang & Brody 2009, 534). This idea of flexible management goes hand in hand with the idea of fully considering the contextual settings. As a land manager implements a practice which s/he hopes will lead to a certain policy objective, s/he will test whether this practice actually gives the desired outcome at regular intervals. Then the practice will either continue or it will be revised. This adaptation improves the plan's quality and credibility. A plan based on the principles of adaptive management is also an acknowledgement that every environmental management plan is an experiment to learn from.

Adaptive management calls for innovation and creativity by acknowledging that surprise is an element in ecoystems. Flexibility to alter plans allows the land manager to integrate information gained from previous treatments of the land, and promotes effective management and increased efficiency in all restoration plans (Marshall, Blackstock, and Dunglinson 2010, 68). Adaptive management promotes a more proactive approach to management and in almost every case can save time and money, and minimizes the loss of ecological and human services. Despite the best intentions and methods, however, ecological process and succession cannot be assumed. Planning for ecosystem health involves maximizing the *chances* of a landscape's resilience to change (Hilderbrand, Watts, and Randle 2005, 7). Planning for uncertainty and monitoring change in the landscape over time allows for an adaptive model for management.

## Common Pitfalls of Vegetation Management

The difficulty of planning for and implementing vegetation management is often linked to the identification of realistic target goals. Many times planning for management focuses upon recreating a pre-disturbance condition, which can be impossible due to the expansive and persistent invasion of exotic vegetation for example (Hilderbrand et al. 2005, 2). Sometimes there is no practical method of removing all non-native species in an area which has been completely converted to non-native, invasive species. One way to avoid setting unrealistic goals can be to create an ecosystem which heavily emphasizes ecosystem function over trying to re-create unattainable historic ecological conditions (Jungwirth, Muhar, and Schmutz 2002, 873). Instead, a more realistic plan could include mowing a field of star-thistle in the fall, spraying broadleaf herbicides on the field in the spring, and broadcasting perennial native grass seed the following fall after the first rains so the native grasses have a chance to establish roots and out-compete the star-thistle.

Another hypothetical example is highlighted as follows. In a restoration area that historically contained larger shrubs, the effect grazing cows have had on the area over the years is soil compaction. This compaction has made it difficult for shrub root to establish. This could only be amended by ripping up the area with mechanical equipment. The type of equipment used for loosening compacted soils though might destroy sensitive plants in this area, and therefore is not a good use of resources in this particular case (Griggs 2009, 17). These sensitive plants are now providing habitat to a recently re-introduced endangered species. Although the field may not look the same as it did in its pre-disturbance condition (which may be almost impossible determine anyway), it is still providing ecosystem services crucial to endemic species.

Another pitfall to vegetation management is poorly constructed planning timelines, unfocused management priorities, and unrealistic financial planning. Poorly constructed planning timelines are seen when land managers expect certain results from in just a few years. Under natural conditions though, these processes might take decades or centuries (Hilderbrand, Watts, and Randle 2005, 1). Awareness of ecological processes benefits the prudent land manager. For instance, many restoration projects require multiple plantings at various seasons throughout a project (Griggs 2009, 17). Planting too soon, regardless of plant quantity, cannot duplicate natural succession.

Furthermore, the land manager must identify management priorities. Species which pose the greatest threat to ecosystem function either through their spread or through their demise (Tear et al. 2005, 840). Targeting species which pose the greatest threat through their *spread* means identifying those which are most widespread or most mobile and have the ability to invade sensitive ecosystems and disrupt their natural processes and flows (Society for Ecological Restoration International 2004, 9-10R). Focused priority setting can make the difference between success and failure in landscape management. Finally, successful planning for habitat restoration requires realistic financial planning. Financial constraints can hinder the implementation of ambitious plans. Certainly every project has differing opportunities and constraints, but an important aspect of all restoration projects is to keep their objectives and scope simple. The more modest the restoration proposal, the more financially feasible it will be and the more likely the actors can claim success and acquire future funding.

# CHAPTER III

# METHODS

## Procedure

At the request of Jeff Mott, Director of the California State University, Chico Reserve Complex, I began to conduct research on landscape management plans. I drafted a review of landscape management plans, which I built into a table in Appendix I. This process began with reviewing several different types of management plans and their formats. I reviewed the documents in order to develop a sense of the content usually contained in landscape and vegetation management plans. The plans were from public agencies and universities, private consulting firms, and non-profit organizations. The types of plans included natural resources management, land management, vegetation management, and master plans. A few of the examined plans were the Deer Creek Conservancy Watershed Management Plan (1998), a University of California Natural Reserves System management plan, the Cosumnes River Preserve Management Plan, California Department of Fish and Game-reviewed wildlife management plans, and national and international natural resources plans.

Once I had a general concept about what a vegetation management plan would contain, I gathered information from preceding management plans for both

Reserves. When necessary, ideas were re-phrased and gaps were filled. Tracking the management history, vegetation communities, and species of highest potential significance for management in the Reserves required secondary sources such as preexisting plans (California State University Chico Research Foundation 2003), and cursory assessments (Hankins 2007). The Technical Advisory Committee for the management of the Reserves was a valuable resource. Additionally, interviews with Jeff Mott, the Reserves Director; Paul Maslin, former Big Chico Creek Ecological Reserve Field Director; and Don Hankins, Butte Creek Ecological Preserve Field Director yielded clues to possible implementation and monitoring strategies. These tools allowed me to produce the vegetation management plan, the product of this project (Appendix A). Another crucial component to this project was the Decision Management Matrix (Appendix E), which allows land managers to constantly track and reassess their management techniques, timing, and costs. The matrix is meant to be the primary tool for effective adaptive management. This matrix is adapted from the Nature Conservancy and World Wildlife Fund 2006. Additionally, Appendices F and G contain monitoring plans specifically tailored to each of the Reserves.

The content of the three interviews described above, with Don Hankins, Jeff Mott, and Paul Maslin, provided realistic timelines and concrete actions for inclusion into the plan, which were not previously contained within management plans of the Reserves. Although the interviews addressed the clients' needs as fully as possible, more input from the United States Department of Agriculture Forest Service, California

Department of Fish and Game, Bureau of Land Management, and United States Fish and Wildlife Service would have been greatly appreciated if time had allowed. The major limitations of this study were time, money, and my lack of plant ecology knowledge. I did not gather primary material on vegetation communities in the preserves. Rather, I depended on secondary source planning information from experts to develop implementation and monitoring strategies.

# CHAPTER IV

# SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

## Summary

A master plan for the Reserves is currently in the production phase. The Director of the Reserves needed a management plan which would encompass both Reserves. One portion of this plan, the vegetation management plan (Appendix A), is the culminating document for this project. The principal goal of this project was to provide a vegetation management plan for the Reserves, which was both practical and productive in realizing habitat and biodiversity protection goals. This updated vegetation management plan was the result of compiling information on historical land-use, existing conditions, and future plans for the Reserves. Although historically the Reserves have been subjected to grazing, mining, wildfire destruction, and various other anthropogenic disturbances, a strong potential exists for restoring ecosystem function to both areas. Guided management is the best tool to foster this growth with a clear vision of desired outcomes and practical implementation strategies.

This plan attempts to communicate a clear vision for the restoration and preservation of the Reserves, and sets forth a set of guiding principles to attain measureable objectives. This meant providing realistic timelines and concrete actions for inclusion into the plan, which were not previously contained within management plans of the Reserves. The plan has the potential to alleviate competing interests, conflicts in strategy, and misunderstandings. Furthermore, it can be used to obtain funding sources and reduce regulatory review for future projects by clearly laying out short and long-term management goals of the Reserves, while at the same time itemizing and justifying costs. Finally, this plan will be useful for natural resources management and land-use planning in the Reserves. A rigorous ecological strategy of implementation and monitoring, and a clear set of standards to follow, promise a higher degree of success. Clearly, laying out an action plan with concrete actions, and not vague goals, will be helpful to land managers and can potentially become a springboard for creating volunteer activities which could promote interest in the Reserves. This interest could lead to funding in the future by the public and the private sector.

## Conclusions

The implementation of this plan will be fraught with difficulties due to lack of human resources and funding. While this vegetation management plan has addressed actions to take regarding vegetation management, it has not tackled issues of funding and human resources needs. Those are not within the scope of this project, but will need to be resolved for this plan to be implemented effectively. Additionally, a crucial component of implementation is the monitoring of the implementation process and its results. This need exists, but will also be complicated due to funding and the lack of qualified people to undertake this project. It is necessary in the long term since the vegetation management plan will need to be amended periodically. This fact contributes to the strength of the project. Methods used in implementation will need to be reviewed for effectiveness, which will provide opportunities for adaptive management (Zhenghong and Brody 2009, 534; Margules and Pressey 2000, 250; Marshall 2010, 68; Noss 2003, 1271; Zhenghong & Brody 2009, 534). Successful strategies can be duplicated, and strategies which do not address issues appropriately, or create too much expense to implement without any ecological gain, can be discarded.

This project addresses both implementation and monitoring needs through its supplemental management tools, which are located in the appendices. First, the 'Threats Matrix' and 'Implementation Schedule' contained in the Management Decision Matrix (Appendix E), ensure that issues and opportunities arising at the Reserves can be tackled with multiple important parameters kept in mind. These include timelines, extent of problems, ability to manage, and budget considerations. Secondly, the monitoring plans drawn up for both Reserves (Appendices F & G) will provide a springboard for future adaptive management options. The Management Decision Matrix and monitoring plans are unique tools and strong additions to this project.

## Recommendations

Future recommendations for those pursuing this type of project include pursuing additional funding for research and allotting sufficient time to gather primary information. Due to lack of funding and time, secondary sources became primary sources for this project. This project would have had more extensive input by federal, state, and local agencies as well as field trials of monitoring plans if it had been feasible. Additionally, field tests of management methods and monitoring strategies would have been strong additions to this project. Furthermore, spending more time at the Reserves getting to intimately know their vegetation communities might have yielded additional effective strategies for non-native vegetation removal and native plant propagation which were not included in the literature. Management methods were purely based on literary and current land manager resources. A final recommendation would be to understand that the process of writing a vegetation management plan requires a clear vision of what content it will contain. Drafting versions of the plan before all the information has been gathered will make numerous re-writes necessary as items are included in the plan. Not only will information need to be added, but potentially previously-written content will change as new information is gathered.

Future studies could include testing the management tools, listed in the conclusion above, for efficacy. A thorough examination of how well the Management Decision Matrix assisted in the implementation of management strategies would be helpful to future protected land areas. Any long term study of the results of using these management tools could be helpful for management schemes in many contexts. Although management is site specific, technique commonalities between sites can many times be found. Finally, a future plan which could spring from the base of knowledge contained in this project would be the fire and fuels management plan. Since the fire and fuels management plan is a crucial component to vegetation management, this will obviously be another chapter contained within the master plan. This master plan is currently being drafted, so proper timing would be an essential component to this project. Finally, the Reserves currently require high-input management to restore the land to its historic ecological function. Due to the land maturing into a healthy ecosystem over time though, the Reserves will ideally need less management. An additional project could explore methods to decrease management, but still maintain a high value of ecosystem function of the area. This could mean updates to the current plan, or could possibly be extended into a whole new plan.

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# APPENDIX A

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## VEGETATION MANAGEMENT PLAN

### BACKGROUND

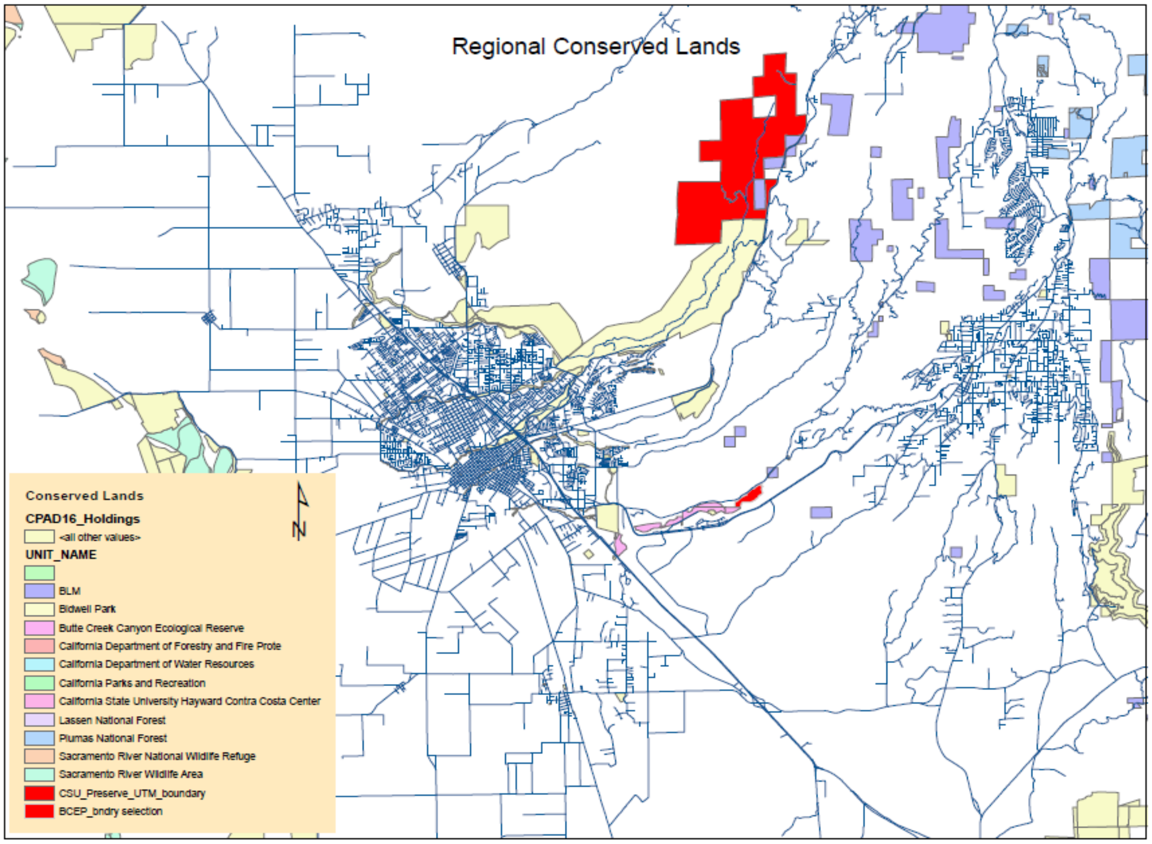
At a coarse scale, the concept of a reserve usually encompasses parcels of interconnected, although potentially distant land, which land managers set aside for maintaining critical habitat for endemic and common floral and faunal species. Often, the reserve will promote habitat critical to native plant population viability and ecosystem processes. For instance, reserves may contain unique characteristics, such as serpentine soils or high elevation sites, which promote growth of endemic species. Without these unique site characteristics, population viability would diminish or not exist at all.

Ecological reserves, preserves, restoration areas, sanctuaries, and other habitat protection areas provide services dependent on connectivity at all levels from global regions, to local landscapes, to single biotic communities (Society for Ecological Restoration International 2004, 5). Sometimes connectivity within the landscape comes from habitat linkages between these areas. A conserved lands map (see Figure 1-A) of the region highlights the connectivity of the Reserves to other important protected lands in the area (California Protected Areas Database 2011).

Soule and Simberloff (1986) highlight the potential irrelevance of debating single large reserve versus several small reserves when it comes to creating minimum viable populations (MVPs). Instead they express the importance of determining optimal gene flow at differing densities of plants [or animals] and various land area requirements. Calculating the minimum area needed to preserve the MVPs of species promotes gene flow. Unfortunately, theoretical reserve design and pragmatic reserve design dictate two highly different outcomes due to economic (Noss 1991, 225) and political constraints. Frequently, these factors force planners to draw the reserve with ecologically arbitrary boundaries. Unfortunately, biota require corridors to promote gene movement in some cases (Everett and Lehmkuhl 1997, 575). In the case of plants for instance, this movement across the landscape can require multiple parcels of land when pollination and other animal-assisted seed dispersal factors come into play. Optimally, reserve design and desired ecosystem function must be addressed simultaneously (Margules and Pressey 2000, 244). This background on reserves serves as a precursor to the following discussion regarding the Reserves.

The Reserves provide open space distally located to urban areas, and the primary anthropogenic influence for the Reserves consists of single-family homes. The California State University, Chico has an affiliation with, but does not own, the Reserves. A non- profit,

**FIGURE 1-A. REGIONAL CONSERVED LANDS MAP**

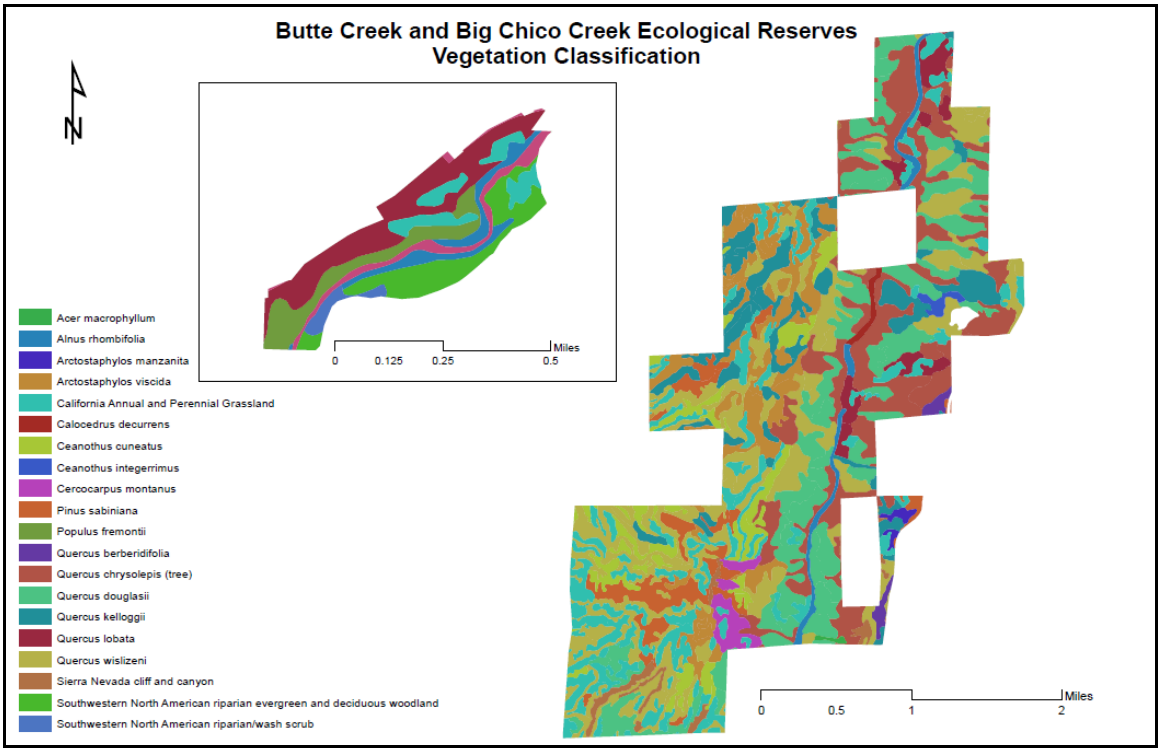



Source**:** Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

the University Foundation privately owns and manages the Reserves. The Reserves fall in county jurisdiction due to their semi-isolated locations. BCEP is located approximately 5 miles southeast of Chico, and BCCER is located approximately 10 miles north of Chico, California (Figure 1-A highlights the Reserves in red). The Reserves, BCCER (approximately 3,950 acres) and BCEP (93 acres), contain mixed habitat including riparian corridors, oak woodlands, pine forests, chaparral, and other sensitive habitats home to species endemic to the area.

A description of the vegetation communities at the Reserves ensues (see Figure 2-A for BCCER and BCEP). Appendix B contains a list of specific targeted floral species, as well as all additional species, found at the Reserves. The primary goal of the Reserves involves management and conservation of native species and ecosystem processes. Additionally, within the plant communities, secondary goals include maintaining natural plant communities and removing and reducing the spread of exotic species, while reducing wildfire threat and optimizing browse and cover for wildlife.

**FIGURE 2-A. BUTTE CREEK AND BIG CHICO CREEK ECOLOGICAL RESERVE VEGETATION COMMUNITIES**

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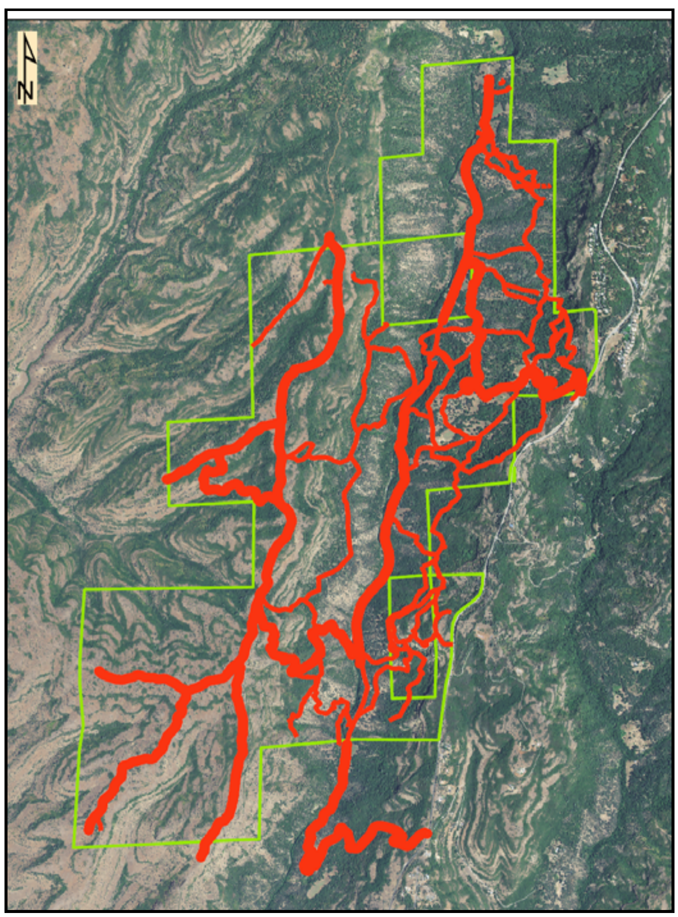
## EXISTING CONDITIONS

## BCCER

Treatment Scale

Since 1999, mechanical treatments have occurred along all major roads and some trails, which consisted of a 200-foot buffer width. The treatments, which were a major disturbance at BCCER, included removal of shrubs, surface and ladder fuels. Additionally, land managers confined treatment (burning and mechanical management) to 5 acre areas per treatment due to safety precautions and practicality issues associated with limited staff to administer treatments. Treated materials were largely burned, which given the limited resources for full removal of materials and the increased potential of uncontrolled wildfires with fuels build-up, this seemed a natural course of action. See Figure 3-A for map of fuel break historical data (personal communication, Paul Maslin).

**FIGURE 3-A. BIG CHICO CREEK ECOLOGICAL RESERVE FUEL BREAK HISTORICAL MAP**




Map by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

*Exotics Management Actions*

1.) Grazing

Historically, cattle grazed on this Reserve after European settlement. Goats, sheep, and cattle grazed this property intensively in the early 1900's. Sheep and goats had year-round access, while cattle were limited to spring and summer grazing. Land managers removed cattle in 2002; however, grazing continued from 2001-2005 on Musty Buck Ridge. Grazing has had the effect of reducing cover and forage, which was certainly the case with the high-intensity grazing in the early 1900's. More recently, the limited cattle grazing negatively affected the ecological services of BCCER not by overgrazing, but instead by eroding stream banks and increasing sedimentation in Big Chico creek. Additionally, cattle selectively chose palatable plants over unpalatable plants, which has been a contributing factor to the increase in noxious weeds. Finally, the high weight/area of hooves have compacted the soils, which lead to increases in surface runoff and erosion. This reduced soil density negatively affected native flora. Degradation of the land from overgrazing and rill de-vegetation caused concern, and fences currently hinder grazing access from surrounding landowners.

Interestingly, land managers can elect to use focused and seasonal grazing, which can be a highly-effective land management tool. Turning cattle onto a range when an undesirable plant is setting seed and taking them off before a more desirable plant begins to seed can help shift the balance of forage species. Grazing can also be used to help reduce fuel load and keep wildfire controllable. A successful example of using grazers to control wildlife and enhance native grass propagation exists in the East Bay Regional Parks of the San Francisco Bay Area, California. The land managers use cattle, sheep, and goats on over almost half of their District's 65 parks. Most of the grazing occurs in the spring and early summer, and over 4o years of experience have proven fruitful in most research accounts (East Bay Regional Park District 2011). The Foundation has considered introducing native grazers to BCCER, but in the past nearby golf course owners cited fears about the effect of unintentional Tule elk introductions onto their courses due to adjacent unfenced Reserve boundaries. The Foundation considers flash grazing an option for effective vegetation management; however, this method lacks a cost-efficient method of implementation. Land managers at BCCER may potentially implement flash grazing, which means seasonal, high-intensity grazing, by building a relationship with the university farm or local cattlemen.

2.) Mechanical

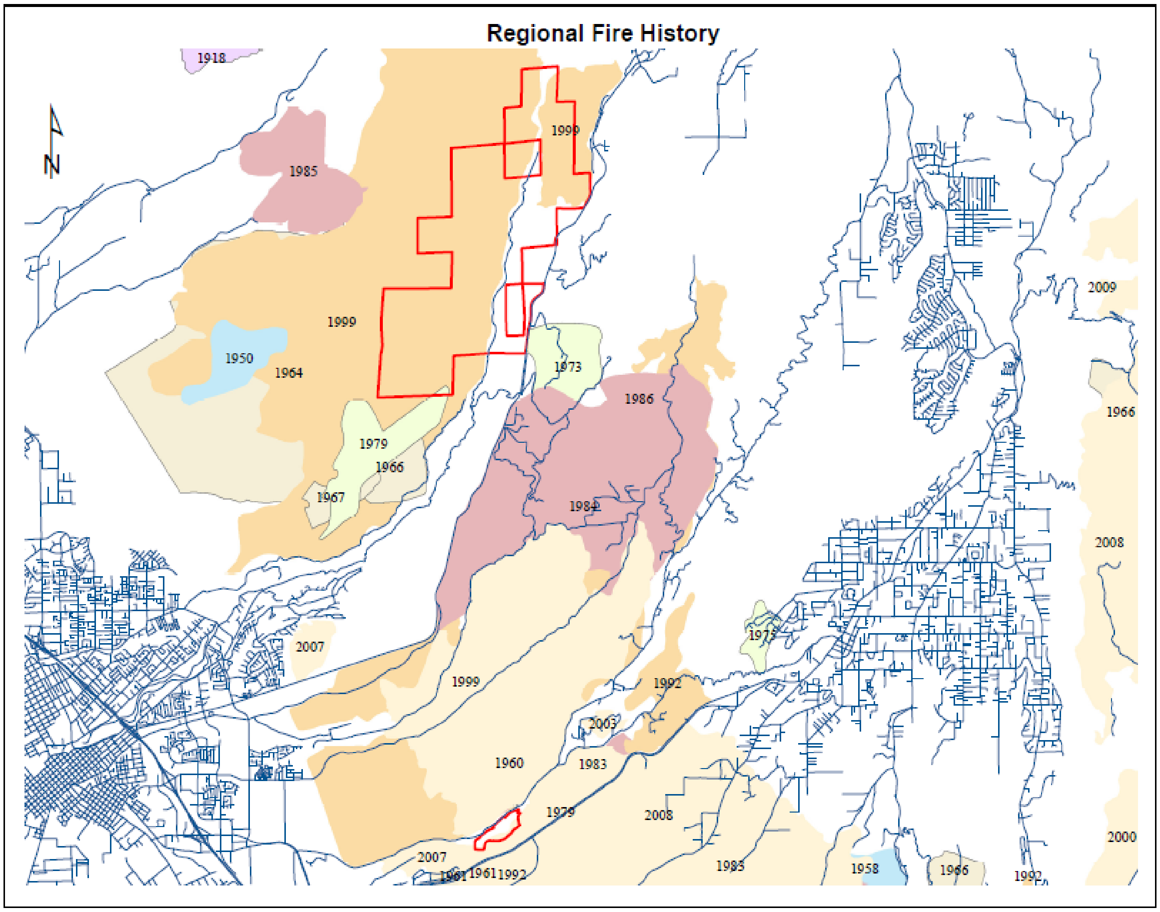
Mechanical abatement of invasive exotics includes pulling mature French (*Genista monspessulana*) and Spanish broom (*Spartium junceum*) plants through most riparian areas within the Reserve. The geographic extent of this action includes Higgin's Hole (about 4 miles upstream of the north reserve boundary) to Iron Canyon (about 0.5 miles downstream of the south reserve boundary). Annual and biannual eradication efforts to arrest recruit growth have occurred largely funded by a USFWS grant. The USFWS awarded this grant in 2004, to accommodate the broom eradication efforts at the site and four other neighboring private-property residences. Since then, annual removal of broom has not been funded but has been continued nevertheless. Funding at this point has primarily consisted of volunteer time input. Additional species removed include small patches of Himalayan blackberry (*Rubus discolor*), Klamath weed (*Hypericum perforatum*) occurring near roads, fig (*Ficus carica*) species (girdled, cut, burned, uprooted), plums (*Prunus sp.*), and Yellow-star thistle (*Centaurea solstitialis*). Burning and mowing of the Yellow-star thistle have largely failed, but improper timing and inconsistent frequency of treatment most likely produced these results. Kyser and DiTomaso 2002, provide an excellent framework for management of Yellow-star thistle based upon flowering phenology.

3.) <u>Fire</u>

In a typical agency context, prescribed burning includes running models and measuring fuel loads. Conversely, the Foundation considers prescribed burning a pragmatic approach to analyzing the landscape in order to apply treatment, but does not include running models or measuring fuel loads. Naturally-started and human-started fires have been an important ecological process for the foothill vegetation communities of the BCCER. Seasonal variations in precipitation have promoted long dry periods and abundant fuels, which have led to wildfires. Lightning provides the catalyst for these naturally-occurring burns. Portions of the property burned in 1961, 1978, 1983, 1993, and 1999 with the 1961 fire burning the most acreage on the Reserve. Figure 4-A illustrates a regional fire history (California Department of Forestry and Fire Protection 2010). In 1999, the majority of the Reserve west of Big Chico Creek burned in the Musty Buck Fire. Old fire scars and multiple-trunked trees attest to numerous earlier fires. Anecdotes about the Maidu people managing ecosystems with fire coupled with archeological evidence suggest that people set fires in the BCCER area for thousands of years. Reserve ecosystems should be considered to be adapted for periodic fire and expected to change character in its absence.

In 2007, prescribed burns primarily occurred at 12 sites consisting of 0.5 acre plots in blue oak-grass woodland habitat. Land managers used prescription burning to manage invasive species including medusa head in patches throughout the reserve. More recently, land managers mechanically treated areas within chaparral communities along Musty Buck Ridge and Sycamore Canyon in preparation for future burns. Aside from the road up the west side of BCCER which contains chaparral habitat and the northern 0.75 miles of Musty Buck Road, land managers created shaded fuel breaks along most roads in the reserve. Additionally, land managers performed brush removal in areas surrounding uncommon species and large species of trees to minimize loss in the event of uncontrolled burning. Furthermore, they cleared dead wood from the bases of trees in closed-canopy forests as a precaution.

**FIGURE 4-A. BIG CHICO CREEK ECOLOGICAL RESERVE REGIONAL FIRE HISTORY MAP**




Source: Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

<u>Natives Management Actions</u>

1.) Plant Propagation

Erosion abatement efforts facilitated riparian plant propagation in some areas. Brush or small rock check dams were constructed to slow runoff, catch silt, and speed channel re-vegetation. Land managers also focused upon seed propagation. They casually attempted to strip seeds off grasses and redistribute them by hand in areas not dominated by exotic grasses, which had indeterminate effects mostly due to lack of resources for monitoring. Land managers consider the success of this simple and inexpensive technique highly correlated with the coinciding use of other actions such as those described below. Additionally, land managers collected and planted seeds in naturally and human disturbed areas. They found this unfruitful, except in areas of high disturbance such as where they outsloped roads, or sowed seeds in cooled burn piles.

Furthermore, land managers at BCCER planted recruits from seeds sown in a greenhouse moved from BCEP to BCCER. The use of the greenhouse has been increasing, and will likely be used more extensively for restoration efforts at both Reserves. They found varied results depending upon on timing and follow-up care. Seedlings seemed to achieve higher rates of success when planted just prior to the rainy season and followed up by periodic weeding. Planting in the summer using irrigation also saw success, although land managers found this heavily time-intensive due to the hardness of the dry summer soil. Also time intensive, mature plant propagation helped establish natives in new areas. Land managers accomplished this task by digging up naturally-occurring bunches of native grasses and replanting them. Associated problems with this method included damage to the original grass plant and generated clones limiting genetic diversity. Recently, the Foundation additionally proposed that land managers could cultivate rows of native grass for seed production. This idea is under consideration, and would generate the need for a tractor and perhaps a seed drill, a harrow, and some irrigation equipment. The Foundation also is considering increases of native grass, herb, and forb seed via commercial production methods. NRCS in Lockeford could do this at a low cost. Building partnerships with the university farm would also be possible.

2.) Prescribed Burning

After the Musty Buck Fire of 1999, extensive sprouting of many woody species including California bay (*Umbellularia californica)*, scrub oak (*Quercus berberidifolia)*, live oak (*Quercus chrysolepis)*, and deer brush (*Ceanothus integerrimus*) occurred. Many seedlings of buck brush (*Ceanothus cuneatus*), manzanita (*Arctostaphylos spp.*), and grey pine (*Pinus sabiniana*) have been observed subsequent to the fire. Historically, the Native Americans burned grasslands and oak woodlands annually or semi-annually (Greenlee and Moldenke 1982). Later, oak woodlands burned at intervals of 8-15 years (Sampson 1944, 18), while the entire foothill zone burned at a median frequency of less than 20 years (McKelvey et al. 1996, 1033). More recently, native species population growth remained largely unchanged by native seed sowing after burning, although reduced exotics created room for natives within the ecosystem. Generally, burning in the early part of the wet season favored native grass recruitment at BCCER.

3.) Mitigating Wildlife Disturbance

Trying to protect developing Valley and Blue Oak recruits from foraging deer, land managers found minimal success when using plastic cylindrical tree guards and rings of “hog wire”. Not only did bears tend to destroy tree guards, but also the surviving tree guards needed constant replacement once trees emerged (typically every two years). Wire rings greater than five feet in diameter worked well though, and those three feet in diameter worked if raised off the ground a foot and fastened to two t-stakes. Additionally, a relationship exists between native grass presence and oak seedling survival (Davis et al. 2005). By addressing noxious weed abatement, possible side benefits could be oak seedling persistence.

**BCEP**

*Treatment Scale*

Treatment (burning and mechanical management) areas have been confined to less than 5-acre areas due primarily to the extent of patches being managed. These areas included the following locations: the riparian corridor adjacent to the downstream California Department of Fish and Game reserve, around the parking lot, in the overflow channel, and in the valley elderberry mitigation area. Land managers confined treatment due to safety precautions and practicality issues associated with limited staff to administer treatments. Treated materials were largely burned in piles. See Figure 5-A for map of fuel break historical data.

**FIGURE 5-A. BUTTE CREEK ECOLOGICAL RESERVE FUEL BREAK HISTORICAL MAP**


Source: Source**:** Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

Exotics Management Actions

1.) Removing exotics

Invasive exotics dominate in much of the Preserve. Common exotics include Spanish broom (*Spartium junceum*), Yellow-star thistle (*Centaurea solstitialis*), Himalayan blackberry (*Rubus discolor*, vinca (*Vinca* sp.), tree of heaven (*Ailanthus altissima*), and cocklebur (*Xanthium spinosum*). Land managers have primarily targeted the eradication of vegetation such as Himalayan blackberry, vinca, and Spanish broom. BCEP benefited from the volunteer efforts of community groups and interns pulling broom and blackberry. Additionally, land managers have managed star thistle primarily with burning and mowing. Summer mowing during initial flowering seemed to effectively minimize recruitment and subsequent cover of star thistle, while prescribed burning has been used to reduce star thistle seedlings and senescent stems (Kyser and DiTomaso 2002, 648). Currently areas of the overflow channel are being burned to reduce the accumulation of star thistle stems and are being re-vegetated with native herbs, forbs and grasses collected on site.

2.) Burning

Land managers have used prescribed fire since 2010 in areas along the riparian forest at the southwestern edge of the preserve, near the parking lot, and in the overflow channel. Other fire-related changes to the landscape have been the Honey Fire of 2007, which burned through the southwest portion of the preserve (approximately 5 acres in area). The Humboldt Fire of 2008 burned through roughly parallel to the areas burned by the Honey Fire. Wildfire affected approximately 40 acres of riparian forest and floodplain grassland. Burn area rehabilitation is currently focused on approximately 10 of the 40 acres burned by the Humboldt Fire.

In 2009, the Butte County Fire Safe Council completed the Honey Run Shaded fuelbreak project. This project resulted in fuel reduction along an area within 300 feet of Honey Run Road. Re-treatment of these areas will be needed due to re-sprouting of species in these targeted areas.

Natives Management Actions

1.) Encouraging natives

Native grass plugs, herbs, and shrubs have been planted; this occurred within portions of the overflow channel. Additionally, Isolated patches of natives, including Santa Barbara sedge (*Carex barbarae*), and mugwort (*Artemesia douglasiana*), exist among the European-based exotic annual grasslands. Restoration activities occurring within the last ten years include planting of a native garden near the outdoor classroom in an area dominated by non-native annual grasslands. K-12 school groups, as well as students from university courses and university-based clubs, assisted with and carried out these restoration activities. Steps were taken to use local ecotypes and avoid hybrids of these plants when possible (Hankins 2007, 3). Species planted in this garden include the following: yerba santa (*Eriodictyon californicum*), gum plant (*Grindelia robusta*) and buckwheat (*Eriogonum* sp.), native bunchgrasses (primarily deer grass [*Muhlenbergia rigens*]), Juncus (*Juncus* sp.), blue oak (*Quercus douglasii*) and valley oak (*Q. lobata*) seedlings, California poppy (*Eschscholzia californica*), California rose (*Rosa californica*), mountain pink currant (*Ribes nevadense*), and Penstemon (*Penstemon* sp.).

Other seed propagation and plant propagation activities occurring within the last couple years include planting mugwort, blue wild rye, gum plant, deer grass, and Lemon's needle grass. Land managers propagated deergrass from wild populations along Honey Run Road. They placed initial outplantings in patches located on the southeastern floodplain. Additionally, they planted plugs of blue wild rye in some areas near the entrance gate. Furthermore, they planted onsite-collected mugwort and gum plant in depressions near the parking lot, while Lemon's needlegrass, originally collected from BCCER, was outplanted in the overflow channel. In general, seed stock has come from local sources such as the BCCER site and seeds propagated in the BCCER greenhouse. Incidentally, the former field director of BCCER provides some of this obtained grass stock from his Chico property. Great care is taken to ensure the use of local ecotypes by fostering relationships with native nurseries in the area. Ideally, a relationship with the Chico State University Farm would provide a seed stock source at a low cost.

Additionally, the California Department of Transportation (CalTrans) has used BCEP as an offsite mitigation area for local developments including the impacted, federally threatened, Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Translocated Mexican elderberry (*Sambucus Mexicana*) supports the threatened Valley elderberry longhorn beetle. Additionally, CalTrans currently funds wetland restoration and enhancement related to BCEP (Stemen *et al*. 2005, 1).

2.) Soil Restoration

Less than optimal soil conditions exist at the Preserve due to historical gold, sand, and gravel mining. Mining has stripped the topsoil, leaving degraded conditions which hinder native plant growth and restoration (Behnke 1990, 4). Previous land owners placed most of the overburden soils from the site in the northeast portion of the preserve, where the soils occupy approximately five acres at a depth of approximately 5 feet (Wert & Associates 1991, 1). Soil analysis profiles reveal gravelly-sandy loam and silty-clay loams buried under approximately 5-6 feet (1.5-1.8 meters) of cobble (Holtgrieve et al. 2000). This lack of organic soil hinders native vegetation growth, particularly of annual grassland dominated areas (Hankins 2007). However, existing sedges and willows along the riparian corridor promote fine sediment and organic matter build-up, which increase viable soil for native vegetation propagation. Although, due to the highly permeable nature of the soils, the bank along the riparian corridor drops sharply into Butte Creek. Water undercuts the bank, which jeopardizes riparian growth.

# NEEDS ASSESSMENT AND IMPLEMENTATION

## Needs Assessment

Needs are driven by constraints and threats to proper ecosystem function of the Reserves. The following descriptions highlight current needs of the Reserves:

### A. Minimize Anthropogenic Disturbance

Users trample sensitive vegetation areas along Big Chico Creek and Butte Creek to a lesser extent. Furthermore, a bank is eroding into Butte Creek which supports an old road along the creek. Additionally, exotic seed introduction at both locations comes from the shoes, clothing, and equipment of users, along with introduction from dogs entering permitted areas of the Reserves. A need exists to establish designated trails and interpretive signage.

### B. Encourage Native Propagation

The blue and valley oak woodlands currently existing on the Reserve show limited evidence of re-generation. A need exists for continued recruitment studies, which land managers could use to identify best management practices to promote oak recruitment. For instance, generated information could support hypotheses indicating that at BCEP oaks seem to propagate well under the canopy of shrubs. Additionally, actions such as native grass seed propagation and recruitment, enhancing soil health, and planning for disturbances, such as flooding and fire, will likely bring about desired results.

### C. Exotics Management

Land managers must manage the non-native naturalized European-based exotic species to the extent possible, especially noxious weeds and grasses. These exotic species not only increase wildfire threat, but they frequently work directly against native species propagation. For a list of the most common or most invasive species, see Table 1.

### D. Fuels Management

Fuel management not only reduces wildfire threat, but also discourages exotics and encourages natives when applied during the appropriate season(s) or according to target species phenology. Fire suppression in the Western U.S. has been shown to be inadequate and counterproductive since it allows fuel to accumulate. Each year the amount spent on fire-fighting goes up and so does the damage done by wildfires. Effective habitat management must assume fire will occur and focus on controlling the way fires will affect the ecosystem. Deliberately set and controlled fires can be an important management tool. A fire management strategy specific to the major vegetation assemblages at a landscape-scale should be explored. Vegetation mosaics would promote fire-resistance of older-stand vegetation on the Reserves. However, prescribed burns can create concerns about air pollution and can generate anxiety due to the proximal locations of the Reserves to the Forest Ranch community and the urban area of Chico. A need exists to implement a smoke management plan.

**TABLE 1-A. EXOTICS PRIMARY THREATS**

| Scientific Name | Common Name | Description |
|---|---|---|
| *Sanguisorba minor* | Garden Burnet | Perennial forb/herb. Tolerant to cold winters, drought, and weakly saline to weakly acidic sites. |
| *Carduus pycnocephalus* L. | Italian Plumeless Thistle | Annual forb/herb. Noxious weed. |
| *Silybum marianum* | Milk Thistle | Annual/biennial herb. Invades roadsides, ditches, and disturbed land. |
| Spartium junceum | Spanish Broom | Perennial, leguminous shrub. Noxious invasive species. |
| *Hypericum perforatum* | Klamath Weed | Perennial grass. Noxious weed. |
| *Ficus carica* | Edible Fig | Large, deciduous shrub or small tree. Shade tolerant. Invades native-plant-dominated riparian areas. |
| *Rubus discolor* | Himalayan Blackberry | Robust, thicket forming shrub. Perennial. Tolerant of disturbance and flooding. |
| *Prunus sp.* | Plum | Large, deciduous shrub or small tree. Depletes soil moisture. |
| *Centaurea solstitialis* | Yellow Star-Thistle | Annual forb. Rapid colonizer. Dense infestations. Depletes soil moisture. Noxious weed. |
| *Taeniatherum caput-medusae* | Medusahead | Annual grass. Noxious weed. Extremely competitive. |

E. Management at the Landscape Level

Although locally-focused management actions have their place in restoration planning, land managers must remember to implement their management strategies with the proper scale in mind. Local actions alone cannot bring about changes that need consideration of the entire ecosystem. Management strategy specific to the major vegetation assemblages at a landscape-scale should be explored. Vegetation mosaics create disruptions in disturbance as well as differing plant propagation strategies (i.e., wind, water, and fire pollination). A holistic assessment of the landscape will likely bring about desired results. A need exists to continue identifying the response of major vegetation communities to differing propagation and eradication treatments. There are also legal constraints tempering management actions. Habitat modifications must meet the requirements of the Endangered Species Act 1973, which could be considered a “take” of those species. Additionally, the CDFG Code Sections 404, 1601, and 1603 and other code sections protect all areas of riparian habitat .bank, bed, or perimeter) within the Reserves. A provided list from the USFWS of likely rare species known to inhabit the Reserves occurs in Appendices C (BCCER-Cohasset Quadrangle) & D (BCEP-Paradise West Quadrangle).

F. Maintain and/or Increase Funding for Management Activities

The University Research Foundation owns the Reserves, and the Institute for Sustainable Development of the California State University, Chico manages them. Currently, the Reserves are officially managed by one director and one field director, the former employed full-time and the latter employed part-time (20% course release from his position as a California State University, Chico Associate Professor) in this capacity. One part-time paid employee also assists with many current management actions. Additionally, California State University, Chico students serve as interns for a limited time span on the Reserves. Unofficially, one former field director and a number of volunteers/interns support vegetation management activities as well. However, spatial and temporal constraints limit implementation of management activities. Lack of funding primarily drives this lack of staffing. A need exists to identify and secure funding to implement exotics management and specific restoration activities. The other revenue available to management projects at the Reserves consist of fundraising once in the spring for BCCER (Candles in the Canyon), which brings in an estimated $20/30,000 profit per year. Additionally, the hunting program carried out on the Reserves generates approximately $12,000 per year. All other funding comes from volunteer time input. No other current or past base funding exists for the various programs and operations of the Reserves.

Management Decision Matrix

Implementation of specific, discrete tasks will be undertaken with the use of the Management Decision Matrix (Appendix E). This matrix contains specific management actions to be implemented that will address and satisfy the goals and objectives posed in the needs assessment section above. Not only are the locations of the activities listed, but also the spatial extent, urgency, ability to manage, timeline, required frequency of activity, and cost are as well. This matrix can be updated as needed, and will structure the prioritization of tasks. Many methods of treatment exist to combat exotics including burning, mowing, hand pulling, herbicide use, grazing, and use of power tools such as chain saws. A multi-method approach usually has the highest rate of success with abatement. Proper timing of treatment by season and frequency also contribute to success. For example, springtime burning can reduce the set of Yellow-star thistle as well as exotic annual grasses or forbs.

Monitoring and Adaptive Management

Additionally, monitoring of all items within the Management Decision Matrix will provide opportunities for adaptive management. The need exists to implement the following monitoring plans. A monitoring plan for vegetation management of BCCER (adapted from Commons 2010) is located in Appendix E. An additional monitoring plan for vegetation management of BCEP (Commons 2010) exists in Appendix G. Finally, a vegetation monitoring sheet appears in Appendix H. These plans provide appropriate and fixed timelines for monitoring activities, along with the necessary protocol for data collection and management. Using collected data will give managers the ability to inform and update management strategies within the Management Decision Matrix. If funding becomes an issue, use of California State University, Chico undergraduates and graduate students should be considered. Additionally, contributing community members and visiting K-12 classes may allay financial concerns regarding need for volunteers on the Reserves. Monitoring activities, like any other management activities, do not have a separate funding pool.

## NARRATIVE OF IMPLEMENTATION OBJECTIVES

A. Contain anthropogenic disturbance.

Use of the Reserves should be in accordance with all posted rules encouraging natives and discouraging exotics.

A1. Preserve natural resources of the Reserves in order to maintain both ecological processes and biological diversity, and protect the Reserves from undue encroachment or damage by human activities.

Natural resource management includes proactive measures to protect natural habitats as well as passive mitigation of human interference in management activities.

A1.1. Minimize anthropogenic disturbance without minimizing recreational and research opportunities at the Reserves.

Although management should foster goals important to the ecological processes of the Reserves, users should not be unduly restricted in their use of resources.

A.1.1.1. Post interpretative signage for users to alert to identification and impacts of exotics.

Users should read signage prior to entrance onto the Reserves and consider themselves informed of rules and regulations concerning exotics management.

A.1.1.2. Develop protocol to request shoes and clothing be cleaned of seeds prior to entering the Reserves.

Users acquainted with exotics impacts on the Reserves should take proper precautions to actively prevent seed dispersal.

A1.2. Develop and implement habitat monitoring program.

A habitat monitoring program will promote targeted faunal population stabilization.

A1.2.1. Conduct assessment and develop step-down narrative. Revise as appropriate.

A narrative will promote shared goals and vision, while revisions will accommodate adaptive management principles.

B. Encourage native species propagation.

Native vegetation loss profoundly affects ecosystem functions, species richness, and native species foraging opportunities. Opportunities to expand native populations should be capitalized upon.

B1. Encourage natives while maximizing their genetic diversity. Propagation of non-cloned natives will maximize and strengthen the genetic biodiversity of the area. Implement proactive measures to increase numbers and density of native plant species.

A proactive approach to establishing native species populations will minimize the need for reactionary tactics, which are frequently resource sinks.

B1.1. Re-establish or expand populations of native species and maintain genetic integrity whenever possible (e.g. enhance soil health, increase native recruitment).

Increase the viability of native plant propagation by setting up optimal conditions for their increased fitness.

B1.1.1. Identify existing populations.

Locate natural and anthropogenic native vegetation communities in the Reserves. Identify density and diversity needs.

B1.1.2. Strip seeds off native grasses and casually redistribute.

Identify native grasses to strip seeds and redistribute seeds, especially in disturbed. Sowed seeds showing an affinity for burned and aerated soils. Local seeds may be gathered and re-distributed in more optimal areas to promote recruitment.

B1.1.3. Collect, increase, propagate, outplant, monitor, and manage native seeds.

Outplant seeds from genetically diverse but ecotypical sources in areas where need identified.

B1.1.4. Manage areas where native seeds planted.

Extensive evidence that weeded areas lead to higher rates of vegetation establishment due to elimination of resource competition. A good success criterion would be establishment of native plants at a rate of 10% higher in weeded patches when compared to a similar group of native plants in a similar but un-weeded plot.

B1.1.5. Clone and propagate root stock to plant native grasses.

Cloned plants have a high rate of success, especially Blue Wild Rye grass (*Elymus glaucus*). Lack of genetic diversity should limit this action to some extent though. Additionally, some species are difficult to propagate by seed. Collection of root stock and other methods should be used as necessary.

B1.1.6. Monitor and enhance Mexican elderberry (*Sambucus mexicana*) dominance to mitigate for local development impacts to the federally-threatened Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*).

Managers should support planted Mexican elderberry to maintain this mitigation site at Butte Creek Ecological Preserve (BCEP).

B1.1.7. Enhance Blue (*Quercus douglasii*) and Valley Oak (*Quercus lobata*) recruitment and survival at BCCER.

Due to limited regeneration of Valley and Blue Oaks, seedlings must be protected from foraging wildlife. When recruitment is low, wire mesh rings can promote survival in the juvenile stages. Wire mesh rings have been successfully implemented across many of the Reserve oak communities. Rings should be periodically replaced and occasionally reassessed for success. A study to assess blue oak recruitment has been proposed at BCCER.

B1.1.8. Develop soil restoration test plots and assess methods suitable to restore degraded soils at BCEP.

Intensive historical land-use of BCEP requires regeneration of healthy soils. Due to a general lack of developed soil horizons, placing borrowed soils on re-vegetation areas may increase native vegetation establishment. Transportation of organic matter, in the form of compost or soil from other sites, to propagation sites may increase successful vegetation establishment. Additionally, targeted manipulations of the soil like mycorrhizal introductions may increase the recruitment of native species. Further manipulations could include incorporation of activated carbon to negate high nitrogen content. This has been shown to favor native over non-native grass recruitment (Henegan et al. 2008, 612). Land managers can achieve native recruitment by developing soil restoration test plots and assessing methods suitable to restore degraded soils.

B1.1.9. Diversification of tree age class structure through thinning, burning, and other treatments.

Ecosystem resiliency depends upon diversified tree age classes. Due to logging practices, wildfires, and other anthropogenic and natural disturbances, trees stands tend to occur in evenly distributed patches. Selective thinning, burning, and other treatments may enhance community resiliency to future disturbance.

B1.1.10. Consult with the local Native American community to identify, enhance and manage culturally significant plants.

Some Native Americans in the area have the ability to identify and enhancenative plant populations due to their cultural knowledge of flora in the region. Consultation may enhance native plant populations as well as promote effective management of them.

B.2. Monitor and adaptively manage natives.

Currently, management treatments have revealed strategic techniques (burning during certain times or with differing frequencies, particularly at BCCER) for encouraging native grasses. Identifying contextually specific effective techniques should enhance natives' propagation.

B2.1. Management treatments should be continued for longer time frames to give succession a chance to occur and be studied.

Treatments frequently require a multi-season timeframe to adequately monitor and assess succession trends using multiple techniques.

B2.1.1. Continue to conduct assessments of techniques specific to both sites.

Consult the monitoring section of this plan (Appendices F & G) for guidelines.

C. Discourage exotic species propagation.

Many non-native species monopolize the sites due to disturbance and a lack of competition.

C1. Reduce populations of exotic species and prevent their spread.

Proactive measures to remove exotic species must be planned spatially and temporally and implemented consistently.

C1.1. Identify exotic species distribution.

Conduct survey with specific protocols to determine the locations of exotics on both Reserves.

C1.1.1. Survey locations of exotic species populations.

Use GPS coordinates to set up map of exotic species distribution for both Reserves.

C1.2. Elimination or reduction of exotics.

Specific management actions such as mechanical, chemical, and biological methods must be implemented depending on the life histories of targeted exotics.

C1.2.1. Eliminate or reduce edible fig (*Ficus carica*) trees .

Primarily an issue in BCCER riparian areas, the edible fig trees can be successfully eradicated by use of girdling, cutting, burning, and uprooting. Using herbicides may be a potentially effective management tool as well.

C1.2.2. Eliminate or reduce Yellow-star thistle (*Centaurea solstitialis*).

A system wide issue for both BCCER and BCEP, techniques for star thistle removal have included burning and mowing directly before seed set in the late spring. Removal without plans for native grass propagation in removal sites are a poor use of resources.

C1.2.3. Eliminate or reduce French (*Genista monspessulana*) and Spanish broom (*Spartium junceum*).

Grants for pulling this fast-spreading primarily riparian plant have been procured for BCCER. Managers have used hand-pulling as a primary elimination technique and should continue to do so.

C1.2.4. Eliminate or reduce Himalayan blackberry (*Rubus discolor*).

A system wide issue for both BCCER and BCEP, managers have used hand-pulling as a primary elimination tool and should continue to do so.

C1.2.5. Eliminate or reduce Medusa-head (*Taeniatherum caput-medusae*) grass.

A system wide issue for both BCCER and BCEP, managers have used burning as a primary elimination tool and should continue to do so. In addition, planting native grasses in these treatment areas enhances the population viability of perennial slower-growing native grasses rather than fast-growing annual invasive grasses.

C1.2.6. Eliminate or reduce Exotic plum (*Prunus sp*.).

An issue in BCCER, exotic plum trees can be successfully eradicated by girdling.

C1.2.7. Eliminate or reduce Klamath weed (*Hypericum perforatum*).

A system wide issue for both BCCER and BCEP, managers have used cutting as a primary elimination tool and should continue to do so. In addition, herbicides should be considered for use in plant elimination. Furthermore, planting native grasses in these treatment areas enhances the population viability of perennial slower-growing native grasses rather than fast-growing annual invasive grasses.

C1.2.8. Eliminate or reduce Garden Burnet (*Sanguisorba minor*).

A system wide issue for both BCCER and BCEP, managers have not begun elimination efforts for this perennial herb. Herbicides should be considered when populations are not located proximally (within 150 ft.) to riparian areas.

C1.2.9. Eliminate or reduce Italian Plumeless Thistle (*Carduus pycnocephalus L.*).

A system wide issue for both BCCER and BCEP, managers have not begun elimination efforts for this species. Herbicides should be considered when populations are not located proximally (within 150 ft.) to riparian areas.

C1.2.10. Eliminate or reduce Milk Thistle (*Silybum marianum*).

A system wide issue for both BCCER and BCEP, managers have not begun elimination efforts for this species. Herbicides should be considered when populations are not located proximally (within 150 ft.) to riparian areas.

C2. Monitor and adaptively manage exotics.

Currently, management test plots have revealed strategic techniques (burning during certain times or with differing frequencies, particularly at BCCER) for removing annual exotic grasses. Managers do not currently use grazing as an exotics management tool, but should consider doing so.

C2.1. Continue to block access to traditional cattle grazing. Consider short term grazing as a management tool; reintroduction of native grazers should be encouraged.

Block traditional cattle grazing and support flash grazing as a management tool.

C2.1.1. Flash grazing should be considered if funds permit.

Native grazing and focused seasonal grazing by small non-soil compacting species such as goats should be considered. Currently funds cannot support this management technique.

C2.2. Establish and monitor management test plots to study treatment effects on exotics.

Grasses management requires a multi-season timeframe to adequately monitor and assess successional trends using multiple techniques.

C2.2.1. Establish monitoring plots to study treatment effects on exotics.

Establish plots within pertinent vegetation communities or at convenient enough locations to ensure ability to continue seasonal treatments.

C2.2.2. Conduct assessments of techniques specific to both sites.
Consult the monitoring section of this plan (Appendices F & G) for guidelines.

D. Practice fire and fuel control.

While fire is an integral part of this region's natural processes, severe and intense fires over extensive areas could be detrimental to conservation and management objectives. Proactive fire management and fuel reduction should be used to mitigate for wildfire.

D1. Reduce wildfire threat.

Actions must be taken to ensure fire resistance and fire resiliency with the vegetation communities of both sites.

D1.1. Develop, implement, and monitor a fire management strategy appropriate to vegetation communities occurring at the Reserves.

Management of the Reserves should be in expectation of fire and other natural processes.

D1.1.1. Develop, implement, and monitor a fire and fuels management strategy (i.e. prescribed burning plan) appropriate to achieve conservation and management objectives appropriate to each vegetation community type.

Plan needs to be updated and express quantifiable and discrete objectives.

D1.1.2. Maintain an agricultural hazard reduction burn permit.

Coordinate with agencies (Air Quality Management District, CalFire, Bureau of Land Management, Department of Fish and Game, and U.S. Fish and Wildlife Service) to plan and implement burning as appropriate.

D1.1.3. Generate a smoke management plan.

Consult with Butte County Air Quality, in conjunction with CalFire, to identify appropriate smoke management strategies to ensure continued good relations between the Reserves staff and neighboring communities.

E. Manage at a landscape scale.

Ecosystem function occurs at every scale. When implementing actions, managers must consider the effects of the action on a landscape scale.

E1. Maintain a landscape that supports natural processes and habitat.

Managers must perform actions at the appropriate scalar context.

E1.1. Holistic management for flora and fauna - on an ecosystem rather than species level; maintain the Reserve as part of a larger ecosystem.

Managers must consider species management by habitat rather than by individual populations, although they may target species' habitat that seems to support the highest biodiversity values possible.

E1.1.1 Identify and preserve fish and wildlife habitat.

Species of special interest exist at both BCCER and BCEP. There are some threatened or endangered species (see Appendices B and C); however, other species are under scrutiny due to research projects. Regardless, habitat of these species must be managed with care at a fine scale.

F. Secure resources for management activities.

Identify, seek, and secure sustainable funding for management and monitoring activities.

F1. Increased financial resources should adequately fund all management activities and labor needed to support the Reserves goals.

Management activities require adequate financial resources.

F1.1. Maintain and/or increase staff and labor resources.

Increase supporting staff and labor for the Reserves.

F1.1.1. Identify staffing needs and promote volunteership.

Conduct needs assessment to determine staffing needs and demands. Secure funding or time compensation for desired staff positions. Encourage volunteer work from surrounding community residents and faculty, staff, and students from California State University, Chico and Butte-Glenn Community College.

F2.1. Increase budget for management activities.

Increase financial resources by soliciting funds.

F2.1.1. Support fundraising activities.

Continue support of Candles in the Canyon, the Hunting Program, IRA funds, and elderberry mitigation. Expand fundraising efforts, and build mutually beneficial relations with surrounding communities and California State University, Chico and Butte-Glenn Community College.

F2.1.2. Develop and implement a financial management plan.

Conduct needs assessment and draft a financial management plan. Implement plan.

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APPENDIX B

**TABLE 1-B. COMPILED VEGETATION SPECIES LIST**

| SCIENTIFIC NAME | COMMON NAME | BCEP | BCCER | NATIVE |
|---|---|---|---|---|
| *Acer macrophyllum* | Big-leaf maple | | x | YES |
| *Acer negundo var. californicum* | Box-Elder | x | | YES |
| *Achyrachaena mollis* | Blow wives | | x | YES |
| *Adiantum capillus-veneris* | Venus-hair fern | | x | YES |
| *Adiantum jordanii* | California maidenhair | | x | YES |
| *Aesculus californica* | California buckeye | | x | YES |
| *Agoseris heterophylla* | Annual agoseris | | x | YES |
| *Agrostis exarata* | Spiked Bentgrass | x | | YES |
| *Ailanthus altissima* | Tree-Of-Heaven | x | | NO |
| *Aira caryophyllea* | Silver European hairgrass | | x | NO |
| *Allium amplectens* | Clasping onion | | x | YES |
| *Allium peninsulare var. peninsulare* | Mexican onion | | x | YES |
| *Alnus rhombifolia* | White Alder | x | x | YES |
| *Amsinkia menziesii var. intermedia* | Common fiddleneck | | x | YES |
| *Amsinkia menziesii var. menziesii* | Menzie's fiddleneck | | x | YES |
| *Anagallis arvensis* | Scarlet pimpernell | | x | NO |
| *Andropogon virginicus var. virginicus* | Broomsedge Bluestem | x | | NO |
| *Anthemis cotula* | Mayweed | | x | NO |
| *Anthriscus caucalis* | Bur-chervil | | x | NO |
| *Aphanes occidentalis* | Western lady's mantle | | x | YES |
| *Arceuthobium campylopodum* | Western Dwarf Mistletoe | x | | YES |
| *Arceuthobium occidentale* | Dwarf Gray Pine Mistletoe | x | x | YES |
| *Arctostaphylos manzanita* | Parry manzanita | | x | YES |
| *Arctostaphylos manzanita ssp. manzanita* | Big Manzanita | x | | YES |
| *Arctostaphylos viscida ssp. viscida* | White-Leaved Manzanita | x | | YES |
| *Aristida ternipes var. hamulosa* | Hook Three-Awn | x | | YES |
| *Aristolochia californica* | California Pipevine | x | x | YES |
| *Artemisia douglasiana* | Douglas' mugwort | x | x | YES |
| *Asclepias speciosa* | Showy Milkweed | x | | YES |
| *Aster chilensis var. chilensis* | Califorica Aster | x | | YES |
| *Astragalus gambelianus* | Gambel's dwarf locoweed | | x | YES |
| *Athysanus pusillus* | Petty athysanus | | x | YES |
| *Avena barbata* | Slender Wild Oat | x | x | NO |
| *Avena fatua* | Slender wild oats | x | x | NO |
| *Baccharis pilularis* | Coyote-Brush | x | | YES |
| *Baccharis salicifolia* | Mule's-Fat | x | | YES |
| *Berberis aquifolium* | Jepson's barberry | | x | YES |
| *Bidens frondosa* | Sticktight | x | | YES |
| *Brassica nigra* | Black mustard | | x | NO |
| *Brickellia californica* | California Brickellia | x | | YES |
| *Briza minor* | Small quaking grass | | x | NO |
| *Brodiaea californica* | California brodiaea | | x | YES |
| *Brodiaea elegans* | Elegant brodiaea | | x | YES |
| *Brodiaea minor* | Blue stars | | x | YES |
| *Bromus carinatus ssp. carinatus* | California brome | | x | YES |
| *Bromus diandrus* | Ripgut Brome | x | x | NO |
| *Bromus hordeaceus* | Soft Chess | x | x | NO |
| *Bromus laevipes* | Woodland brome | | x | YES |
| *Bromus madritensis ssp. rubens* | Red Brome | x | x | NO |
| *Bromus madritensis var. madritensis* | Foxtail brome | | x | NO |
| *Bromus sterilis* | Poverty brome | | x | YES |
| *Calandrinia ciliata* | Red maids | | x | YES |
| *Callitriche heterophylla* | Variable-Leaved Water-Starwort | x | | YES |
| *Calocedrus decurrens* | Incense cedar | | x | YES |
| *Calochortus luteus* | Yellow mariposa lily | | x | YES |
| *Calochortus monophyllus* | Yellow star-tulip | | x | YES |
| *Calochortus superbus* | Superb rnariposa lily | | x | YES |
| *Calycadenia oppositifolia (CNPS LIST 1B)* | Butte calycadenia | | x | YES |
| *Calycadenia sp. (no flowers)* | Rosinweed | | x | YES |
| *Calycanthus occidentalis* | Western Spicebush | x | x | YES |
| *Capsella bursa-pastoris* | Shepherd's purse | | x | NO |
| *Cardamine californica var. californica* | MilLmaids | | x | YES |
| *Cardamine oligosperma* | Western bitter cress | | x | YES |
| *Carex barbarae* | Santa Barbara Sedge | x | x | YES |
| *Carex densa* | Dense sedge | | x | YES |
| *Carex multicaulis* | Many-stemmed sedge | | x | YES |
| *Carex nudata* | Torrent Sedge | x | x | YES |
| *Carya illinoinensis* | Pecan | x | | NO |
| *Castilleja affinis ssp. affinis* | Lay-and Collie's Indian paintbrush | | x | YES |
| *Castilleja attenuata* | Valley tassels | | x | YES |
| *Castilleja lacera* | Cut-leaved Indian Paintbrush | | x | YES |
| *Ceanothus cuneatus var. cuneatus* | Buckbrush | x | x | YES |
| *Ceanothus integerrimus* | Deerbrush | | x | YES |

**TABLE 1-B. (CONTINUED)**

| SCIENTIFIC NAME | COMMON NAME | BCEP | BCCER | NATIVE |
|---|---|---|---|---|
| *Centaurea solstitialis* | Yellow Star-Thistle | x | x | NO |
| *Centuarium venustum* | Canchalagua | | x | YES |
| *Cephalanthus occidentalis* | California buttonbush | x | x | YES |
| *Cerastium glomeratum* | Sticky chickweed | | x | NO |
| *Ceratophyllum demersum* | Hornwort | x | | YES |
| *Cercis occidentalis* | Western Redbud | x | x | YES |
| *Cercocarpus betuloides* | Mountain rnahogany | | x | YES |
| *Chamaesyce serpyllifolia ssp. serpyllifolia* | Thyme-Leaved Spurge | x | | YES |
| *Chamllesyce ocellata ssp. ocellata* | Valley spurge | | x | YES |
| *Chamomilla suaveolans* | Common pineapple weed | | x | NO |
| *Chenopodium ambrosioides* | Mexican-Tea | x | | NO |
| *Chenopodium botrys* | Jerusalem-Oak | x | | NO |
| *Chlorogalum angustifolium* | Narrow-leaved soaproot | | x | YES |
| *Chlorogalum pomeridianum* | Wavy-leaved soaproot | x | x | YES |
| *Cichorium intybus* | Chicory | x | x | NO |
| *Cirsium vulgare* | Bull Thistle | x | x | NO |
| *Clarkia purpurea ssp. quadrivulnera* | Purple clarkia | | x | YES |
| *Claytonia parviflora* | Srnall-flowered rniner's lettuce | | x | YES |
| *Claytonia perfoliata* | Miner's lettuce | | x | YES |
| *Clematis lasiantha* | Chaparral clematis | | x | YES |
| *Clematis ligusticifolia* | Western virgin's bower | | x | YES |
| *Collinsia heterophylla* | Chinese houses | | x | YES |
| *Collinsia sparsiflora* | Few-flowered collinsia | | x | YES |
| *Comandra umbellata* | Bastard toadflax | | x | YES |
| *Convolvulus arvensis* | Bindweed | | x | NO |
| *Conyza canadensis* | Canadian Horseweed | x | | YES |
| *Conyza floribunda* | Many-Flowered Horseweed | x | | NO |
| *Conyza sp.* | Horseweed | | x | NO |
| *Cornus glabrata* | Brown dogwood | | x | YES |
| *Cornus sessilis* | Black-fruited dogwood | | x | YES |
| *Crassula connata* | Pygmyweed | | x | YES |
| *Crucianella angustifolia* | Crosswort | x | | NO |
| *Crypsis schoenoides* | Swamp Pricklegrass | x | | NO |
| *Cryptantha flaccida.* | Cryptantha | | x | YES |
| *Cynoglossum grande* | Pacific hound's tongue | | x | YES |
| *Cynosurus echinatus* | Hedgehog Dogtail | x | x | NO |
| *Cyonodon dactylon* | Berrnudagrass | | x | NO |
| *Cyperus eragrostis* | Tall Cyperus | x | x | YES |
| *Cyperus strigosus* | False Nutsedge | x | | YES |
| *Cystopteris fragilis* | Brittle fern | | x | YES |
| *Darmera peltata* | Indian-rhubarb | | x | YES |
| *Daucus pusillus* | Rattlesnake-weed | | x | YES |
| *Delphinium hesperium ssp. pallens?* | Larkspur | | x | YES |
| *Delphinium nudicale* | Red larkspur | | x | YES |
| *Delphinium patens ssp. patens* | Slender larkspur | | x | YES |
| *Delphinium variegatum* | Royal larkspur | | x | YES |
| *Deschampsia danthonoides* | Annual hairgrass | | x | YES |
| *Dichelostemma capitatum* | Blue dicks | | x | YES |
| *Dichelostemma multiflorum* | Many-flowered ookow | | x | YES |
| *Dichelostemma pulchellum* | Blue dicks | | x | YES |
| *Dichelostemma volubile* | Twining ookow | | x | YES |
| *Digitaria sanguinalis* | Hairy Crabgrass | x | | NO |
| *Dodecatheon clevelandii ssp. patulum* | Lowland shootingstar | | x | YES |
| *Draba verna* | Spring whitlow grass | | x | NO |
| *Dudleya cymosa* | Spreading dudleya | | x | YES |
| *Echinochloa colona* | Jungle-Rice | x | | NO |
| *Echinochloa crus-galli* | Barnyard Grass | x | | NO |
| *Eleocharis sp.* | Spikerush | | x | YES |
| *Elymus elymoides* | Squirreltail | | x | YES |
| *Elymus glaucus ssp. glaucus* | Blue Wild-Rye | x | x | YES |
| *Elymus multisetus* | Big Squirreltail | x | | YES |
| *Epilobium brachycarpum* | Tall Annual Willowherb | x | | YES |
| *Epilobium canum ssp. latifolium* | California fuchsia | | x | YES |
| *Epilobium ciliatum ssp. ciliatum* | Fringed Willowherb | x | x | YES |
| *Epilobium densiflorum* | Dense-flowered spike-prirnrose | | x | YES |
| *Epilobium minutum* | Srnall-flowered willow herb | | x | YES |
| *Epilobium torreyi* | Torrey's spike-prirnrose | | x | YES |
| *Epipactis gigantea* | Stream orchid | | x | YES |
| *Equisetum arvense* | Common Horsetail | x | | YES |
| *Equisetum laevigatum* | Smooth Scouring-Rush | x | | YES |
| *Eremocarpus setigerus* | Turkey-Mullein | x | x | YES |
| *Eriodictyon californicum* | California Yerba-Santa | x | x | YES |
| *Eriogonum luteolum var. luteolum* | Wicker Buckwheat | x | | YES |

**TABLE 1-B. (CONTINUED)**

| SCIENTIFIC NAME | COMMON NAME | BCEP | BCCER | NATIVE |
|---|---|---|---|---|
| *Eriogonum nudum* | Naked-stemmed buckwheat | | x | YES |
| *Eriogonum nudum var. pubiflorum* | Hairy-Flowered Buckwheat | x | | YES |
| *Eriophyllum lanatum var. grandiflorum* | Large-Flowered Woolly-Sunflower | x | x | YES |
| *Erodium botrys* | Big heronbill | | x | NO |
| *Erodium brachycarpum* | Obtuse filaree | | x | NO |
| *Erodium cicutarium* | Red-sternrned filaree | | x | YES |
| *Erodium moschatum* | White-Stemmed Filaree | x | | NO |
| *Erythronium multiscapoideum* | Fawn lily | | x | YES |
| *Eschscholzia caespitosa* | Foothill poppy | | x | YES |
| *Eschscholzia californica ssp. californica* | California-Poppy | x | x | YES |
| *Eschscholzia lobbii* | Frying pan poppy | | x | YES |
| *Festuca arundinaceae* | Reed fescue | | x | YES |
| *Festuca subulata* | Bearded Fescue | x | | YES |
| *Ficus carica* | Edible Fig | x | x | NO |
| *Filago californica* | California filago | | x | YES |
| *Fraxinus dipetala* | California ash | | x | YES |
| *Fraxinus latifolia* | Oregon Ash | x | x | YES |
| *Fritillaria affinis var. affinis* | Checkered fritillary | | x | YES |
| *Fritillaria recurva* | Scarlet fritillary | | x | YES |
| *Galium aperine* | Cleavers | | x | NO |
| *Galium parisiense* | Wall bedstraw | | x | NO |
| *Galium porrigens var. tenue* | Narrow-leaved climbing bedstraw | | x | YES |
| *Garrya fremontii* | Fremont's silktassel | | x | YES |
| *Gastridium ventricosum* | Nitgrass | x | x | NO |
| *Genista monspessulana* | French-Broom | x | | NO |
| *Geranium carolinianum* | Carolina geranium | | x | NO |
| *Geranium dissectum* | Cut-leaved geranium | | x | NO |
| *Geranium molle* | Dove's-Foot Geranium | x | x | NO |
| *Gilia tricolor* | Bird's-eye gilia | | x | YES |
| *Githopsis pulchella ssp. campestris* | Large-fiowered bluecup | | x | YES |
| *Gnaphalium canescens ssp. beneolens* | Fragrant Cudweed | x | | YES |
| *Gnaphalium luteo-album* | Weedy Cudweed | x | | NO |
| *Gnaphalium sp.* | Cudweed | | x | NO |
| *Grindelia hirsutula var. davyi* | Foothill Gumplant | x | x | YES |
| *Hedera helix* | English ivy | | x | NO |
| *Hedypnois cretica* | Crete Weed | x | | NO |
| *Heliotropium europaeum* | European Heliotrope | x | | NO |
| *Hemizonia fitchii* | Fitch's tarweed | | x | YES |
| *Hetermeles arbutifolia* | Toyon | x | | YES |
| *Heteromeles arbutifolia* | Toyon | | x | YES |
| *Heterotheca grandiflora* | Telegraph-Weed | x | | YES |
| *Heuchera micrantha var. rubescens* | Crevice alumroot | | x | YES |
| *Hirschfeldia incana* | Mediterranean Hoary-Mustard | x | | NO |
| *Hordeum marinum ssp. gussoneanum* | Mediterranean barley | | x | NO |
| *Hordeum murinum ssp. leporinum* | Hare wall barley | | x | NO |
| *Hypericum anagalloides* | Tinker's penny | | x | YES |
| *Hypericum perforatum* | Klamathweed | x | x | NO |
| *Hypochoeris glabra* | Smooth cat's-ear | | x | NO |
| *Iris macrosiphon* | Long-tubed iris | | x | YES |
| *Isoetes nuttallii* | Nuttall's quillwort | | x | YES |
| *Juglans californica var. hindii* | Northern California Black-Walnut | x | | YES |
| *Juncus acuminatus* | Sharp-Fruited Rush | x | | YES |
| *Juncus bufonius var. bufonius* | Common toadrush | | x | YES |
| *Juncus effusus var. exiguus* | Short Rush | x | | YES |
| *Juncus effusus var. pacificus* | Diffuse rush | | x | YES |
| *Juncus patens* | Spreading Rush | x | x | YES |
| *Keckiella breviflora var. glabrisepala* | Gaping keckellia | | x | YES |
| *Kickxia elatine* | Sharp-Leaved Fluellin | x | | NO |
| *Lactuca serriola* | Prickly Lettuce | x | x | NO |
| *Lagophylla glandulosa* | Glandular Hareleaf | x | x | YES |
| *Lamium amplexicaule* | Giraffehead | | x | NO |
| *Lasthenia californica* | California goldfields | | x | YES |
| *Lathyrus sp.* | Sweet pea | | x | YES |
| *Layia fremontii* | Tidy-tips | | x | YES |
| *Leersia oryzoides* | Rice Cutgrass | x | | YES |
| *Lemna minuta* | Least Duckweed | x | | YES |
| *Lemna sp.* | Duckweed | | x | YES |
| *Lepidium nitidum* | Shining peppergrass | | x | YES |
| *Lessingia nemaclada* | Slender-Stemmed Lessingia | x | | YES |
| *Lessingia sp.* | Lessingia | | x | YES |
| *Lilium sp (nf)* | Lily | | x | YES |
| *Linanthus bicolor* | Bicolored linanthus | x | x | YES |
| *Linanthus ciliatus* | Whiskerbrush | | x | YES |

**TABLE 1-B. (CONTINUED)**

| SCIENTIFIC NAME | COMMON NAME | BCEP | BCCER | NATIVE |
|---|---|---|---|---|
| *Linanthus filipes* | Wild baby's breath | | x | YES |
| *Lipocarpha micrantha* | Small-Flowered Lipocarpha | x | | YES |
| *Lithophragma bolanderi* | Bolander's woodlandstar | | x | YES |
| *Lithophragma sp. (probably parviflora) (nf)* | Woodland star | | x | YES |
| *Lolium multiflorum* | Annual Ryegrass | x | x | NO |
| *Lomatium macrocarpum* | Large-fruited lomatium | | x | YES |
| *Lomatium utriculatum* | Common lomatium | | x | YES |
| *Lonicera interrupta* | Chaparral Honeysuckle | x | x | YES |
| *Lotus humistratus* | Foothill Lotus | x | x | YES |
| *Lotus micranthus* | Small-flowered lotus | | x | YES |
| *Lotus purshianus var. purshianus* | Spanish Lotus | x | x | YES |
| *Lotus wrangelianus* | Wrangel lotus | | x | YES |
| *Lupinus albifrons var. albiforns* | Silver bush lupine | x | x | YES |
| *Lupinus bicolor* | Bicolored lupine | | x | YES |
| *Lupinus microcarpus var. densiflorus* | White-whorled lupine | | x | YES |
| *Lupinus nanus* | Sky lupine | | x | YES |
| *Lycopus americana* | Cut-Leaved Bugleweed | x | | YES |
| *Lythrum hyssopifolium* | Hyssop loosestrife | | x | NO |
| *Madia elegans ssp. vernalis* | Spring madia | | x | YES |
| *Madia subspicata* | Spiked tarweed | | x | YES |
| *Malus sylvestris* | Apple | x | | NO |
| *Marah fabaceus* | California manroot | | x | YES |
| *Marrubium vulgare* | Horehound | | x | NO |
| *Matricaria matricarioides* | Pineapple weed | | x | NO |
| *Meconella californica* | California meconella | | x | YES |
| *Medicago arabica* | Spotted medick | | x | YES |
| *Medicago lupulina* | Black Medick | x | | NO |
| *Medicago polymorpha* | Bur clover | | x | NO |
| *Melica californica.* | California melica | | x | YES |
| *Melica torreyana* | Torrey's Melic | x | x | YES |
| *Melilotus alba* | White sweet clover | x | x | NO |
| *Mentha arvensis* | American Wild Mint | x | x | YES |
| *Mentha spicata var. spicata* | Spearment | x | | NO |
| *mentzelia laevicaulis* | Giant Blazingstar | x | | YES |
| *Micropus californicus* | Q-tip | | x | YES |
| *Microseris acuminata* | Sierra foothil1 microseris | | x | YES |
| *Mimulus aurantiacus ssp. aurantiacus* | Bush Monkey-Flower | x | | YES |
| *Mimulus cardinalis* | Scarlet Monkey-Flower | x | | YES |
| *Mimulus glaucescens (CNPS List 4)* | Shield-bracted monkey-flower | | x | YES |
| *Mimulus guttatus* | Seep Monkey-Flower | x | x | YES |
| *Minuartia californica* | California sandwort | | x | YES |
| *Mollugo venticillata* | Indian-Chickweed | x | | NO |
| *Monardella villosa* | Coyote mint | | x | YES |
| *Morus alba* | White Mulberry | x | | NO |
| *Muhlenbergia mexicana* | Mexican muhly | | x | YES |
| *Muhlenbergia rigens* | Deergrass | x | x | YES |
| *Nassella pulchra* | Purple needlegrass | | x | YES |
| *Navarretia intertexta* | Needle-leaved navarretia | | x | YES |
| *Navarretia pubescens* | Downy navarretia | | x | YES |
| *Navarretia tagetina* | Marigold navarretia | | x | YES |
| *Naverretia filicaulis* | Thread-stemmed navarretia | | x | YES |
| *Nemophila heterophylla* | Variable-leaved nemophylla | | x | YES |
| *Nemophila pedunculata* | Meadow nemophila | | x | YES |
| *Nicotiana acuminata var. multiflora* | Many-Flowered Tobacco | x | | NO |
| *Odontostomum hartwegii* | Hartweg's odontostomum | | x | YES |
| *Olea europaea* | Olive | x | | NO |
| *Oxalis comiculata* | Creeping Wood-Sorrel | x | | NO |
| *Panicum acuminatum var. acuminatum* | Western Panicgrass | x | | YES |
| *Parvisedum pumilum* | Dwarf-stonecrop | | x | YES |
| *Paspalum dilatatum* | Dallisgrass | x | x | NO |
| *Pellaea andromedifolia* | Coffe fern | | x | YES |
| *Pellaea mucronata var. mucronata* | Common Bird's-Foot Fern | x | | YES |
| *Penstemon heterophyllus* | Foothill beardtongue | | x | YES |
| *Pentagramma pallida* | Whiteback fern | | x | YES |
| *Pentagramma triangularis ssp. triangularis* | Gold-Backed Fern | x | x | YES |
| *Perideridia kelloggii* | Kellogg's yampah | | x | YES |
| *Petrorhagia dubia* | Grass-Pink | x | x | NO |
| *Phacelia egena* | Rock phacelia | | x | YES |
| *Philadephus lewisii ssp. californicus* | Mock orange | x | x | YES |
| *Phoradendron macrophyllum* | Big-Leaved Mistletoe | x | x | YES |
| *Phoradendron villosum* | Hairy mistletoe | | x | YES |
| *Phytolacca americana* | American Pokeweed | x | | NO |
| *Pinus halepensis* | Aleppo Pine | x | | NO |
| *Pinus ponderosa var. ponderosa* | Pacific Ponderosa Pine | x | x | YES |

**TABLE 1-B. (CONTINUED)**

| SCIENTIFIC NAME | COMMON NAME | BCEP | BCCER | NATIVE |
|---|---|---|---|---|
| *Pinus sabiniana* | Foothill pine (Grey pine) | x | x | YES |
| *Piperia elongata* | Dense-flowered rein orchid | | x | YES |
| *Piptatherum miliaceum* | Smilograss | x | | NO |
| *Pistacia chinensis* | Ornamental Pistachio | x | x | NO |
| *Plagiobothrys austinae* | Austin's popcorn-flower | | x | YES |
| *Plagiobothrys canescens* | Valley popcorn-flower | | x | YES |
| *Plagiobothrys fulvus* | Fulvous popcorn-flower | | x | YES |
| *Plagiobothrys nothofulvus* | Common popcorn-flower | | x | YES |
| *Plantago erecta* | California plantain | | x | YES |
| *Plantago lanceolata* | English Plantain | x | x | NO |
| *Plantago major* | Common Plantain | x | x | NO |
| *Platanus racemosa* | Western Sycamore | x | x | YES |
| *Platanus X acerifolia* | London Plane-Tree | x | | NO |
| *Plectritis ciliosa* | Pink plectritis | | x | YES |
| *Plectritis macrocera* | White plectritis | | x | YES |
| *Poa annua* | Annual bluegrass | | x | NO |
| *Poa secunda ssp. secunda* | One-sided bluegrass | | x | YES |
| *Poa sp.* | Bluegrass | | x | YES |
| *Polygala cornuta* | Milkwort | | x | YES |
| *Polygonum arenastrum* | Common Knotweed | x | x | NO |
| *Polygonum bidwelliae CNPS List 4)* | Bidwell's knotweed | | x | YES |
| *Polygonum californicum* | California knotweed | | x | YES |
| *Polygonum hydropiper* | Water-Pepper | x | | NO |
| *Polygonum persicaria* | Lady's-Thumb | x | | NO |
| *Polygonum punctatum* | Dotted Smartweed | x | | YES |
| *Polypodium calirhiza* | California polypody | | x | YES |
| *Polypogon australis* | Southern Beardgrass | x | | NO |
| *Polypogon interruptus* | Annual beardgrass | | x | NO |
| *Polypogon monspeliensis* | Annual Beardgrass | x | | NO |
| *Populus fremontii* | Fremont's Cottonwood | x | x | YES |
| *Prunella vulgaris var. lanceolata* | Mountain Selfheal | x | | YES |
| *Prunus dulcis* | Almond | x | | NO |
| *Pseudotsuga menziesii* | Douglas fir | | x | YES |
| *Ptelea crenulata* | Hoptree | | x | YES |
| *Pteridium aquillinum var pubescens* | Western bracken | | x | YES |
| *Pterostegia drymarioides* | Pterostegia (Granny's hairnet) | | x | YES |
| *Pyracantha fortunena* | Firethorn | | x | NO |
| *Quercus berberidifolia* | Scrub oak | | x | YES |
| *Quercus chrysolepis var. chrysolepis* | Canyon live oak | | x | YES |
| *Quercus douglasii* | Blue Oak | x | x | YES |
| *Quercus kelloggii* | California black oak | | x | YES |
| *Quercus lobata* | Valley Oak | x | x | YES |
| *Quercus wislizeni var. wislizeni* | Interior Live Oak | x | x | YES |
| *Quercus X morehus* | Oracle Oak | x | | YES |
| *Ranunculus canus* | Sacramento Valley buttercup | | x | YES |
| *Ranunculus hebecarpus* | Hairy-fruited buttercup | | x | YES |
| *Ranunculus occidentalis* | Western buttercup | | x | YES |
| *Raphanus sp.* | Wild radish | | x | NO |
| *Rhamnus crocea* | Redberry | | x | YES |
| *Rhamnus ilicifolia* | Holly-Leaved Redberry | x | | YES |
| *Rhamnus tomentella ssp. tomentella* | Hoary Coffeeberry | x | x | YES |
| *Rhus trilobata* | Skunkbrush | | x | YES |
| *Robinia pseudoacacia* | Black Locust | x | | NO |
| *Rorippa nasturtium-aquaticum* | Watercress | x | x | YES |
| *Rosa californica* | California rose | x | x | YES |
| *Rubus discolor* | Himalayan Blackberry | x | x | NO |
| *Rubus laciniatus* | Cut-Leaved Blackberry | x | x | NO |
| *Rubus ursinus* | California Blackberry | x | x | YES |
| *Rumex crispus* | Curly Dock | x | x | NO |
| *Rumex pulcher* | Fiddle Dock | x | | NO |
| *Rumex salicifolius var. salicifolius* | Willow Dock | x | | YES |
| *Rumex sp.* | Dock | | x | NO |
| *Salix exigua* | Sandbar Willow | x | | YES |
| *Salix goodingii* | Goodding's Black Willow | x | x | YES |
| *Salix laevigata* | Red Willow | x | x | YES |
| *Salix lasiolepis* | Arroyo Willow | x | x | YES |
| *Salix melanopsis* | Dusky Willow | x | | YES |
| *Sambucus mexicana* | Blue Elderberry | x | x | YES |
| *Sanicula bipinnata* | Poison sanicle | | x | YES |
| *Sanicula bipinnatifida* | Purple sanicle | | x | YES |
| *Sanicula crassicaulis* | Pacific sanicle | | x | YES |
| *Saponaria officinalis* | Bouncing-Bet | x | | NO |
| *Saxifraga californica* | California saxifrage | | x | YES |
| *Scleranthus annuns* | Knawel | | x | NO |

**TABLE 1-B. ( CONTINUED)**

| SCIENTIFIC NAME | COMMON NAME | BCEP | BCCER | NATIVE |
|---|---|---|---|---|
| *Scrophularia californica* | California figwort | | x | YES |
| *Scutellaria californica* | California skullcap | | x | YES |
| *Sedum spathulifolium* | Broad-leaved stonecrop | | x | YES |
| *Selaginella hansenii* | Hansen's spikemoss | | x | YES |
| *Senecio vulgaris* | Old man of spring | | x | NO |
| *Setaria pumila* | Yellow Bristlegrass | x | | NO |
| *Sherardia arvense* | Field sherardia | | x | YES |
| *Sidalcea hartwegii* | Hartweg's sidalcea | | x | YES |
| *Sidalcea robusta (CNPS !B)* | Butte County checkerbloom | | x | YES |
| *Silene californica* | California Indian pink | | x | YES |
| *Silene gallica* | Windmill pink | | x | NO |
| *Silybum marianum* | Milk-Thistle | x | | NO |
| *Sisymbrium officinale* | Hedge mustard | | x | NO |
| *Smilax californica* | California Greenbrier | x | x | YES |
| *Solanum americanum* | American Black Nightshade | x | | YES |
| *Solanum parishii* | Parish's nightshade | | x | YES |
| *Solidago californica* | California Goldenrod | x | | YES |
| *Sonchus asper ssp. asper* | Spiny-Leaved Sow-Thistle | x | x | NO |
| *Sorghum halepense* | Johnsongrass | x | x | NO |
| *Spartium junceum* | Spanish-Broom | x | | NO |
| *Spergularia bocconei* | Sandspurry | | x | NO |
| *Spergularia rubra* | Ruby Sandspurry | x | | NO |
| *Stachys ajugoides var. rigida* | Rigid Hedge-Nettle | x | | YES |
| *Stachys pycnantha* | Short-Spiked Hedge-Nettle | x | | YES |
| *Stachys stricta* | Sonorna hedge nettle | | x | YES |
| *Stellaria media* | Chickweed | | x | NO |
| *Stellaria nitens* | Chickweed | | x | NO |
| *Sylibimum martimum* | Milk thistle | | x | NO |
| *Symphoricarpos albus var. Iaevigatus* | Cornmon snowberry | | x | YES |
| *Taeniathreum caput-medusoe* | Medusa-head | | x | NO |
| *Taraxacum officianale* | Dandelion | | x | NO |
| *Tauschia hartwegii* | Hartweg's tauschia | | x | YES |
| *Thysanocarpus curvipes* | Fringepod | | x | YES |
| *Torilis arvensis* | Common Hedge-Parsley | x | x | NO |
| *Torilis nodosa* | Knotted hedge parsley | | x | NO |
| *Toxicodendron diversilobum* | Western Poison-Oak | x | x | YES |
| *Tribulus terrestris* | Puncture-Vine | x | | NO |
| *Trichostemma lanceolata* | Vinegarweed | x | x | YES |
| *Trifolium albopurpureum* | Indian clover | | x | YES |
| *Trifolium ciliolatum* | Foothill clover | | x | YES |
| *Trifolium depauperatum* | Cowbag clover | | x | YES |
| *Trifolium hirtum* | Rose Clover | x | x | NO |
| *Trifolium microcephalum* | Small-headed clover | | x | YES |
| *Trifolium variegatum* | White-tipped clover | | x | YES |
| *Trifolium wildenovii* | Tomcat clover | | x | YES |
| *Triteleia bridgesii* | Bridge's triteleia | | x | YES |
| *Triteleia hyacinthine* | White triteleia | | x | YES |
| *Triteleia laxa* | Ithuriel's spear | | x | YES |
| *Tryphisaria eriantha* | Johnny-tuck | | x | YES |
| *Typha latifolia* | Broad-Leaved Cattail | x | | YES |
| *Umbellularia californica* | California bay-laurel | | x | YES |
| *Verbascum blattaria* | Common mullein | | x | NO |
| *Verbascum thapsus* | Woolly Mullein | x | x | NO |
| *Verbena sp.* | Verbena | | x | YES |
| *Veronica americana* | American Brook Lime | x | | YES |
| *Veronica persica* | Persian speedwell | | x | NO |
| *Vicia sativa* | Spring vetch | | x | NO |
| *Vicia villosa* | Hairy vetch | | x | NO |
| *Vicia villosa ssp. varia* | Winter Vetch | x | | NO |
| *Vinca major* | Periwinkle | x | | NO |
| *Vitis californica* | California Wild Grape | x | x | YES |
| *Vulpia bromoides* | Six-week's-fescue | | x | NO |
| *Vulpia microstachys var. pauciflora* | Few-flowered fescue | | x | YES |
| *Vulpia myurus var. hirsuta* | Foxtail fescue | | x | NO |
| *Woodwardia fimbriata* | Giant chainfern | | x | YES |
| *Wyethia angustifolia* | Narrow-leaved mule's-ears | | x | YES |
| *Xanthium strumarium* | Cocklebur | x | x | YES |
| *Yabea microcarpa* | False hedge parsley | | x | YES |
| *Zigadenus venonosus* | Death camas | | x | YES |

APPENDIX C

**U.S. Fish & Wildlife Service**
**Sacramento Fish & Wildlife Office**
**Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the**
**COHASSET (592B)**
**U.S.G.S. 7 1/2 Minute Quad**
Database last updated: September 18, 2011
Report Date: October 25, 2011

**Listed Species**

*Invertebrates*

Branchinecta conservatio
Conservancy fairy shrimp (E)

Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)

*Fish*

Hypomesus transpacificus
delta smelt (T)

Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

*Amphibians*

Rana draytonii
California red-legged frog (T)

---

**Key:**

- (E) *Endangered* - Listed as being in danger of extinction.
- (T) *Threatened* - Listed as likely to become endangered within the foreseeable future.

- (P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.
- (NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
- *Critical Habitat* - Area essential to the conservation of a species.
- (PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
- (C) *Candidate* - Candidate to become a proposed species.
- (V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.
- (X) *Critical Habitat* designated for this species

Source: United States Fish & Wildlife Service. 2011. Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Cohasset (592B) U.S.G.S. 7 1/2 Minute Quad. http://www.fws.gov/endangered/ [last accessed: 25 October 2011].

# APPENDIX D

**U.S. Fish & Wildlife Service**
**Sacramento Fish & Wildlife Office**
**Federal Endangered and Threatened Species that Occur in**
**or may be Affected by Projects in the**
**PARADISE WEST (592C)**
**U.S.G.S. 7 1/2 Minute Quad**
Database last updated: September 18, 2011
Report Date: October 25, 2011

**Listed Species**

*Invertebrates*
Branchinecta conservatio
Conservancy fairy shrimp (E)
Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)
Lepidurus packardi
vernal pool tadpole shrimp (E)

*Fish*
Hypomesus transpacificus
delta smelt (T)
Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)
Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

*Amphibians*
Rana draytonii
California red-legged frog (T)

*Reptiles*
Thamnophis gigas
giant garter snake (T)

*Plants*
Limnanthes floccosa ssp. californica
Critical habitat, Butte County (Shippee) meadowfoam (X)

**Candidate Species**

*Birds*

Coccyzus americanus occidentalis

Western yellow-billed cuckoo (C)

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**Key:**

- (E) *Endangered* - Listed as being in danger of extinction.
- (T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
- (P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.
- (NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
- *Critical Habitat* - Area essential to the conservation of a species.
- (PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
- (C) *Candidate* - Candidate to become a proposed species.
- (V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.
- (X) *Critical Habitat* designated for this species

Source: Data taken from United States Fish & Wildlife Service. 2011. Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Paradise West (592C) U.S.G.S. 7 1/2 Minute Quad. http://www.fws.gov/endangered/ [last accessed: 25 October 2011].

APPENDIX E

**Table 1-E. Management Decision Matrix**

| *Management Decision Matrix* | | | | | | |
|---|---|---|---|---|---|---|
| *Treatment Site* | | *Implementation per Objective* | *Spatial Extent*<br>0 = non-existent or unknown<br>1 = localized<br>2 = several isolated locations<br>3 = Extensive | *Urgency*<br>0 = lack of action does not result in adverse impacts preserve<br>1 = Moderate adverse impacts if neglected<br>***2 = Severe adverse impacts if neglected*** | *Ability to Manage*<br>0 = Low<br>1= Moderate<br>2= High | *Total*<br>Highest score is the highest priority task. |
| **BCCER** | **BCEP** | *Threats & Management Actions* | | | | |
| | | A. Minimize anthropogenic disturbance | | | | |
| x | x | **Post interpretative signage for visitors to alert to identification and impacts of exotics.** | 1 | 0 | 2 | **3** |
| x | x | **Develop protocol to request shoes and clothing be cleaned of seeds prior to entering the Reserves.** | 1 | 0 | 2 | **3** |
| x | x | **Conduct assessment and develop step-down narrative. Revise as appropriate.** | 3 | 1 | 2 | **6** |
| | | B. Encourage native propagation | | | | |
| | | B.1. Prepare for native propagation | | | | |
| x | x | **Identify pre-existing populations.** | 3 | 2 | ***2*** | **7** |
| x | x | **Collect, increase, propagate, outplant, monitor, and manage native seeds.** | 1 | 1 | 2 | **4** |
| x | | **Clone and propagate root stock of native grasses and other native species.** | 2 | 1 | 2 | **5** |
| | x | **Establish clear and focused mitigation bank for Mexican elderberry (*Sambucus mexicana*) to mitigate for development impacts to the federally threatened Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*).** | 1 | 0 | 2 | **3** |
| | x | **Develop soil restoration test plots and assess methods suitable to restore degraded soils.** | 1 | 1 | 2 | **4** |
| x | x | **Continue to conduct assessments of techniques specific to both sites.** | 0 | 0 | 1 | **1** |
| x | x | **Consult with Native American community to identify, enhance and manage culturally significant plants.** | 0 | 0 | 2 | **2** |
| | | B.2. Implement native propagation. | | | | |
| x | x | **Manage areas with native seeds planted (weed)** | 2 | 1 | 1 | **4** |
| | x | **Diversification of tree age class structure through thinning (mechanical and fire)** | 2 | 0 | 1 | **3** |
| x | | **Enhance Blue (*Quercus douglasii*) and Valley Oak (*Quercus lobata*) recruitment and survival.** | 1 | 2 | 2 | **5** |
| | | C. Exotics management | | | | |
| x | x | **Develop a management treatment as appropriate for target native and non-native species.** | 3 | 2 | 1 | **6** |
| x | x | **Identify exotic species distribution** | 3 | 2 | 1 | **6** |
| x | x | **Edible fig (*Ficus carica*) trees (manage as appropriate)** | 2 | 2 | 2 | **6** |

**Table 1-E. (Continued)**

| *Management Decision Matrix* | | | | | | |
|---|---|---|---|---|---|---|
| *Treatment Site* | | *Implementation per Objective* | *Spatial Extent*<br><br>0 = non-existent or unknown<br>1 = localized<br>2 = several isolated locations<br>3 = Extensive | *Urgency*<br><br>0 = lack of action does not result in adverse impacts preserve<br>1 = Moderate adverse impacts if neglected<br>***2 = Severe adverse impacts if neglected*** | *Ability to Manage*<br><br>0 = Low<br>1= Moderate<br>2= High | *Total*<br><br>Highest score is the highest priority task. |
| **BCCER** | **BCEP** | *Threats & Management Actions* | | | | |
| x | x | **Yellow-star thistle (*Centaurea solstitialis*) (manage as appropriate)** | 3 | 2 | 0 | **5** |
| x | x | **French (*Genista monspessulana*) and Spanish broom (*Spartium junceum*) (manage as appropriate)** | 2 | 2 | 1 | **5** |
| | x | **Himalayan blackberry (*Rubus discolor*) (manage as appropriate)** | 2 | 2 | 2 | **6** |
| x | x | **Medusa-head (*Taeniatherum caput-medusae*) grass (manage as appropriate)** | 3 | 1 | 1 | **5** |
| x | x | **Exotic plum (*Prunus sp.*) (manage as appropriate)** | 2 | 2 | 2 | **6** |
| x | x | **Klamath weed (*Hypericum perforatum*) (manage as appropriate)** | 2 | 2 | 2 | **6** |
| x | | **Garden Burnet (*Sanguisorba minor*) (manage as appropriate)** | 3 | 2 | 2 | **7** |
| x | | **Italian Plumeless Thistle (*Carduus pycnocephalus L.*) (manage as appropriate)** | 3 | 2 | 2 | **7** |
| x | | **Milk Thistle (*Silybum marianum*) (manage as appropriate)** | 2 | 2 | 1 | **5** |
| x | x | **Establish monitoring plots to study treatment effects on exotics.** | 1 | 1 | 1 | **3** |
| | | D. Fuels management | | | | |
| x | x | **Maintain an agricultural burn permit.** | 3 | 2 | 2 | **7** |
| x | x | **Develop and implement a smoke management plan.** | 3 | 2 | 1 | **6** |
| x | x | **Develop and implement a fire and fuels management strategy (i.e. prescribed burning plan) appropriate to achieve conservation and management objectives appropriate to each vegetation community type.** | 3 | 2 | 1 | **6** |
| | | E. Management at the landscape level | | | | |
| x | x | **Identify and preserve fish and wildlife habitat** | 3 | 1 | 0 | **4** |
| | | F. Maintain and/or increase funding for management activities | | | | |
| x | x | **Identify staffing needs and promote volunteership** | 0 | 0 | 2 | **2** |
| x | x | **Support fundraising activities** | 0 | 1 | 2 | **3** |
| x | x | **Develop and implement a financial management plan** | 0 | 1 | 2 | **3** |

Source: Table adapted from The Nature Conservancy and World Wildlife Fund. 2006. Standards for ecoregional assessments and biodiversity visions. http://www.conservationgateway.org/file/standards -ecoregional-assessments-and-biodiversity-visions [last accessed: March 15, 2012].

# REFERENCE

The Nature Conservancy and World Wildlife Fund. 2006. Standards for ecoregional assessments and biodiversity visions. http://www.conservationgateway.org/file/standards-ecoregional-assessments-and-biodiversity-visions [last accessed: March 15, 2012]

APPENDIX F

## Big Chico Creek Ecological Reserve, California

*Objectives for long-term vegetation monitoring*

Long-term vegetation monitoring provides land managers an opportunity to observe and quantify changes in the landscape composition and structure. However, this requires the monitoring techniques to be effective in measuring the changes. The vegetation communities represented at the Big Chico Creek Ecological Preserve (BCCER) include riparian, grassland, and oak woodland systems. These systems have evolved with the presence of fire. To properly manage these ecosystems, a natural fire return interval should be implemented within the BCCER. Although there is a broad understanding of natural return intervals in these types of ecosystems, the specific seasonality and fire intensity is not precisely known. As a result, accurate measurements of the direct and indirect effects of fire should be incorporated into a long-term vegetation monitoring plan for BCCER. An additional component to sample might include fuels, which are recommended to be included, but are not outlined in this document. In addition to the presence of fire as a process, fluctuations in the flow of Big Chico Creek also create a natural and necessary process for these ecosystems. Again, although it is understood that there will be changes resulting from flood events, it is unknown precisely how the vegetation affected will respond. These changes should also be measured as a component of the long term vegetation monitoring objectives.

Because there are limited funds and resources to implement monitoring plans, the sampling techniques should be designed to measure all of the expected changes under the highest efficacy. The proposed design utilizes a hybrid approach that incorporates commonly used techniques customized for the specific objectives of BCCER. Monitoring should occur annually in mid-spring or more frequently if desired, with results reported in a spreadsheet. This information should then be communicated to land managers and used to adaptively manage the landscape for the purpose of meeting management goals. Appendix H provides a sample data sheet which can be adapted for the purposes of BCCER monitoring.

*Biogeography of the Site*

There are 20 vegetation communities covering a range of areas from localized to several hundred acre patches. They are listed as follows: *Acer macrophyllum, Alnus rhombifolia, Arctostaphylos manzanita, Arctostaphylos viscida, California Annual and Perennial Grassland, Calocedrus decurrens, Ceanothus cuneatus, Ceanothus integerrimus, Cercocarpus montanus, Pinus sabiniana, Populus fremontii, Quercus berberidifolia, Quercus chrysolepis (tree), Quercus douglasii, Quercus kelloggii, Quercus lobata, Quercus wislizeni, Sierra Nevada cliff and canyon, Southwestern North American riparian evergreen and deciduous woodland, and Southwestern North American riparian/wash* *scrub.* Each label describes the dominant vegetation species for that area (the figure on the right in Figure 1-F).

Sampling Method

When sampling vegetation, it is important to sample from sites that are representative of all samples you are trying to characterize. There are many methods to sample vegetation, and each has their strengths and weaknesses. The relevé is a semi-quantitative approach to assess biodiversity and trends at a landscape scale. This method relies on estimates of plant cover for each species identified in their respective vertical layers (i.e., ground, shrub, and canopy) rather than total census of vegetation communities within the sampling area.

**Plot size**

Sampling of these systems will be performed using relevé plots of the appropriate scale for each vegetation community. Discrete sampling units will be the following sizes: 5m x 5 m plots in grasslands/herbaceous communities, 10m x 20 m in shrub communities, and 20m x 20 m plots in tree communities. Tree, shrub, and grassland designations are indicated in Table 1-F.

**Number of Plots**

The data collector must go out initially in mid-Spring and set up 75 plots in the grassland communities, 60 plots (20 in each of the four shrub communities) in the shrub communities, and 28 plots (two in each of the 14 tree communities) in the tree communities. To get a representative yet realistic sample size, a number between 150-200 plots was selected. The smaller the size of the typical species in the sampling designation, the greater the number of plots assigned.

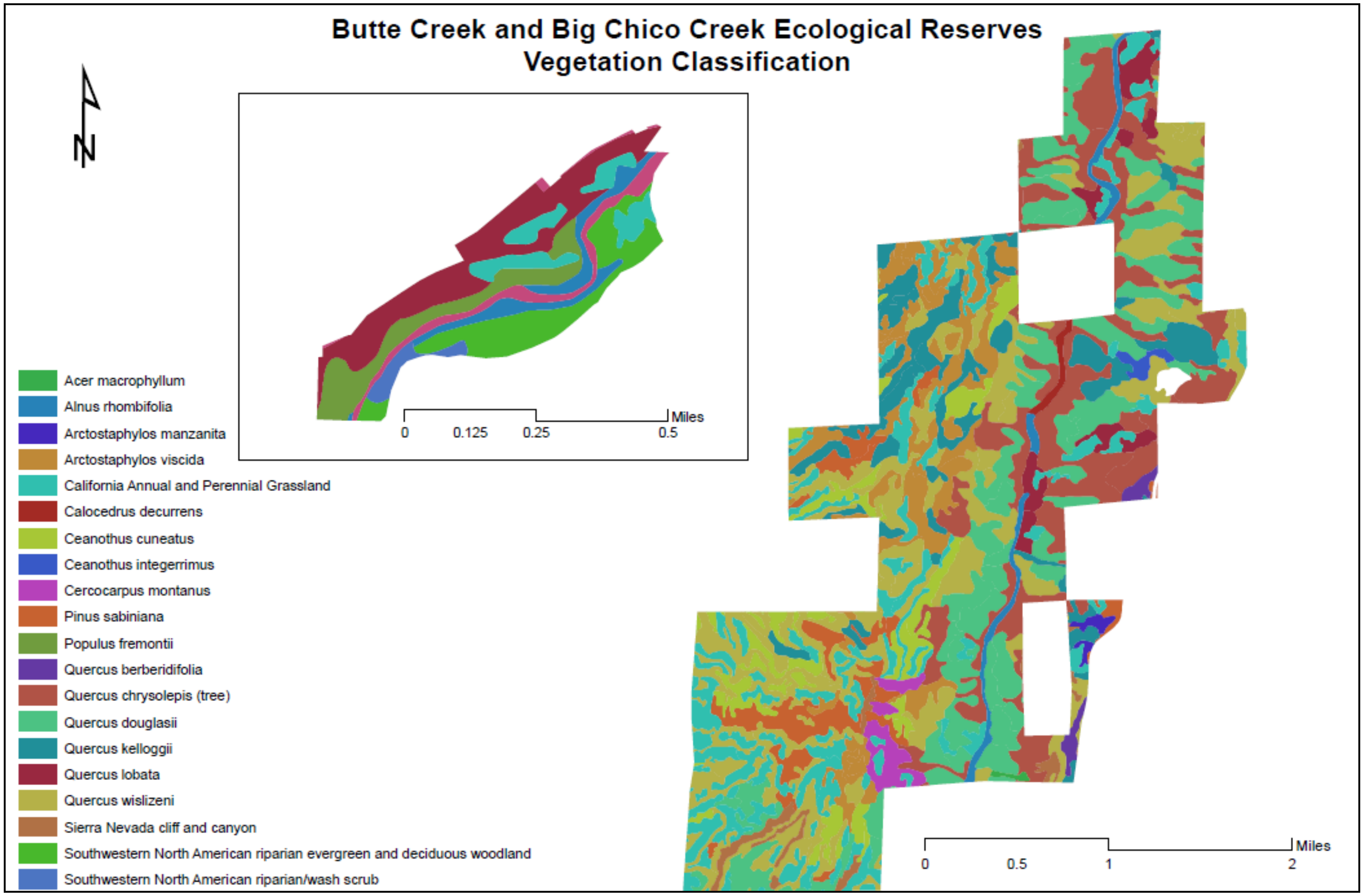
## Performing the Relevé

The following sections explain how to perform the actual relevé, the Estimation of Cover Values.

1) DBH if >10 cm:

   The diameter at breast height (dbh) is important in certain studies. It may be recorded next to each tree species name. First indicate the species name by code and then record the number of sprouts/trunks in clonal trees. You should measure the tree dbh of every tree trunk/sprout that has diameter > or = 10 cm at breast height in the plot, and each measurement should be in centimeters (cm) using a dbh tape measure. For trunks that may be fused below breast height and branched at breast height, each trunk at breast height gets a separate measurement. Also indicate if each tree/clone is in the overstory or understory. Trees in the overstory

**FIGURE 1-F. BUTTE CREEK AND BIG CHICO CREEK ECOLOGICAL RESERVES.**




Source: Map produced by Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

**Table 1-F. Sampling Designations**

| Vegetation Community | Sampling Designation |
|---|---|
| *Acer macrophyllum* | Tree |
| *Alnus rhombifolia* | Tree |
| *Arctostaphylos manzanita* | Tree |
| *Arctostaphylos viscida* | Tree |
| *California Annual and Perennial Grassland* | Grassland |
| *Calocedrus decurrens* | Tree |
| *Ceanothus cuneatus* | Shrub |
| *Ceanothus integerrimus* | Shrub |
| *Cercocarpus montanus* | Shrub |
| *Pinus sabiniana* | Tree |
| *Populus fremontii* | Tree |
| *Quercus berberidifolia* | Tree |
| *Quercus chrysolepis (tree)* | Tree |
| *Quercus douglasii* | Tree |
| *Quercus kelloggii* | Tree |
| *Quercus lobata* | Tree |
| *Quercus wislizeni* | Tree |
| *Sierra Nevada cliff and canyon* | None |
| *Southwestern North American riparian evergreen and deciduous woodland* | Tree |
| *Southwestern North American riparian/wash scrub* | Shrub |

are generally at canopy level. Trees in the understory are entirely below the general level of the canopy.

If snags are encountered in plot, record the dbh and denote it as dead by circling its dbh measurement. If you are unable to identify the snag to species, put the four letter code “SNAG” in the species column. Depending on the density of trees in each plot, you can record dbh of trees for every tree trunk in the plot, or you can sub-sample the trunks to estimate dbh for every tree species in relatively dense plots. For woodland/forest plots, sub-sampling is appropriate for half the plot if there are at least 50 trees/resprouts.

When sub-sampling, make sure to denote this as a sub-sample (note on the data form) and record the sub-sample of dbh's for each tree species in the appropriate row on the Field Form. Once the data are post-processed and entered into a database, then you will need to record each sub-sampled dbh reading three additional times to come up with a full sample of dbh readings. For example, with a sub-sampled tree dbh of 15 cm, this value of 15 should be entered four times (not just once) when it is entered in the database.

2) Lifeform and size class:

If dbh <15.2 cm, counts should be made for conifers and hardwoods in two different size classes. Count seedlings (≤ 2.54 cm) and saplings (> 2.54 but < 15.2 cm). First estimate if there are more than 50 seedlings in one half (50% subsample) of the plot. If so, then do counts of seedlings and saplings.

3) Estimating Cover:

There are many ways to estimate cover. Many people who have been in the cover estimation "business" for a long time can do so quickly and confidently without any props and devices. However, to a novice, it may seem incomprehensible and foolhardy to stand in a meadow of 50 different species of plants and systematically be able to list by cover value each one without actually "measuring" them in some way.

Of course, our minds make thousands of estimates of various types every week. We trust that estimating plant cover can be done by anyone with an open mind and an "eye for nature." It's just another technique to learn. It is very helpful to work initially with other people who know and are learning the technique. In such a group setting, typically a set of justifications for each person's estimate is made and a "meeting of the minds" is reached. This consensus approach and the concomitant calibration of each person's internal scales is a very important part of the training for any cover estimate project.

An underlying point to remember is that estimates must provide some level of reliable values that are within acceptable bounds of accuracy. If we require an accuracy level that is beyond the realm of possibility, we will soon reject the method for one more quantitative and repeatable. As with any scientific measurement, the requirement for accuracy in the vegetation data is closely related to the accuracy of the information needed to provide a useful summary of it. Put into more immediate perspective - to allow useful and repeatable analysis of vegetation data, one does not need to estimate down to the exact percent value the cover of a given plant species in a given stand.

**Data to Collect** (input into data sheet Appendix H)

*GENERAL PLOT INFORMATION*

-Polygon or Relevé number: Assigned either in the field or in the office prior to sampling.
-Date: Date of sampling.
-County: County in which located.
-Observers: Names of individuals assisting. Circle name of recorder.
-Plot size: length of rectangle edges, circle radius, or size of entire stand. NOTE: See page 2 for standard plot sizes.
-Study Plot Revisit: If the relevé plot is being revisited for repeated sampling, please circle "Yes".
-Latitude and Longitude, Site location and description: Degrees north latitude and west longitude. Indicate where the GPS reading was taken within the plot. In general, the location of the GPS reading should be on the Northwestern corner of the plot. Please indicate units.
-Slope: Degrees, read from clinometer or compass, or estimated; averaged over relevé.
-Aspect: Degrees from true north (adjust declination), read from a compass or estimated; averaged over relevé.
-Site history: Briefly describe the history of the stand, including type and year of disturbance (e.g., fire, landslides or avalanching, drought, flood, or pest outbreak). Also note the nature and extent of land use such as grazing, timber harvest, or mining.

*VEGETATION DESCRIPTION*

-Dominant layer: Indicate whether the community is dominated by the Low layer (L), Mid-layer (M), or Tall (T) layer.
-Dominant Vegetation Group: Extrapolate from provided map (Figure 1-A).
-Photographs: Write the name or initials of the camera owner and the JPEG numbers for photos taken. Write the camera's view direction from compass bearings. Take four or eight photos (depending on the project) from the same point as the GPS reading (center of a circle or NW corner of rectangle). Using a compass, take the first photo from the north, and rotate clockwise, taking the photos in sequence, N, NE, E etc, or N, E, S, W. Keep camera at same orientation, zoom level, and distance from ground for all four (or eight) photos. You may take photos close to the ground, if for instance, you are photographing a low herbaceous stand. Additional photos of the stand may also be helpful. If using a digital camera or scanning in the image into a computer, relevé numbers and compass directions can be recorded digitally.
-Unknown plant specimens: List the numbers of any unknown plant specimens, noting any information such as family or genus (if known), important characters, and whether or not there is adequate material for identification. Do not take samples of plants of which there are only a few individuals or which you think may be rare. Document these plants with photographs.
-Additional comments: Feel free to note any additional observations of the site, or deviations from the standard sampling protocol. If additional data were recorded, e.g. if tree diameters were measured, please indicate so here.

*SURFACE COVER AND SOIL INFORMATION*

-Surface cover: Estimate the cover class of each size at or near the ground surface averaged over the plot. Always remember to estimate what you actually see on the surface as opposed to what you think is hiding under, organic litter, big rocks, etc. However, rocks, organic litter, or fine material visible under the canopy of shrubs or trees should be included in the cover estimate. One way to consider this is to assume that all of the components of surface cover plus the basal cross-section of living plant stems and trunks (at ground level) will add up to 100%.

-Soil Information: These data are asked for because certain categories of surface cover of rock and other materials have been shown to correlate with certain vegetation types and are thus likely influencing the type of vegetation that is growing in a given area. These estimates should be made quickly with the main point to keep in mind being a rough estimate of the relative proportions of different coarse fragments on the plot.

- Fines: Fine mineral fragments including sand, silt, soil, "dirt" < 2 mm in diameter
- Gravel: rounded and angular fragments 0.2-7.5 cm (0.08 -3 in.) diameter
- Cobble: rounded and angular fragments >7.5-25 cm (3 -10 in.) in diameter
- Stone: rounded and angular coarse fragments >25 cm-60 cm (10 -24 in.) in diameter
- Boulder: rounded and angular coarse fragments >60 cm (>24 in.) in diameter
- Bedrock: continuous, exposed, non-transported rock
- Litter: extent of undecomposed litter on surface of plot (this includes all organic matter, e.g. fallen logs, branches, and twigs down to needles and leaves).
- Living stems of vascular plants: basal area of living stems of the plants at ground surface

*VEGETATION DATA*

-Assessment of Layers: Data are recorded for five layers (tree overstory, tree understory, shrub, herb, and non-vascular). The layer a species occupies is determined by life-form. The estimates need not be overly precise and will vary among vegetation types. A young tree, if shrub sized, is considered an understory tree. A caveat: if several relevés are being sampled within the same vegetation type, it is important to be consistent when assigning layers. Some types will have more than five layers (e.g., two tree layers of different maximum height); this should be indicated in the relevé description.

-Species List: The collection of vegetation data continues with making a comprehensive species list of all vascular plants within the relevé. This list is achieved by meandering through the plot to see all microhabitats. During list development, observers document each taxon present in each layer in which it occurs separately, recording it on a different line of the data form and noting which layer is represented. This is important for data entry because each layer of each represented taxon will be entered separately. Each individual plant is recorded in only one layer, the layer in which the tallest portion of the individual is found.

Adapted from: California Native Plant Society - Relevé Protocol 2007. CNPS Vegetation Committee. http://www.cnps.org/cnps/vegetation/pdf/cnps_releve_protocol_20070823.pdf [Last accessed: February 16, 2012]

# REFERENCES

California Native Plant Society, Aerial Information Systems, and Tehama Co. Resource Conservation District. 2011. Northern Sierra Nevada Foothills vegetation map. http://www.cnps.org [last accessed: May 20, 2011].

California Native Plant Society - Relevé Protocol 2007. CNPS Vegetation Committee. http://www.cnps.org/cnps/vegetation/pdf/ nps_releve_protocol_20070823.pdf [Last accessed: February 16, 2012]

Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

APPENDIX G

## BUTTE CREEK ECOLOGICAL RESERVE, CALIFORNIA

### *Objectives for Long Term Vegetation Monitoring*

Long term vegetation monitoring provides land managers an opportunity to observe and quantify changes in the landscape composition and structure. However, this requires the monitoring techniques to be effective in measuring the changes. The vegetative ecosystems represented in the Butte Creek Ecological Preserve (BCEP) include riparian and oak woodland systems. Both of these systems have evolved with the presence of fire. To properly manage these ecosystems, a natural fire return interval should be implemented within the BCEP. Although there is a broad understanding of natural return intervals in these types of ecosystems, the specific seasonality and fire intensity is not precisely known. As a result, accurate measurements of the direct and indirect effects of fire should be incorporated into a long term vegetation monitoring plan for BCEP. In addition to the presence of fire as a disturbance agent, fluctuations in the hydrologic flow of Butte Creek also create a natural and necessary disturbance for these ecosystems. Again, although it is understood that there will be changes resulting from flood events, it is unknown precisely how the vegetation will respond. These changes should also be measured as a component of the long term vegetation monitoring objectives.

Because there are limited funds and resources to implement monitoring plans, the sampling techniques should be designed to measure all of the expected changes under the highest efficacy. The proposed design utilizes a hybrid approach that incorporates commonly used techniques customized for the specific objectives of BCEP.

Effects of Fire Return Interval and Intensity

Surface fuel loading- dead/live

Understory fuel loading- dead/live

Height to crown base

Effects of Hydrologic Shifts

Spatial distribution of vegetation associations

Modified-Whittaker plot for assessing species richness and cover at multiple scales

Relevé assessment of vegetation composition and structure

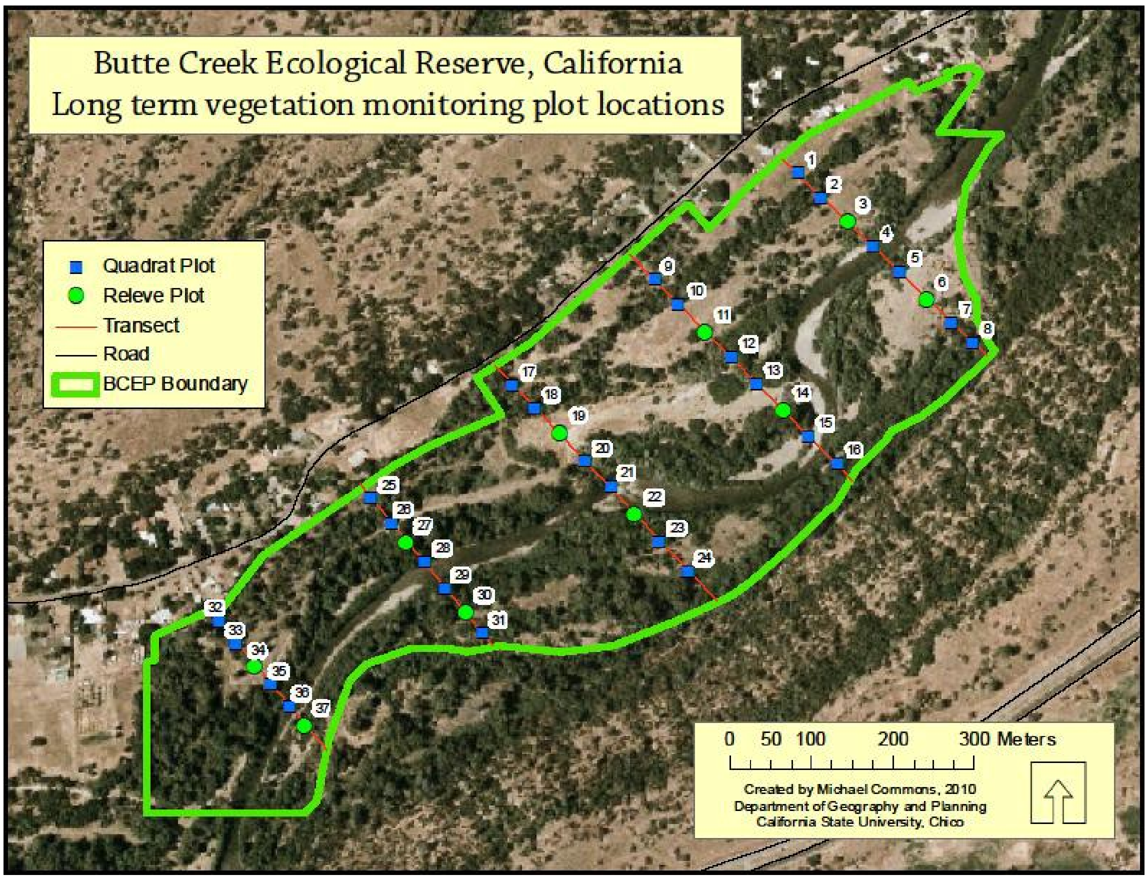
# Butte Creek Ecological Reserve, California

*Long Term Vegetation Monitoring Protocol*

## PLOT DISTRIBUTION

A series of seven parallel transects, spaced approximately 235 meters apart, span the naturally linear shape of the reserve. The transects are aligned perpendicular to the fluvial flow of Butte Creek and contain thirty-seven plots, including twenty-seven nested quadrat plots and ten relevé plots. (See Figure 1-G)

**FIGURE 1-G. PLOT LOCATIONS WITHIN BUTTE CREEK ECOLOGICAL RESERVE, CALIFORNIA.**

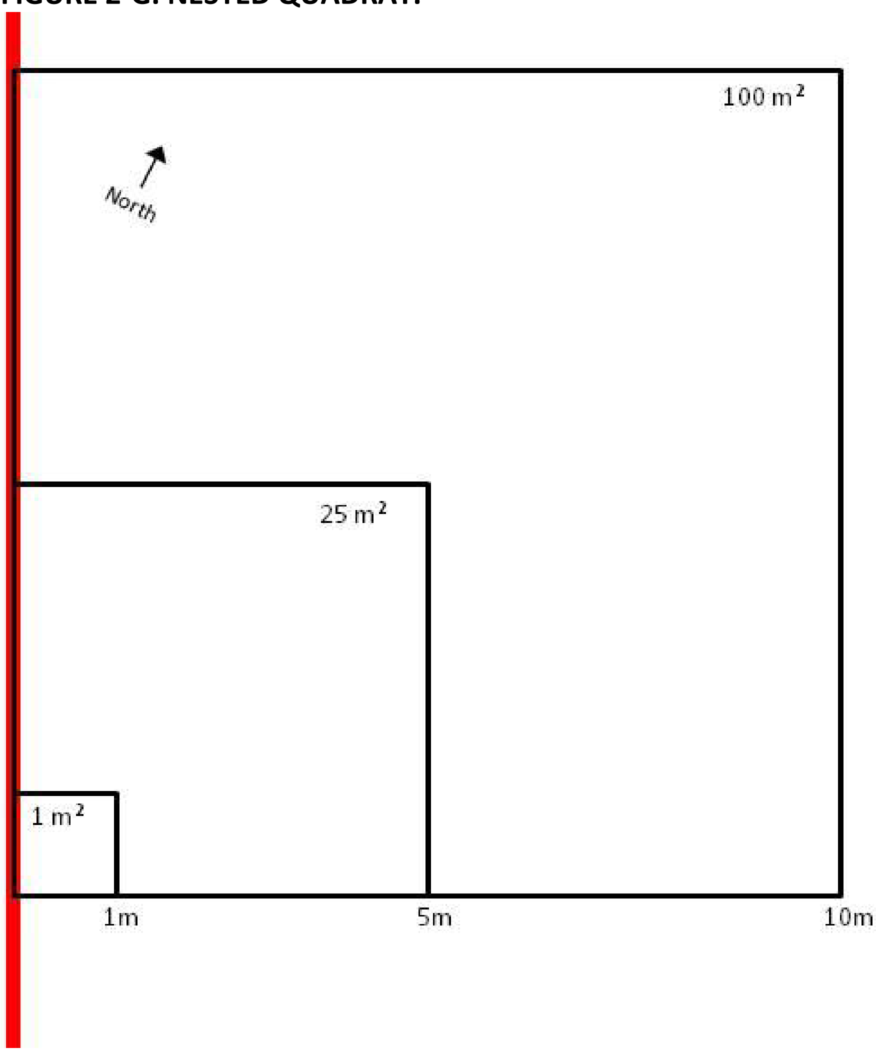



Source: Map produced by Michael Commons. Commons. M. 2010. California State University, Chico Geography and Planning Department. Used with permission.

PLOT DESIGN

Each nested quadrat plot consists of three nested plots, with a common corner located on the north east side of the transects. The nested plots measure $1m^2$ (1m x 1m), $25m^2$(5m x 5m) and $100m^2$(10m x 10m). (See Figure 2-G) The corner of each 20m x 10m Relevé plot is located on the transects, and extend 20m along the transect, and 10 meters perpendicular, to the north east.

**FIGURE 2-G. NESTED QUADRAT.**




Source**:** Map produced by: Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

PLOT MEASUREMENTS

**Nested Quadrat Plots**

*Vegetation Species and Cover*

Annual, perennial and woody species will be identified to the species level. For each species, a percent **foliar cover**[1] will be estimated, according to one of **seven classes**[2] and classified into three **vertical strata**.[3] Individual plant specimens may exist in one or more of the strata, and would be counted separately within each strata. For example, a single shrub may have a class 2 foliar cover in strata 1, class 3 foliar cover in strata 2, and a class 1 foliar cover in strata 3. These measurements will be individually taken for each of the three square **nested quadrats**.[4] Lastly, bare ground, rock, moss and lichens will be treated as a single entity, and measured within strata 1 of all three nested plots.[5]

*Tree species*

Each individual standing tree will be counted, and the DBH measured (if tree is at least 2 meters in height and 2cm in DBH) within the entire 100m² plot (the specific nested plot will also be recorded). If tree specimens exist, but are less than 2 meters, they will be counted and allocated "n/a" for DBH. For multi-stemmed trees, the DBH of each stem should be summed for a single, combined DBH value. Live and dead trees will be recorded, as long as the majority of the roots are
intact within the ground. Live and dead trees will be differentiated in the recordings.

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[1] **Foliar cover** is the total canopy cover of that species within the given area within each of the three strata, as a value between 0% and 100%

[2] **Seven Cover Classes:** Class 1 = >0%<1%; Class 2 = >1% to <5%; Class 3 = >5% to <10% ; Class 4 = >10% to <25%;
Class 5 = >25% to <50% ; Class 6 = >50% to <70% ; Class 7 = >70%

[3] **Vertical Strata:** Strata 1 = <1 meter; Strata 2 = >1 meter to 2 meters; Strata 3 = >2 meters

[4] **Nested Quadrats:** The innermost plot is 1m² (1m x 1m); middle plot is 25m²(5m x 5m) and the largest is 100m²(10m x 10m)

[5] Bare ground, rock, moss and lichens will only be included when they exist on the ground surface, not perched on a tree or other vegetation.

**Nested Quadrat Plots (cont.)**

*Live/Dead fuels*

General fuel measurements will be taken for the $100m^2$ plot. Height and cover class will be measured for live and dead fuels (differentiated by grass and shrub). Additionally, the average height to canopy base for shrubs and trees will also be measured. For this purpose, shrubs are defined as woody vegetation less than four meters tall.

*Substrate*

Underlying substrate will be estimated and classified by cover class, with minimal disturbance to the vegetation cover, for the entire $100m^2$ plot.[6]

*Photopoints*

A photopoint is established at the designated corner marker for each plot. From each photopoint, four photographs will be taken, one in each of the four cardinal directions (according to true north).

**<u>Relevé Plots</u>**

Vegetation within the Relevé plots will be identified to the species level, and the canopy cover for each will be recorded, as a percent of the total area within each of the three strata used for the nested quadrat plots. Additionally, a general qualitative assessment of the plot will be recorded, including any recent disturbances. Each individual tree, pole size or larger[7], will be counted and the DBH measured.

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[6] Substrate classes include: clay, silt, sand, gravel, cobble and boulder
[7] Pole size trees are defined as trees with a DBH of 10cm or greater.

# APPENDIX H

RIPARIAN RELEVÉ FIELD FORM

Date_____________________ Observer(s)__________________________________________
Relevé Plot Number/Code_________________
GPS Coordinates (decimal degrees)
____________________________________________________
Elevation___________ Slope (degrees)____________ Aspect_____________
Macrotopography________________________
Microtopography___________________________
Photographs (NESW) ______________________________________________________________

ENVIRONMENTAL DESCRIPTION
*Site Impacts* (circle) ATV, Grazing, Invasive Species, Road/Trail, Biocides, Vandalism/Dumping, Foot traffic/Trampling, Improper Burning Regime, Woodcutting, Feral Animals, Disease
*Notes* (include intensity for impact: light, moderate, high)
________________________________________________________________________________
________________________________________________________________________________
*General Notes* (site history: fires, anthropological, etc.)
________________________________________________________________________________
________________________________________________________________________________

| *Type* | *Fine* | *Gravel* | *Cobble* | *Stone* | *Boulders* | *Bedrock* | *Litter* | *Water* | *Vegetation* |
|---|---|---|---|---|---|---|---|---|---|
| *Desc.* | *Sand/ mud* | *0.2-7.5 cm* | *7.5-25 cm* | *25-60 cm* | *>60 cm* | *Outcrops* | *Organics* | | |
| *Cover Class* | | | | | | | | | |
| *% Cover* | | | | | | | | | |

*Cover classes 1 (<1%), 2(1-5%), 3(5-15%), 4(15-25%), 5(>25-50%), 6 (>50-75%), 7 (>75%)*
Litter Depth_________
Soil Texture______________________________________________________________

VEGETATION DESCRIPTION
Vegetation Community Description
________________________________________________________________________________
Vegetation Group Abbreviation
________________________________________________________________________________
Dominant Vegetation Layer Height _____0-0.5 m, _____0.5-5 m, _____5-10 m
Patch Size ______< 1 ha, ______1-5 ha,______ >5 ha
Phenology (Early, Peak, Late) _______ Ground, _______ Shrub, _______ Tree
Document each taxon in each layer in which it is present

Riparian Relevé Field Form (Continued)

Non-vascular

| Species | Collection | Cover Class | % Cover |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

Grasses, Herbs, Forbs, and Woody Seedlings

| Species | Collection | Cover Class | % Cover |
|---|---|---|---|
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Riparian Relevé Field Form (Continued)

Shrubs

| Species | Collection | Cover Class | % Cover |
|---|---|---|---|
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Low-Medium Tree (Note stems by classes (<10 cm)

| Species | Collection | DBH | Cover Class | % Cover | Estimate |
|---|---|---|---|---|---|
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Canopy

| Species | Collection | DBH | Cover Class | % Cover |
|---|---|---|---|---|
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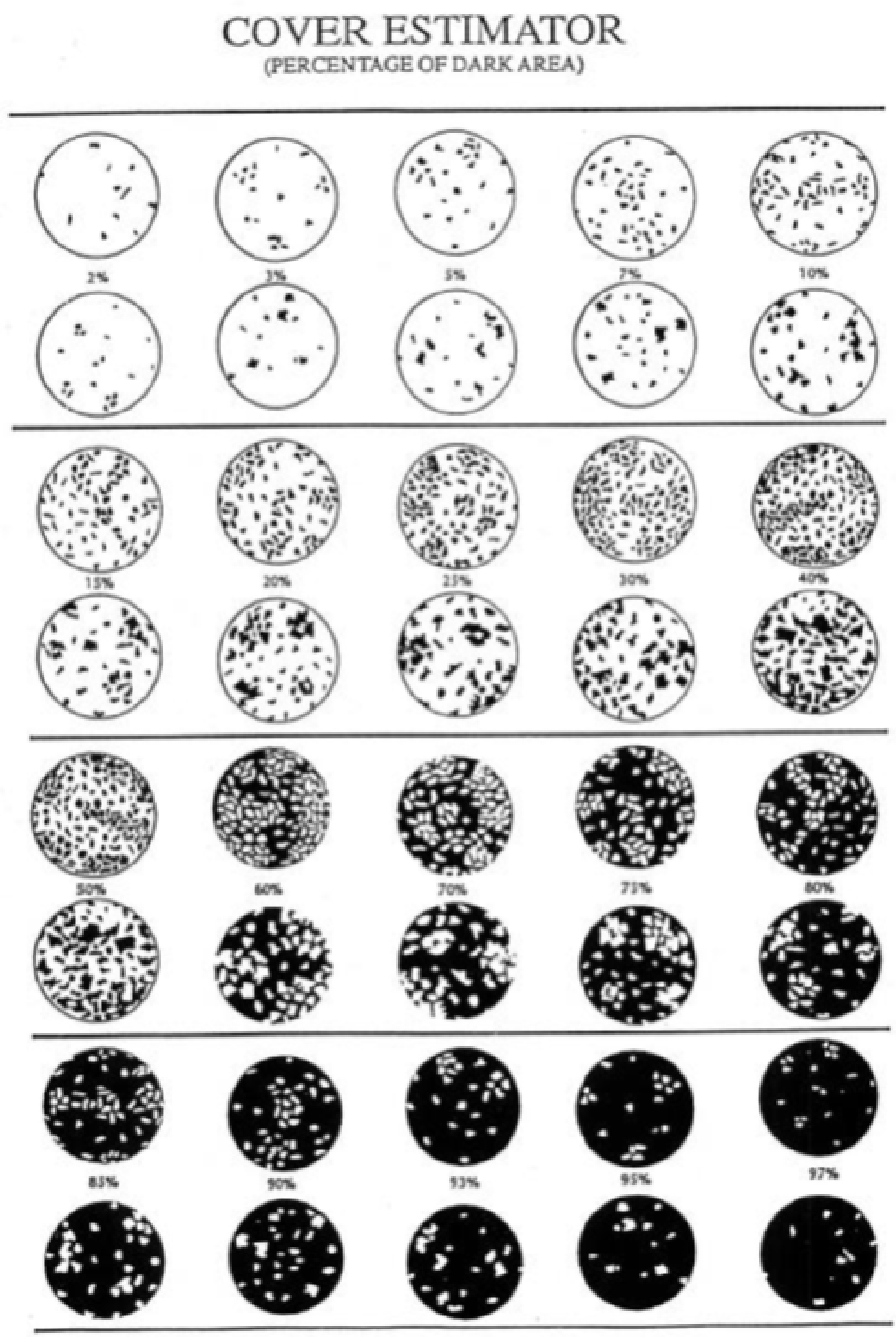
See coverage estimator on following page.

Source: Form produced by Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.




Source: Estimator produced by Don Hankins. Hankins, D. 2011. California State University, Chico Geography & Planning Department. Used with permission.

APPENDIX I

**TABLE 1-I. METHODS: PLANS REVIEWED**

| | Plan Name | Source (Date) | Location | Objectives | Format |
|---|---|---|---|---|---|
| 1 | Cañada de los Osos Ecological Reserve Management Plan | California Department of Fish and Game (2005) | ~10 miles east of Gilroy, CA | 1) Habitat management; 2) Native floral/faunal inventory; 3) Public use guide; 4) Operations & Maintenance-personnel requirements; 5) Budget planning aid; 6) Environmental impact assessment; 7) Environmental compliance documents | I. Intro., II. Property Description, III. Habitat and Species Description, IV. Management Goals, V. Operations & Maintenance Summary |
| 2 | Heenan Lake Wildlife Area Land Management Plan | California Department of Fish and Game (2007) | ~7 mi. SE of Markleeville, CA in eastern Alpine County | 1) Habitat management; 2) Retain and enhance biodiversity; 3) Monitor habitat communities for target species; 4) Public use guidelines; 5) Operations & Maintenance; 6) Fishing and hunting program | I. Intro., II. Property Description, III. Habitat and Species Description, IV. Management Goals, V. Environmental Impacts |
| 3 | Land Management Plan for the Rancho Jamul Ecological Reserve | Technology Associates (2006) | Honey Springs Road within the County of San Diego, CA | 1) Habitat management; 2) Public use guide; 3) Budget planning aid; 4) Environmental impact assessment | I. Intro., II. Property Description, III. Habitat and Species Description, IV. Management Goals and Environmental Impacts; V. Operations & Maintenance Summary |
| 4 | Fitzgerald Marine Reserve Master Plan | Brady/LSA Planners and Landscape Architects (2002) | Moss Beach, CA | 1) Preserve and enhance natural resources; 2) Education/ Interpretation opportunities; 3) Staff requirements and training; 4); Improve baseline info.; 5) Visitor & facilities management; 6) Minimize impact to neighbors; 7) Protect cultural resources; 8) Recreation; 9) Funding opportunities | I. Intro., II. Master Plan Concept, III. Natural Resource Management Program, IV. Visitor Management Program, V. Facilities Management Program, VI. Implementation Program, VII. Location and Setting, VIII. Visitor Use and Programs, IX. Access, X. Intertidal Zone and Shoreline Area, XI. Upland and Marsh Biology, XII. Hydrology, XIII. Geological Considerations, XIV. Cultural Resources |
| 5 | Angelo Reserve Management Plan | University of California Natural Reserve System (2004) | East of Elkhorn Ridge-Mendocino County, CA | 1) Research; 2) Outreach; 3) Education; 4) Habitat protection; 5) Funding | I. The Past, II. The Present, III. The Future |
| 6 | Kakadu National Park Management Plan | Kakadu National Park Board of Management (2007) | Northern Territory-Australia | 1) Conservation-biological & cultural resources; 2) Economic enhancement of region; 3) Joint management-Aboriginals & Australian Government | I. Description of Park, II. Introduction, III. How the Park will be Managed |

**TABLE 1-I. (CONTINUED)**

| | Plan Name | Source (Date) | Location | Objectives | Format |
|---|---|---|---|---|---|
| 7 | Miesville Ravine Park Reserve Master Plan | Hoisington Koegler Group, Inc. (2005) | South of Miesville, Minnesota | 1) Protect and preserve important natural, historic and/or cultural areas and landscapes; 2) Provide opportunities for the recreation and education; 3) Complement the opportunities offered by other outdoor education and recreation providers. | I. Intro., II. Recreational Needs Forecast , III. Vision & Guiding Principles, IV. Cultural Resource Stewardship , V. Natural Resource Stewardship, VI. The Development Master Plan, VII. Park Boundary & Acquisition, VIII. Cultural & Environmental Education, IX. Implementation & Management |
| 8 | Cosumnes River Preserve Management Plan | Kleinschmidt Associates Energy & Water Resource Consultants (2008) | Sierra Nevada to the Sacramento –San Joaquin Delta-Central Valley, CA | 1) Natural and cultural resources stewardship; 2) Enhancing watershed processes; 3) Agricultural stewardship; 4) Public use; 5) Property management; 6) Operations, Maintenance, and Monitoring | Executive Summary, I. Intro., II. Description of the Cosumnes River Watershed and the Preserve, III. Natural Resource Stewardship, IV. Agricultural Stewardship, V. Public Use, VI. Cultural and Visual Resources, VII. Property Descriptions and Management, VIII. Operations, Maintenance, and Monitoring |
| 9 | Deer Creek Watershed Conservancy Management Plan | Deer Creek Watershed Conservancy (1998) | Headwaters in mountains near Lassen National Park to its mouth in the Sacramento River, CA | 1) Optimize use of public and private resources; 2) Sustainability of watershed processes, natural resources, economic viability and preserve cultural heritage and resources; 3) Respect and protect private property rights and public resources; 4) Manage for spatial and temporal uncertainty; 5) Protect target species; 6) Education, research and public outreach; 7) improved communication and cooperation between agencies and organizations; 8) Long-term monitoring program | Executive Summary, I. Intro., II. Identifying Impairments, III. Estimating Pollution Load Reductions, IV. Management Measures, V. Technical & Financial Assistance, VI. Public Information & Education, VII. Schedule, VIII. Milestones, IX. Performance, X. Monitoring |
| 10 | Lost Creek and Crags Campgrounds Lassen Volcanic National Park: Vegetation Management Plan | National Park Service (publishing date: unknown) | Lassen Volcanic National Park, CA | 1) Improve vigor and survivorship of pine and fir; 2) Promote the establishment of pine in the overstory of future forest stands; 3) Reduce the occurrence and spread of root disease; 4) Reduce the occurrence of hazardous trees | I. Intro., II. Project Goals and Strategy, III. Forest Characteristics, IV. Insects and Pathogens, V. Management Actions, VI. Monitoring |