PACIFIC COOPERATIVE STUDIES UNIT
UNIVERSITY OF HAWAI`I AT MĀNOA
Dr. David C. Duffy, Unit Leader
Department of Botany
3190 Maile Way, St. John #408
Honolulu, Hawai'i 96822

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HAWAII'S STATEWIDE AQUATIC WILDLIFE CONSERVATION STRATEGY

December 2005*

Dwayne Meadows[1], Austin L. Kane[1]
Christen Mitchell[2] and Christine Ogura[2]

[1] Pacific Cooperative Studies Unit, University of Hawai'i and Hawai'i Division of Aquatic Resources, Honolulu, Hawaii 96813. Email: DwayneMeadows@msn.com

[2] Pacific Cooperative Studies Unit, University of Hawai'i and Hawai'i Division of Forestry and Wildlife, Honolulu, Hawaii 96813. Email: Christen.W.Mitchell@hawaii.gov

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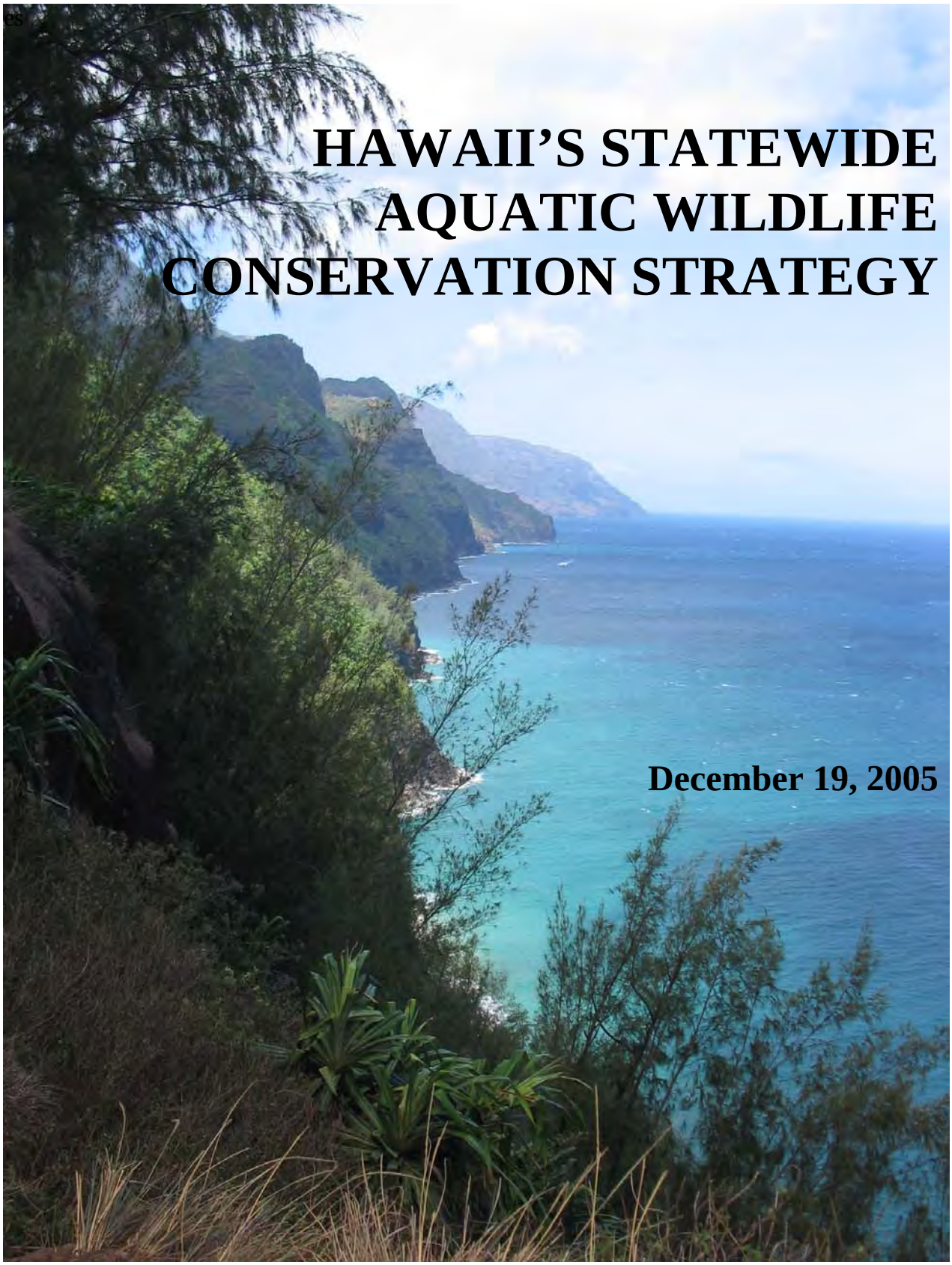

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December 19, 2005

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Department of Land and Natural Resources
Division of Aquatic Resources
1151 Punchbowl Street, Room 330
Honolulu, HI 96813

By:

Dwayne Meadows[1], Austin Kane[1], Christen Mitchell[2], and Christine Ogura[2]

[1] Pacific Cooperative Studies Unit, University of Hawai'i and Hawai'i Division of Aquatic Resources.
[2] Pacific Cooperative Studies Unit, University of Hawai'i and Hawai'i Division of Forestry and Wildlife, Room 325.

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LIST OF ACRONYMS

BRA	Bottomfish Restricted Area
CITES	Convention on International Trade of Endangered Species
CWCS	Comprehensive Wildlife Conservation Strategy
DAR	Division of Aquatic Resources (State)
DHHL	Department of Hawaiian Home Lands (State)
DLNR	Department of Land and Natural Resources (State)
DOFAW	Division of Forestry and Wildlife (State)
DOH	Department of Health (State)
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FMA	Fishery Management Area
IUCN	International Union for the Conservation of Nature and Natural Resources
KIRC	Kahoʻolawe Island Reserve Commission
MGD	Million gallons per day
MHI	Main Hawaiian Islands
MLCD	Marine Life Conservation District
MMA	Marine Managed Area
NGOS	Non-governmental organizations
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NWHI	Northwestern Hawaiian Islands
NWR	National Wildlife Refuge
SGCN	Species of Greatest Conservation Need
SWG	State Wildlife Grant
TNC	The Nature Conservancy of Hawaiʻi
UH	University of Hawaiʻi
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

BACKGROUND

Hawaii's Statewide Aquatic Wildlife Conservation Strategy (SAWCS) is a historic initiative that comprehensively reviews the status of the full range of the State's aquatic species, over 1,000 of which are found nowhere else on earth. Hawaii's SAWCS presents strategies for long-term conservation of these species and their habitats. The development of the SAWCS built upon Hawaii's strong history of conservation and involved working with resource managers, biologists, and concerned individuals statewide. As a result, the SAWCS has a broad level of support, increasing the likelihood that the conservation strategies identified will be implemented by multiple partners as well as the Hawai'i Department of Land and Natural Resources.

STRATEGY APPROACH AND DEVELOPMENT

The reason for developing a SAWCS is to continue participation in the State Wildlife Grant (SWG) program administered by the U.S. Fish and Wildlife Service (USFWS). Every state in the nation and all the U.S. territories and commonwealth of Puerto Rico are preparing Comprehensive Wildlife Conservation Strategies, of which the SAWCS is a component, by October 1, 2005 that contains the following eight required elements:

1) Information on the distribution and abundance of species of wildlife identified as "species of greatest conservation need," including low and declining populations, as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife;
2) Descriptions of the locations and relative condition of key habitats and community types essential to the conservation of species identified in (1);
3) Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats;
4) Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions;
5) Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions;
6) Descriptions of procedures to review the plan at an interval not to exceed ten years;
7) Plans for coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats;

8) Provisions to ensure public participation in the development, revision, and implementation of projects and programs.

The Hawai‘i Department of Land and Natural Resources, Division of Aquatic Resources has taken the lead in preparing the SAWCS and has gone beyond simply meeting mandated requirements by making the SAWCS an even more useful document to guide conservation efforts across the State. The Strategy uses the best available science, and it integrates information from the many existing management, conservation, and recovery plans. The SAWCS synthesizes information gathered from existing conservation partnerships and cooperative efforts with other local, State, and Federal agencies, non-governmental organizations, private landowners, and interested citizens. A combination of outreach methods, including public meetings, technical workshops, a website, and phone and email were used to invite and expand participation in the development of the SAWCS. Chapter 2 of this document outlines the methods and approaches used to develop Hawaii's SAWCS.

Recognizing the effectiveness of taking conservation actions at a habitat-level in addition to a species-specific level, the SAWCS emphasizes threats to species and their habitats and conservation needs at three levels: statewide, ecosystem, and taxa-specific. Chapter 3 presents an overview of Hawaii's unique species and their habitats, identifies the major threats to the long-term conservation of these species and habitats, and present seven conservation objectives to address these threats. Chapters 4, 5, and 6 present specific information, including specific strategies relating to the seven statewide conservation objectives, for the marine environment (Chapter 4), the freshwater environment (Chapter 5), and the Northwestern Hawaiian Islands (Chapter 6). Fact sheets on individual species or on groupings of taxa were developed to present information relating to USFWS required elements 1 through 5, and are compiled in Chapter 7. Finally, recognizing that monitoring and implementation are critical to the overall success of the SAWCS, Chapter 8 discusses existing and needed monitoring programs for species and habitats as well as implementation and monitoring of Hawaii's SAWCS, including the 10-year revision.

HAWAII'S STATEWIDE AQUATIC WILDLIFE CONSERVATION STRATEGY

Hawaii's Species of Greatest Conservation Need (SGCN) include all endemic aquatic plants, algae, and animals, other aquatic species protected by State, Federal, or International laws or conventions, and additional aquatic animals identified as in need of conservation attention. The SGCN includes: five freshwater fishes, 23 freshwater invertebrates, 20 anchialine pond-associated fauna, 26 marine mammals, six marine reptiles, 156 marine fishes, 1424 marine invertebrates, two marine plants, and 112 aquatic algae.

The major threats facing Hawaii's native wildlife are common to most species groups and habitats and include:

- Loss and degradation of habitat resulting from human development, alteration of hydrology, invasive species, recreational overuse, natural disaster, and climate change;
- Introduced invasive species;
- Limited information and insufficient information management;
- Uneven compliance with existing conservation laws, rules and regulations;
- Excessive extractive use;
- Management constraints; and
- Inadequate funding to implement needed conservation actions.

To address these threats, the SAWCS identifies multiple strategies to implement the following seven priority conservation objectives for the State:

1) *Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive;*
2) *Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication;*
3) *Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs;*
4) *Strengthen existing and create new partnerships and cooperative efforts;*
5) *Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawai‘i;*
6) *Support policy changes aimed at improving and protecting native species and habitats; and*
7) *Enhance funding opportunities to implement needed conservation actions.*

Successful implementation of the SAWCS will require an ongoing effort of local, State, and Federal agencies, non-governmental organizations, private landowners, and individual citizens working together. Though the magnitude and scope of the work needed to protect and recover Hawaii's native species are challenging, implementation of the identified strategies is critical if future generations are to see and experience the unique native wildlife of Hawai‘i.

Acknowledgements

Though the Division of Aquatic Resources took the lead in developing Hawaii's Statewide Aquatic Wildlife Conservation Strategy (SAWCS), it is the assistance and involvement of many partners, organizations, and interested citizens that made it possible. As a result of the comments received, resources shared, and staff time committed, Hawaii's SAWCS is truly a strategy by and for the people of Hawai'i.

Invaluable assistance was provided by various people and organizations at different stages of the Strategy's development. To everyone involved, a big mahalo for your *kokua* in developing and contributing to Hawaii's SAWCS.

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CHAPTER 1
PURPOSE AND VALUE

Mission Statement: *The mission of Hawaii's Statewide Aquatic Wildlife Conservation Strategy is to guide conservation efforts across the State to ensure protection of Hawaii's wide range of aquatic wildlife and the diverse habitats that support them.*

PURPOSE OF HAWAII'S STATEWIDE AQUATIC WILDLIFE CONSERVATION STRATEGY

The purpose of developing Hawaii's Statewide Aquatic Wildlife Conservation Strategy (SAWCS) is to provide the opportunity for aquatic resource managers to develop a comprehensive planning process to help manage Hawaii's unique aquatic wildlife. Hawaii's SAWCS is truly comprehensive in scope recognizing the interconnectedness of Hawaii's diverse aquatic species and creating an integrated, strategic blueprint for the protection and recovery of Hawaii's aquatic biodiversity. Although the magnitude and scope of the work needed to protect Hawaii's aquatic species is challenging, this Strategy will improve the biological, cultural, and economic well-being of the islands and their people.

Legislative Mandate and Guidance

Historically, wildlife funding at the national level has been targeted towards species that were hunted or fished for sport and towards species federally listed as threatened or endangered. Declining populations of non-game, non-endangered species throughout the nation and the lack of stable funding to address the needs of these species led to the creation of the Wildlife Conservation and Restoration Program (WCRP) for fiscal year 2001 and the State Wildlife Grants (SWG) program (2002 to present) by the United States Congress. These programs provide funds to state agencies to begin the work needed to protect and secure viable populations of the full range of wildlife and their habitats in each state. The Hawai‘i Department of Land and Natural Resources (DLNR) holds the constitutional and statutory authority to protect wildlife resources and administers the use of these funds.

As a condition for participation in these Federal aid programs, Congress required states to develop a Comprehensive Wildlife Conservation Strategy (CWCS), which includes both aquatic and terrestrial species and habitats, to remain eligible for SWG funding. Hawaii's SAWCS is based on this strategy, but is focused only on aquatic resources conservation and management. Each CWCS, and the SAWCS, must include the following eight elements:

1) Information on the distribution and abundance of species of wildlife identified as "species of greatest conservation need," including low and declining populations, as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife;

2) Descriptions of the locations and relative condition of key habitats and community types essential to the conservation of species identified in (1);
3) Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats;
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6) Descriptions of procedures to review the plan at an interval not to exceed ten years;
7) Plans for coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats;
8) Provisions to ensure public participation in the development, revision, and implementation of projects and programs.

The Hawai‘i DLNR Division of Aquatic Resources (DAR) is leading the effort to collect the best available information from the existing plans and programs and to coordinate with other local, State, and Federal agencies, non-governmental organizations, private landowners, and interested citizens to develop and implement the best approaches to ensure the long-term conservation of Hawaii’s aquatic wildlife through Hawaii’s SAWCS.

VALUE OF THE SAWCS

The value of Hawaii’s SAWCS toward achieving its mission lies in its ability to integrate the needs of the full range of native aquatic species and habitats into a coordinated effort that enhances the effectiveness of broad cooperation among agencies, organizations, and the public toward the conservation of native species and habitats. The benefit of having one document covering the needs of a diverse range of species groups makes Hawaii’s SAWCS a historic endeavor. Additionally, by working with and soliciting information from a broad range of governmental agencies, non-governmental organizations, and citizens, Hawaii’s SAWCS has helped to create consensus, excitement, support, and momentum to protect our native species.

By identifying important species and habitats, key threats, and objectives and strategies for their conservation, and by creating a framework to measure the effectiveness of these strategies, Hawaii’s SAWCS lays the foundation for conservation of native aquatic wildlife and their habitats. By taking a proactive approach, Hawaii’s SAWCS takes a fiscally responsible stand. The SAWCS focuses on actions to prevent species from reaching threatened or endangered status, providing a cost-effective alternative to recovering species after they have been listed as threatened or endangered. Additionally, by emphasizing measures that benefit multiple species groups and habitats in which they reside, the SAWCS is a change from single species management. The true challenge, however, will come with the implementation of this SAWCS.

Hawaii's Unique Aquatic Wildlife Resources

A SAWCS is especially important to Hawai'i, the United States, and even the world, because of the unique biology, cultural importance, and economic value of aquatic Hawaiian species. The Hawaiian Islands are the most isolated archipelago in the world, situated in the middle of the Pacific Ocean more than 3,200 kilometers (2,000 miles) from the nearest continent. Because of this extreme isolation, relatively few life forms survived the rigors of the ocean crossing and reached the islands. Fewer still were able to successfully establish populations in the archipelago over its 70 million year history. Those that did, however, found a diversity of climatic and geological features that provided an enormous range of habitat types. With limited gene flow from their distant, original populations, colonists rapidly adapted to their novel environments. The diversity of unique species that have evolved in the islands is nothing less than astounding, with plants and animals that are so distinctive that the archipelago has some of the world's highest endemism for marine species: about 20 percent.

For more than 70 million years, the evolution of new Hawaiian species vastly exceeded losses to extinction. Yet after the arrival of humans to the islands, within what is a blink of an eye in geological time, numerous species began precipitous declines to extinction, especially terrestrial species. Aquatic species faced different pressures, primarily over harvesting and habitat alteration in watersheds and along coastlines. Today, the Hawaiian Islands hold 13 aquatic animals listed by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) as endangered or threatened and six species are candidates for listing.

In present day Hawai'i, the link between Native Hawaiian culture and native species has not been lost and continues to be practiced in belief systems as well as traditional practices such as gathering of native plants and animals for hula, traditional medicines, carving, weaving, tool making, jewelry, and ceremonies. The special role and relationship Native Hawaiians have with the native species and ecosystems in the islands is perhaps most reflected in their increasing role in natural resource management in places such as the island of Kaho'olawe and Mo'omomi, Moloka'i where traditional management practices such as *kapu* (taboo) and *ahupua'a* (watershed)-scale thinking predominate.

Native wildlife is also important to all of Hawaii's residents. Based on a 2004 "Wildlife Values in the West" survey, a large majority of Hawaii's residents (71.4%) strongly agree that it is important to take steps to prevent the extinction of endangered species (Teel & Dayer, 2005). Economically, wildlife viewing opportunities are worth hundreds of millions of dollars to the State's $10 billion a year tourism industry (U.S. Department of Interior, 2003). Hawaii's aquatic wildlife and their habitats also provide hundreds of millions of dollars in important goods and services to residents. A recent University of Hawai'i study of the economic valuation of water quality, in-stream uses, species habitat, hunting, commercial harvest, ecotourism, and climate control estimated the value of services to be between $7.4 to $14 billion in the Ko'olau Mountains of O'ahu alone (Kaiser, 1999). Other examples of ecological services provided by native habitats include coral reefs that protect beaches, homes, and businesses from erosion, storms, and tsunami waves, and wetland habitats that filter the water supply. Finally, actions preventing the introduction of invasive species benefit people as well as native wildlife: introduced ungulates (hooved animals) denude native forest, causing soil erosion and sedimentation of streams and nearshore reefs and impacting fishing opportunities, and introduced

plants such as *Miconia calvescens* provide much less erosion control than native trees, threatening billions of gallons of water provided by our watersheds.

REFERENCES

Kaiser B, Krause N, Roumasset J. 1999. Environmental valuation and the Hawaiian economy. Honolulu: University of Hawai‘i Economic Research Organization.

Teel TL, Dayer AA. 2005. Preliminary state-specific results from the research project entitled “Wildlife values in the west 2004.” Fort Collins: Human Dimensions in Natural Resources Unit, Colorado State University.

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2003. 2001 National survey of fishing, hunting, and wildlife-associated recreation. available at: http://www.census.gov/prod/2003pubs/01fhw/fhw01-hi.pdf (accessed May 24, 2005).

CHAPTER 2
STRATEGY DEVELOPMENT

APPROACH

Given Hawaii's biological uniqueness on a global scale, the Statewide Aquatic Wildlife Conservation Strategy (SAWCS) recognizes the importance of protecting all endemic aquatic wildlife and other aquatic species threatened with decline. On the ecological level, the SAWCS takes a habitat management approach that takes into account the complex inter-relationships between species and their habitats. The SAWCS builds on and synthesizes information gathered from existing conservation partnerships and cooperative efforts. Additionally, the SAWCS highlights these partnerships and their efforts in Hawai'i with a goal to enhance and expand existing and to create new partnerships, ultimately increasing support for conserving Hawaii's aquatic wildlife.

The Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources (DAR) coordinated the development of Hawaii's SAWCS. The SAWCS primarily is based on aquatic sections included in Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS) that was developed with joint cooperation by the Hawai'i Division of Forestry and Wildlife and the DAR, the divisions primarily charged with protecting the State's terrestrial and aquatic resources. The SAWCS team consisted of staff hired through the Pacific Cooperative Studies Unit of the University of Hawai'i (UH). In addition, other SAWCS contributors include members of the Statewide Aquatic Wildlife Conservation Strategy Advisory Committee (see Acknowledgements), which had representatives from Federal and State agencies, resource user groups, and non-profit organizations, and other internal and external stakeholders, and additional technical workshops and public meetings participants.

Because most of the SAWCS comes from the larger CWCS, many of the processes used for development are the same. Additionally, several methods that were part of putting the CWCS together encompassed the SAWCS; thus, only the CWCS is referenced.

Public Participation

A variety of methods and opportunities were used to reach out to the public to introduce them to Hawaii's SAWCS. The primary method used to engage the public as well as our managers and technical experts was Hawaii's CWCS website, www.state.hi.us/dlnr/dofaw/cwcs/index.html. The public was encouraged to comment at all stages of SAWCS development, beginning with the draft list of species covered by the SAWCS to taxa-specific fact sheets and the Draft and Final Draft Strategy. The website was updated monthly, and whenever new announcements, workshops or public meetings, or products for review were available. Three types of contact information were provided so that people could share information by email, phone, or mail. Each interested person was added to a SAWCS Contact List, which was used to keep people updated and engaged in the process. This list was initially developed through an e-mail and a brochure mailing to over 200 individuals, agencies, and organizations. During the month of April 2005, an outreach initiative involving Earth Day celebrations were conducted where the

distribution of informational brochures, games, and items such as bookmarks helped to raise public interest and support for Hawaii's SAWCS. During the months of June and July, public meetings were held on six islands to engage the public in developing a Final Draft of Hawaii's CWCS. Following the public meetings, another opportunity to comment on a revised final draft was provided on the website and people were contacted by email, phone, and mail.

Resource Manager and Technical Expert Participation
Conservation and management of natural resources in Hawai‘i traditionally have involved strong collaborative efforts. Hawaii's SAWCS benefited from this foundation of established partnerships and built upon existing species recovery plans, location-specific management plans, and other available habitat or species related plans and documents.

The SAWCS team invited resource managers and technical experts to participate in the development of the SAWCS through an initial outreach effort, sent both by mail and email, to a wide range of local, State, and Federal agencies, non-governmental organizations, and researchers. The SAWCS core team also identified existing partners and individually contacted them to introduce the strategy and invite their participation. Members of the SAWCS team attended several professional conferences where additional biologists and researchers were invited to participate in the development of the SAWCS. Based on these outreach efforts, a formal Advisory Committee was developed providing information used to develop the SGCN list and the Draft SAWCS. Technical workshops on four different islands were conducted once the Draft CWCS was complete, to provide a forum for managers and technical experts to review the CWCS materials, provide comments, and suggest additions for incorporation into the Final Draft of Hawaii's CWCS.

Major collaborators included a wide range of agencies and organizations that have been integral in building support for the SAWCS, sharing data and information, providing comments and recommendations, and assisting in the overall planning effort. Major contributors include the Bishop Museum, The Nature Conservancy of Hawai‘i, Hawai‘i Invasive Species Council, UH, U.S. Fish and Wildlife Service (USFWS), U.S. National Oceaic and Atmospheric Administration, U.S. National Park Service, and the U.S. Marine Corps.

METHODS

Identifying Species of Greatest Conservation Need and Their Habitats
The Hawaiian Islands are biologically diverse, with aquatic fauna characterized by high levels of endemism. To recognize the global rarity of these species or the importance of Hawai‘i to these species, Hawaii's preliminary list of Species of Greatest Conservation Need (SGCN) was selected using the following criteria: 1) all endemic aquatic animals, plants, or algae; 2) any aquatic animal taxa on the Federal threatened, endangered, candidate, or species of concern list; 3) any animal protected by the U.S. Marine Mammal Protection Act; 4) any native aquatic animal on the International Union for the Conservation of Nature and Natural Resources' (IUCN) Threatened Red List or the Convention on International Trade in Endangered Species (CITES) appendices; and 5) additional animals suggested by the Statewide Aquatic Wildlife Conservation Strategy Advisory Committee as deserving of attention for other reasons.

Hawaii's preliminary SGCN list was reviewed by partners, posted on the website for public consideration and comment, and discussed at technical workshops and public meetings. Given the large number of species, for organizational and management purposes, species were grouped into the following categories: freshwater fishes, freshwater invertebrates, anchialine pond fauna, marine mammals, marine reptiles, marine fishes, marine invertebrates, and aquatic flora.

Identifying Threats, Conservation Objectives, Research Needs, Monitoring, and Priorities
Hawaii's SAWCS team identified the threats and needs of native wildlife and habitats by using multiple methods and at three levels. The first step was to review and analyze existing plans, policies, and scientific literature from local, State and Federal agencies, private landowners, non-governmental organizations, or academic researchers. The SAWCS team solicited additional information from resource managers and biologists through conversations, emails, and meetings. Based on this research and analysis, draft threats, conservation objectives, research needs, and monitoring issues for species and habitats were determined at three levels: SGCN, ecosystem, and statewide. At the statewide level, major common threats to and needs of many of Hawaii's SGCN and their important habitats were emphasized, and seven objectives were identified to address these threats. These seven objectives reflect the conservation priorities for the State without regard to the limitations of the State Wildlife Grants program, recognizing the need to comprehensively identify the State's conservation priorities to enhance the possibility of implementation. Because conservation needs in Hawai'i far exceed the resources available, implementation of any of the identified strategies will benefit native wildlife and habitats. Important threats and conservation strategies are highlighted in separate chapters for marine environments, freshwater and anchialine environments, and the Northwestern Hawaiian Islands.

Plan Review
The plan review for Hawaii's CWCS encompassed the review of Hawaii's SAWCS. Drafts of Hawaii's CWCS were shared through multiple venues including the website, technical workshops, public meetings, and the CWCS contact list. Availability of the Draft CWCS and the schedule of public meetings were publicized to the CWCS contact list and additional parties by email, direct mail, press release, and on the website. Upon the conclusion of the technical workshops and public meetings, the comments were compiled, reviewed, evaluated, and incorporated as appropriate into the Revised Draft CWCS. This Revised Draft CWCS was posted on the website for review and both emailed and mailed to the CWCS Contact List. This was followed by another public comment period from which comments were again reviewed and incorporated as appropriate into a Final CWCS. Chapter 8 was substantially rewritten based on internal review and comment. The CWCS was then finalized and presented to the Board of Land and Natural Resources for approval.

ORGANIZATION AND FORMAT OF HAWAII'S SAWCS

Hawaii's SAWCS is organized in a way that addresses the eight elements required by the USFWS at multiple scales, from the statewide perspective to ecosystem-specific and species-specific levels. Chapter 1, **Purpose and Value**, gives background information on the SAWCS. This chapter describes the processes used to develop the Strategy and addresses required elements 7 and 8. Chapter 3, **State Overview, Threats, and Conservation Actions**, provides a statewide overview outlining the current condition of the State's natural aquatic resources,

management activities, key threats to native species and habitats, and statewide conservation goals, objectives, and strategies. Chapter 4, **Marine Conservation Needs**, and Chapter 5, **Freshwater and Anchialine Conservation Needs**, go beyond the statewide perspective to ecosystem-specific threats and strategies, including those for the **Northwestern Hawaiian Islands** in Chapter 6. Chapter 7, **Species of Greatest Conservation Need**, provides details on all the listed wildlife in fact sheets that contain information for one taxa, closely related groups of species, or species facing similar threats. Chapters 3 through 7 address USFWS required elements 1 through 5. Chapter 8, **Monitoring, Implementation, and Adaptive Management,** discusses existing and needed monitoring programs for species and habitats as well as implementation and review of the SAWCS itself, addressing USFWS required elements 6 and 7. Finally, supporting **Appendices** consisting of a Glossary and list of all SGCNs are included to provide additional detail.

CHAPTER 3
STATE OVERVIEW, THREATS, AND CONSERVATION ACTIONS

Due to its extreme isolation, Hawai‘i is characterized by high levels of endemism in its aquatic animals. The islands also have a large human population. As a result, Hawai‘i presents both tremendous opportunities and challenges for conservation. To fully understand these opportunities and threats requires a detailed understanding of the background conditions and issues in the State. The goal of this chapter is to provide this background and then develop the major conservation objectives to deal with the challenges raised.

SOCIAL OVERVIEW

Human Landscape

The population of the State of Hawai‘i was estimated at 1,262,840 people in 2004, with the majority (70%) found on O‘ahu, in the City and County of Honolulu (899,593). The nearly seven million visitors in 2004 contributed an additional average of 170,000 people per day, mostly on O‘ahu and Maui. Hawai‘i has four local governments: the City and County of Honolulu (island of O‘ahu and the Northwestern Hawaiian Islands), the County of Kaua‘i (islands of Kaua‘i and Ni‘ihau), the County of Maui (islands of Maui, Moloka‘i, Lāna‘i and Kaho‘olawe), and the County of Hawai‘i (island of Hawai‘i). Hawai‘i also has a fifth county, Kalawao County, which does not have a separate government unit. Kalawao County covers the former Hansen’s disease settlement at Kalaupapa (Moloka‘i) and is managed by the National Park Service (NPS) under a cooperative agreement with the State Department of Health.

Based on a 2004 “Wildlife Values in the West” survey, 71 percent of Hawaii’s residents strongly agree that it is important to prevent the extinction of endangered species and 94 percent find it acceptable to close some areas to human use to protect wildlife (Teel & Dyer, 2005). In 2001, an estimated 20 percent of the population participated in some type of wildlife-associated recreation (e.g., fishing, hunting, wildlife watching), with a large proportion of the $10 billion dollar tourism sector indirectly related to the viewing of marine wildlife. One study estimates that snorkeling and diving alone generate $364 million dollars each year in added value for the State.

Fishing is another industry with economic ties to the aquatic environment. Total recorded commercial landings for marine species in 2003 for Hawai‘i (most recent statistics) was over 22 million pounds with a direct value of over 50 million dollars. Of that, approximately 5 million pounds were caught in the Main Hawaiian Islands (MHI), approximately 300,000 pounds in the Northwestern Hawaiian Islands (NWHI), and 17 million pounds in “other areas,” which includes mid-ocean and records of catch that did not specify area. The total commercial landings include approximately 13.6 million pounds of tuna, just under three million pounds of bill and swordfish, just under four million pounds of pelagic fishes, 520,000 pounds of deep bottomfishes, and 750,000 pounds of akule and opelu. Total commercial landings also include approximately 64,000 pounds of invertebrates (lobsters, crabs, shrimps, octopus, squid, and opihi) and 9,000

pounds limu or seaweed species. Recreational and subsistence catches are poorly known but likely to be in this range as well.

Water and Land Use

Hawai‘i withdraws about two billion gallons per day of water, with just over 500 million gallons coming from groundwater sources, and the rest from surface water diversions and withdrawals. Water consumption is about 550 million gallons per day (mgd). Freshwater resources are managed by a number of different State and Federal agencies. The DLNR-Division of Aquatic Resources (DAR) and the U.S. Fish and Wildlife Service (USFWS) are responsible for managing freshwater animals. The Hawai‘i Department of Health and the U. S. Environmental Protection Agency are responsible for managing water quality and pollution under the Clean Water Act and other legislation. Coastal zone management, including development permits in Special Management Areas, is the joint responsibility of the State Department of Business, Economic Development, and Tourism Coastal Zone Management Program and the U. S. National Oceanographic and Atmospheric Administration (NOAA). The DLNR Commission on Water Resources Management is responsible for water quantity and stream alterations.

Nearly half of Hawaii’s 1.66 million hectares (4.1 million acres) are managed by the State or Federal government. The largest landowner, the State of Hawai‘i, manages over 467,000 hectares (1,155,900 acres) for watershed protection, preservation of natural resources, agricultural use, recreation, transportation, and public safety. The Federal government owns or manages, through leases or cooperative agreements, more than 270,000 hectares (671,579 acres) for a variety of purposes, including conservation of natural and cultural features, protection of wildlife habitat, military support and training, and public safety. The remaining land is in private ownership and much of this land is controlled by a few owners. Some of these lands are managed in cooperation with adjacent landowners for conservation purposes as part of a watershed partnership. There are nine watershed partnerships on six islands, involving more than 50 public and private partners and covering over 344,000 hectares (850,000 acres) of forested watershed.

Unlike many other states, Hawai‘i has statewide land use classifications, with all land being zoned in one of four categories: Conservation, Agricultural, Urban, and Rural. A significant portion of the State (31%) has been designated for long-term resource protection and receives varying degrees of management, especially in the Conservation District. In addition, in Special Management Areas located along the shoreline, each county provides special control of development, even for land already subject to Conservation District restrictions. The Hawaiian Islands Humpback Whale National Marine Sanctuary (NOAA and DLNR) protects an additional 364,200 hectares (900,000 acres) of marine waters, while the NWHI Coral Reef Ecosystem Reserve protects submerged lands and waters in the NWHI. Over 40 additional marine areas have conservation protections or restrictions on various forms of fishing.

Tourism, of which a large part is related to use of the marine environment, is the primary economic activity in the State, with more than 6.9 million visitors and $10.3 billion in expenditures in 2004 alone. Agriculture, primarily pineapple cultivation and diversified agriculture, and military expenditures are important secondary economic drivers.

However, over the last decade, major land use trends include the transition from agriculture (e.g., sugar cane, pineapple cultivation) to resort-residential development and large-lot residential subdivisions on agricultural lots. This affects Hawaii's watersheds because although there has been a decrease in agricultural non-point source pollution, there has been an increase in domestic and commercial non-point and point source pollution.

Cultural Use of Native Wildlife

Wildlife in Hawai‘i play a significant role in Native Hawaiian culture. Historically, whale ivory, shells, and shark's teeth were used for necklaces and other adornments. Fish and sea turtle bones were used as kitchen implements, tools, and fishhooks, while sea turtle shells and scutes were used as containers. Koa (*Acacia koa*) trees were used for the ocean-voyaging canoes. Numerous other examples of the use of native plants and animals in both daily life and ritual exist (see articles by Titcomb in references). In present day Hawai‘i, the link between Native Hawaiian culture and native species has not been lost and continues to be practiced in belief systems, as well as in traditional practices such as gathering of native wildlife for hula, traditional medicines, carving, weaving, and ceremonies.

The belief system of the Native Hawaiians links people with all living and non-living things. Native Hawaiians, as *kanaka maoli* (native people), see themselves as guardians of ecosystems and their well-being is directly related to the well-being of these ecosystems. Many species such as sea turtles, sharks, and several terrestrial animals are believed to be *‘aumakua* (ancestors or guardians) of certain Hawaiian families. Hawaiian names have been given to many native and Polyensian species, and they have been incorporated into *oli* (chants) and *mo‘olelo* (legends). Native Hawaiian land ownership and resource management were often based on a unit called the *ahupua‘a*, which typically corresponded with what we today call watershed areas. This understanding of the link from uplands to the ocean was ahead of its time. *Kapu* (taboo) systems that limited certain classes or sexes from eating certain animals or fishing in certain places or at certain times may have aided in the conservation of some species (e.g., only men were allowed to eat honu (green sea turtle) and only royalty could eat certain fishes). Today, Native Hawaiian teachings play an increasing role in natural resource management, especially in areas of cultural significance like Kaho‘olawe or Wao Kele o Puna (island of Hawai‘i). The SAWCS recognizes that the State and its agencies are obligated to protect the reasonable exercise of customarily and traditionally exercised rights of Native Hawaiians to the extent feasible, in accordance with *Public Access Shoreline Hawaii versus Hawaii County Planning Commission* and subsequent case law.

Conservation Funding

Hawai‘i ranks near the bottom (48th) in the nation for state spending on fisheries and wildlife, though the State boasts the largest area of marine protected areas in the United States. In Fiscal Year 2006, the State Department of Land and Natural Resources was allocated approximately $76.8 million of the State's $8.9 billion dollar executive budget. With less than one percent of the State's budget, the Department must manage the State's marine and freshwater resources (e.g., commercial fisheries, aquaculture, aquatic resources protection, recreational fisheries), protect threatened and endangered species, manage State-owned lands (both those for lease and those set aside as forest reserves, natural areas, plant and wildlife sanctuaries, and parks), manage statewide ocean recreation and coastal areas programs (i.e., boating), oversee permitting

associated with the Conservation District, implement the State's historic preservation mandates, maintain the statewide recording system for title to real property, and enforce the Department's rules and regulations. Just implementing the conservation measures described in endangered species recovery plans for endangered whales, monk seals, and sea turtles would cost tens of millions of dollars per year. And there are thousands of more species in the state, including at least 1,000 aquatic species that are endemic so that the State has most responsibility for ensuring their continued existence.

Funding levels from Federal sources are also inadequate and inequitably apportioned. With more than 30 percent of the nation's imperiled species, Hawai'i receives less than 15 percent of the national appropriation under the Endangered Species Act, Traditional Section 6 Program and only one percent of the national appropriation under the State Wildlife Grants Program. Clearly, unprecedented efforts are needed to increase the funding base for the protection of Hawaii's wildlife and their habitats. Comprehensive and integrated strategies are needed to ensure that limited funding for wildlife conservation is used wisely and for maximal benefit.

ECOLOGICAL OVERVIEW

The Hawaiian Archipelago spans over 2,400 kilometers (1,500 miles) and is comprised of eight main islands and approximately 124 smaller islands, reefs, and shoals that vary in size from fractions of hectares to thousands of square kilometers. The archipelago was formed over the last 70 million years through volcanic eruptions from a relatively stationary hotspot beneath the slowly moving seafloor. The island of Hawai'i is the youngest island, with island age increasing to the northwest as the Pacific plate carries the older islands away from the hotspot. Millions of years of erosion, subsidence, and reef building resulted in the formation of the atolls which form the NWHI and the submerged seamounts which used to be islands even further northwest.

Located over 3,200 kilometers (2,000 miles) from the nearest continent, Hawai'i is the most remote island chain in the world. Despite its relatively small area (less than 1.7 million hectares or 4.1 million acres), an elevation range from sea level to 4,205 meters (13,796 feet) results in Hawai'i containing all the major known ecological zones. With a wide temperature range due to the elevational gradient and with average annual rainfall ranging from less than 40 centimeters to over 1,200 centimeters (15 inches to over 480 inches) per year, Hawai'i displays most of the earth's variation in climatic conditions. Finally, Hawai'i has many natural wonders: the most active volcano in the world, the wettest place on earth, the tallest seacliffs, and extensive coral reefs.

Aquatic Habitats

Aquatic habitats ecologically link together most of the terrestrial habitats. Over geologic time, the flow of water and wind has carved the topography of the mountains and valleys creating microhabitats in which many plants and animals have evolved and adapted. The flow of water that rains down on the high mountaintops transports nutrients, organic matter (energy), and water down through the various forested and shrubland habitats into estuaries and wetlands at low elevations and then finally into the sea. This organic energy from dead plants and animals fertilizes the growth of other plants and animals in lower elevation habitats, while the streams and groundwater flow play an important role in providing water for plants and animals

throughout the ecosystem. Many of Hawaii's native freshwater aquatic animals migrate between the ocean, estuaries, and upper reaches of streams as part of their life cycle.

Streams

Small streams usually join together to form larger and larger streams and rivers until finally the largest stream in a system or watershed enters the ocean. A map of the smaller streams that are interconnected with the single bigger stream usually looks like the branches on a tree. This interconnected network of streams and the adjacent land areas share much of the same nutrients, energy, and water and often becomes the home area of populations of living things. This network and the habitat it encloses is called a watershed, similar to the traditional Hawaiian land division of the *ahupua'a*. Activities or threats that affect one part of this interconnected system will affect some other part or the whole of the system. Thus, to effectively protect watersheds, often the entire ahupua'a must receive adequate protection and attention.

Hawaiian streams, or sections of streams, are either perennial or intermittent. Perennial streams flow year round. Some perennial streams flow continuously, discharging into the ocean, while others are "interrupted", not flowing continuously along their length, at least for part of the year. Perennial streams are important to most of Hawaii's endemic freshwater fauna, because these species depend on the ocean for part of their larval life stage and would not survive without this connection to the sea. Perennial streams are habitat to all of Hawaii's freshwater fauna including five native stream fishes or 'o'opu, invertebrates including mollusks and shrimps, algae, and mosses. Intermittent streams, or sections of streams, flow only seasonally, typically with high rainfalls, when these streams may reach the ocean. These streams may have water in their upper sections year-round, while their lower sections are dry. Although some recent studies suggest that viable populations of stream animals can survive in intermittent streams, intermittent stream fauna is more limited and primarily consists of oligochaete worms, several crustaceans, and algae. Hawai'i has 376 perennial streams.

The biology and ecology of stream systems also are defined by the "order" of a stream. First order streams are the smallest initial streams at the highest altitudes in an ahupua'a. They are often in the steepest gradient areas and have the coolest waters with least amounts of nutrients and energy. Many freshwater species cannot inhabit the upper reaches or parts of these streams in Hawai'i because of these limiting factors. Some native fishes, however, are highly evolved at climbing waterfalls and can exist in these upper reaches. Second order streams are stream sections downstream from the junction of two first order streams and third order streams are sections below the junction of two second order streams, and so on down to fourth and higher order stream sections. Hawai'i does not have many streams higher than fourth order because of the steep terrain and short distance to the sea. Streams in flatter areas have more nutrients and energy in them and are bigger and easier to inhabit for stream fishes and invertebrates. These areas also have the highest number of threats from sedimentation caused by grazing animals at higher elevations, nearby development, water diversions and dams, channelizing or concreting of the stream bottom and sides, and introduced gamefish. Streams in disturbed areas also do not typically have native vegetation along their banks, reducing shade, nutrient inputs from decaying plant matter, and shelter provided by tree roots. In some streams, non-native vegetation adjacent to streams provides excessive shading and nutrient input, leading to declines in native aquatic organisms. These threats are often most acute in the middle sections of streams as the areas

nearest the ocean receive greater protection through zoning and coastal zone management requirements.

Estuaries

As streams near the ocean, the streambed often becomes dominated by finer grain sediments and salty seawater intrudes with the tides. The area where seawater from the ocean mixes with freshwater is an estuary. Most estuaries in Hawai‘i are small. Nevertheless, estuaries in Hawai‘i typically have a unique group of species that can tolerate the variable conditions and the large amount of sediments and sand in the water and on the bottom. Too much sediment, however, can be harmful even here. In addition, many marine animals also can inhabit these areas where the salinity is not too low, so the overall diversity of species is high in many estuaries. Many of the same threats occurring in the middle sections of streams such as sedimentation, development, and invasive species occur in estuaries as well, though coastal zone regulations provide some degree of protection. Because estuaries are often calmer areas of water, boat harbors and other sources of human disturbance are often concentrated in these areas.

Sandy Bottom Marine Systems

The amount of sediment moving into the open ocean largely determines the presence of various types of marine habitats in Hawai‘i. Too much sediment limits the presence and growth of corals, so coral reefs can only occur away from estuaries. Instead of coral reefs, these areas close to estuaries are dominated by various sandy bottomed habitats that are rich in animals that live in the sand, like many worms or shelled animals, and in fishes like rays and flatfishes that feed in or on top of soft sediments.

Coral Reefs

Coral reefs develop in most of the rest of the shallow water fringe around the high islands. This results in the formation of “fringing reefs” that have coral growth near the surface of the water, very close to shore, with limited shallow water lagoons inshore of the reef. Reefs in areas with relatively recent lava flows, such as on the island of Hawai‘i, have poorly developed friniging reefs. Kāne‘ohe Bay on O‘ahu and a small area of Kaua‘i also have “barrier reefs,” where the development of coral occurs further offshore. There is a more extensive shallow water lagoon inshore of the barrier reef that has a higher degree of development of what are called patch reefs, or small sections of coral interspersed in sandy habitat in waters of one to ten or even 20 meters (three to 65 feet) deep. Many of the low islands in the Northwestern Hawaiian Islands are “atoll reefs.” These reefs are the tops of drowned and submerged volcanic peaks that result in a ring of coral that can be many miles in circumference. They may or may not surround a small sandy island or islands somewhere inside a very extensive lagoon that also usually contains numerous patch reefs. Kure Atoll and Pearl and Hermes Reef are classic examples of atoll reefs. Coral reefs are threatened by human impacts, invasive species, disease, and global climate change.

Bathypelagic, Mesopelagic, and Pelagic

Because the Main Hawaiian Islands are the tops of steep volcanic peaks, waters off these islands become very deep very quickly so that even within the three mile (five kilometer) boundary of State waters, the water is thousands of meters or feet deep with many unique species living on the bottom here. In the bathypelagic or deep zone waters, the water is cold and dark, with many unusual fishes and swimming invertebrates about which little is known. In the mesopelagic or

middle realm (waters of only around 100 to 300 meters (330 to 1,000 feet) depth), there is some small amount of light and the species that occur here are often different from both the shallower and deeper species. Many species in this zone are important food sources for marine mammals in Hawai‘i. The pelagic or nearshore waters on the surface above these deep water areas are home to some of the most desirable gamefishes including ono, mahimahi, ‘ahi (tunas), and marlins, which increases the importance of this habitat. Offshore aquaculture is a potential new threat to these areas.

Additional Marine Habitats

Tidepools and rocky beaches provide important habitat for many of Hawaii’s invertebrate species and larvae of many fishes. Desirable species, including ‘opihi (limpets) and some shelled invertebrates, occur here. Some species are adapted to the strong wave action in these areas. Seagrass beds provide foraging areas for sea turtles as well as habitat for endemic invertebrates, though true seagrasses are rare in most areas of Hawai‘i. Beaches are essential nesting grounds for sea turtles as well as areas where monk seals haul out, give birth, and protect and feed young. Threats to these habitats include direct and indirect human impacts due to proximity to the coast.

Anchialine-ponds

Anchialine ponds are found in geologically young lava fields. The lava in these areas has fissures that connect the ponds to the ocean. The subterranean water system reaches the surface through natural or man-made connections and where the salinity of seawater intrudes to at least some degree. Thus these ponds are always close to the sea and have varying salinity levels and tidal influence. Most ponds are less than 100 square meters in size and less than 1.5 meters in depth. Anchialine ponds are home to numerous animals. Anchialine pond shrimp are found in the water column and on the substrate of anchialine ponds as well as in the interstitial spaces that are part of the system linking the pond’s water to oceanic influences. Amphipods, ostracods, snails, worms, and various fishes can also be found in the pools. Many ponds have been filled or had non-native species introduced. Threats to the ponds themselves include excessive use, filling in or alteration of ponds for alternate use or development, and the introduction of invasive predatory fishes and invertebrates. Needed conservation actions include better managing human access, ensuring protection of pond habitats, and finding effective methods to prevent and control invasive species.

Aquatic Taxa

Because of the extreme isolation and distance, relatively few life forms successfully colonized the Hawaiian Archipelago over its 70 million year history. Hawai‘i displays some of the world’s premier examples of evolution, with the creation of countless new lineages of plants and animals. Rates of endemism (i.e., percent of species found nowhere else on earth) are high for aquatic fauna, typically 15 to 20 percent. Although thousands of Hawaiian species have yet to be described, the estimated number of aquatic indigenous species is thought to include more than 100 freshwater and 6,400 marine taxa. Examples of this unique evolutionary history are the many species of wrasses, eels, and marine stomatopods (snapping shrimps). Additionally, there are species with unusual characteristics or life-histories, such as amphidromous fish that scale 300-meter (1,000-foot) waterfalls. It is important to note the species that are not here as well. Throughout many parts of the world, shallow reefs are inhabited by fishes in the snapper and

grouper families; however, in Hawai‘i, these families are rare. Instead, other species have taken over and filled their usual niches.

Beginning with the arrival of Polynesians to Hawai‘i around 1,600 years ago, and accelerating with the arrival of Westerners after the 1780s, humans have taken a dramatic toll on the biota of the Hawaiian Islands. The effects of novel pressures on the native biota of the islands resulted in rapid declines and extinctions among hundreds if not thousands of native species, although extinctions of aquatic species are less well documented. Some species were exterminated by Polynesians for food or jewelry, some species were lost because of degradation or destruction of their unique habitats, and others persisted in more remote areas only to be weakened or overcome by non-native predators. Particular harm to aquatic systems is likely to have come from the extensive alteration of the land and watersheds for the cultivation of taro and from the construction of numerous fishponds that alter water flow and change aquatic habitat.

The following species or taxa are covered in the Statewide Aquatic Wildlife Conservation Strategy (SAWCS) as Species of Greatest Conservation Need (SGCN): 23 freshwater invertebrates, five freshwater fishes, 24 species of endemic freshwater algae, 20 anchialine-pond associated fauna, 26 marine mammals, six marine reptiles, 156 marine fishes, 1424 marine invertebrates, and 90 species of endemic marine plants or algae. A brief discussion of each species group is presented below, with more specific information presented in Chapter 7 (Species of Greatest Conservation Need).

Aquatic Plants and Algae

Hawai‘i has an endemic marine plant, the seagrass *Halophila hawaiiana*, which is host to an endemic snail. Threats to the seagrass include limited habitat, as it occurs in discrete patches on sandy substrate off a few islands, limited sexual reproduction as male and female flowers occur on separate plants and male plants are seldom found, and nearshore disturbance (e.g., dredging or sedimentation).

Little is known about Hawaii’s endemic algae and their role in the ecosystem. Red algae are the dominant group. Many species of calcareous algae are important to maintaining the physical structure of coral reefs, and in death become a large proportion of local beach sand. Algae are an important food source for some marine fishes, invertebrates, and green sea turtles and are eaten by many native Hawaiians and immigrants.

Freshwater Species

Streams in Hawai‘i have a relatively small number of native species. There are five native fishes or ‘o‘opu, that occur in freshwater streams and evolved from two families of marine fishes. These ‘o‘opu are mostly small herbivores or omnivores. There are 35 freshwater invertebrates of conservation need, including two omnivorous shrimps, at least eight species of herbivorous snails, ten rotifers, one endemic worm species, and one sponge species. Some of these invertebrates spend a brief part of their larval stage in the ocean before returning to the freshwater streams as juveniles. Threats include insufficient instream flow standards, stream diversions, dams, and channelizations, and sedimentation and pollution of streams. Needed actions include reversing or mitigating these destructive impacts and organizing management for stream animals along continuous stream corridors from the mountain to the ocean.

Marine Species

Marine ecosystems in Hawai‘i support over 1,200 species of fishes, with around 500 species adapted to live on coral reefs, and the rest adapted to the open ocean waters, deep habitats, estuaries, or areas characterized by sandy bottoms. These fishes occupy a range of niches from herbivores to carnivores that specialize on microscopic plankton, seashells, crabs, shrimp, or other fishes. At the top of the food chain are the apex predators such as the many sharks and large ulua (jacks) of Hawai‘i. Over 4,000 marine invertebrates are known from Hawai‘i, including over 100 species of hard, soft and precious corals, as well as hundreds of types of seashells, crabs, and shrimps and small numbers of worms, jellyfish, sponges, starfish, and tunicates. Many commercially or recreationally fished species are protected by Fishery Management Plans developed under the U.S. Magnuson-Stevens Fishery Conservation and Management Act. Stony corals, black corals, lace corals, seahorses, and some sharks are protected by the Convention on International Trade in Endangered Species (CITES) Appendix II.

A small number of marine reptiles occur in Hawai‘i. Two sea turtles are common residents here, and three others are more occasional visitors. All sea turtles are listed as threatened or endangered by the USFWS. The honu (green sea turtle, *Chelonia mydas*) is an herbivore and the hawksbill sea turtle (*Eretmochelys imbricata*) specializes on eating sponges. Both lay eggs on Hawaii’s beaches. There are two species of sea snake reported from Hawaiian waters, although these are rarely seen.

About 26 species of marine mammals are resident or occasional visitors to Hawai‘i. All are protected by the Marine Mammal Protection Act. These include the popular spinner (*Stenella longirostris*) and bottlenose dolphins (*Tursiops truncatus*), resident year-round, and the migratory humpback whales (*Megaptera novaeangliae*) which spend a few months each year in Hawaiian waters to birth and breed. Humpback whales and the Hawaiian monk seal (*Monachus schauinslandi*) are the more commonly occurring marine mammals in Hawai‘i that are also listed as endangered under Federal and State law. Many of the resident whales and dolphins feed on fishes and squids that occur in the moderately deep waters off Hawaii’s coasts.

Anchialine-pond Fauna

Eight species of anchialine shrimps are hypogeal, which means they live in subterranean aquatic habitats in the water that occurs in cracks and slits between rocks. Six of these species are candidates for listing under the Endangered Species Act. These shrimps can be found in anchialine ponds. It is not clear whether anchialine ponds are necessary for the survival of any of the eight shrimp species, as one shrimp has also been found in the open ocean, and many species have been found in artificially created ponds, some many miles from the nearest naturally formed pond. However, the importance of the little-understood hypogeal system is clear, and the anchialine ponds may greatly increase the amount of energy in the hypogeal systems because of the access to photosynthetic organisms in the pools. Anchialine ponds are also home to eleven species of amphipods, two of which have also been found in the open ocean. Little is known about their biology or ecology. One snail species is also often commonly found

in anchialine ponds and other estuarine habitats. Many other marine species can be occasionally found in anchialine ponds.

STATEWIDE THREATS

This section discusses the major threats affecting aquatic species statewide, followed by seven objectives to address the major threats outlined. The adoption of these seven objectives and the associated conservation strategies outlined in Chapters 4 to 6 by the people and institutions of Hawai‘i will ensure that a legacy of healthy biodiversity is left for future generations.

Loss and Degradation of Habitat
Alterations of streams, non-point source pollution, sedimentation, and storm water runoff have decreased, fragmented, or degraded freshwater habitats. Marine systems downstream are affected by changes in stream systems, especially by any increase in sediment load. Corals, in particular, are susceptible to both pollution and excessive sedimentation. Anchialine ponds are threatened by the filling and trampling of the ponds, and the photosynthetic organisms (algae) that form the base of their food chain are easily disturbed. More specific examples follow.

Many important wetland and coastal habitats are threatened by residential development. The limited amount of shoreline and the constant demand for beach-front housing has resulted in the division and conversion of formerly open coastal areas to homes and residential landscaping. Shoreline alterations, including dredging, the building or expansion of harbors, seawalls, and other structures and inland commercial and residential areas damage marine habitats for corals and other species directly or indirectly by changing water flows or sediment deposition. The closure of sugar plantations has resulted in many former fields being subdivided for residential use. As housing demand increases, development constitutes a threat away from the coast as well in areas formerly considered “remote,” such as Ka‘ū on the island of Hawai‘i. Prime areas for development are often near middle reaches of streams, which are important ecologically and sensitive to development, but have few protections.

Alteration of hydrology, which includes watershed development, stream diversions, channelizations, and excessive water withdrawals that lower the aquifer, degrades or destroys habitat used by native fishes and invertebrates. Insufficient instream flows with a lack of set flow standards threaten many streams that have diversions or alterations. Inadequate zoning in riparian zones threatens aquatic ecosystems by allowing agriculture, grazing, or development to occur too close to streams.

The cumulative impact of human interaction with native species and habitats is a growing concern. Attention recently has centered on marine activities, including the potential for dolphin and whale watching and shark feeding tours to change the behavior of these species. Turtle feeding is another area where increased human-interactions may change behaviors. Excessive trampling of coral reefs, tidepools, and other shoreline areas by recreational users directly kill many marine organisms or indirectly kill their algal or invertebrate food sources. Many sensitive habitats such as anchialine ponds, coral reefs, and offshore islands are compromised or outright

destroyed by the presence of people. Off-road vehicles in coastal dune ecoystems degrade habitat for nesting turtles.

Hurricanes and tsunamis can be particularly devastating to nearshore habitats as debris, pollution, and sedimentation are washed off shore. Lava from volcano eruptions flows into the sea destroying all it covers and other alterations to water chemistry and temperature can harm nearby areas.

Global climate change is anticipated to have multiple and disastrous effects on Hawaiian aquatic wildlife. First, sea level rise will inundate the NWHI, reducing habitat for nesting monk seals and sea turtles and alter coastal habitats throughout Hawai‘i. Second, Hawai‘i could experience increased frequency of El Nino/Southern Oscillation (ENSO) events that may have implications for marine wildlife. Third, increases in ocean temperatures could impact invertebrate and fish populations. Increases in seawater temperature also contributes to the phenomenon of coral bleaching, in which corals temporarily or permanently lose their symbiotic algae, potentially resulting in the death of the corals. Although Hawai‘i was spared the reef bleaching events of the 1980s and 1990s, some bleaching in the NWHI has recently been documented. Increased carbon dioxide has caused the acidity of the ocean to increase, making it more difficult for corals and mollusks to form skeletons and shells. Finally, increased ultraviolet radiation could also harm native wildlife. Many of the above mentioned impacts are known or currently anticipated effects of global climate change; additional impacts that are not currently anticipated or understood may also occur.

Introduced Invasive Species

Hawaii’s aquatic species are particularly susceptible to the threats posed by the introduction and spread of introduced invasive species and pathogens. Invasive species are species whose introduction does or is likely to cause environmental or economic harm or harm to human health. Virtually no native habitat is free from the threat of introduced (also called “non-native,” “alien,” or “exotic”) species, and most native habitats experience some negative effects related to non-native species. Non-native species may outcompete native species or may directly harm native species through predation or infection. Non-native species may also threaten native species through interbreeding and hybridization, leading to the loss of the native species as a unique species.

No longer isolated, Hawai‘i is highly vulnerable to human-assisted alien introductions due to its role as a central military, trade, and tourist hub. Before human arrival, the estimated rate of successful new colonizations was one species every 25,000 years. Over the last two centuries alone, the rate of plant introductions alone has been more than 40 species per year. It is estimated that over 400 introduced aquatic species are now established. Some were purposeful introductions for fishing or aquaculture, while others were accidental releases, or hitchhikers on ships or other wildlife, such as for parasites. In addition to the already established introduced species, numerous species currently not found on the islands are poised to invade island ecosystems.

No other region of the United States has experienced a similar invasion of non-native competitors, predators, and vectors of infectious disease and pathogens. Invasive algae species

have become a threat in recent years. These organisms can outcompete and overgrow native algae species and kill corals, altering the structure of local coral reef communities. Nearshore eutrophication (water pollution caused by excessive nutrients that stimulate excessive plant growth) from non-point source pollution or leaking cesspools and sewage systems may contribute to the explosive growth of these algae. Leeward areas of Maui and areas in Kāneʻohe Bay, Oʻahu and Waikīkī, Oʻahu have experienced algal blooms or have growing invasive algae populations. Another marine invasive, snowflake coral (*Carijoa*), outcompetes and overgrows native coral species, possibly including the precious black corals found in deeper waters off Maui. Introduced fishes such as smallmouth bass have been documented to prey on native freshwater fishes and invertebrates. Anchialine ponds also are threatened by introduced fishes and shrimps that prey on the native shrimp and alter the habitat structure. Invasive species that are carriers of foreign diseases also are a significant threat. Introduced top minnows have been shown to carry a pathogen that affects the native oʻopu. Recent work has shown that many species of corals have diseases that, in some cases, are on the increase and may be caused by introduced species. Honu (*Chelonia mydas* [green sea turtles]) in most areas suffer from fibropappiloma, which may also be caused by an introduced disease. With little natural resistance to disease, the Hawaiian aquatic fauna is expected to be highly susceptible, and prevention of the establishment of new diseases is a top priority need.

Limited Information and Insufficient Information Management

Accurate population estimates or even population trends for most aquatic wildlife are not available. Large numbers of native invertebrates have not even been described, making assessment of their populations and consideration of the consequences of proposed management actions problematic at best. Huge gaps in knowledge exist for many aquatic species. Population censuses that do occur cannot provide data on basic demographic parameters or determine threats to specific species. Such information is often necessary to direct management, especially for those species persisting at low populations. Data on the effects of different threats to native species also is often lacking, as is information on the effects of different management techniques or actions on natural resources. Management decisions based on inadequate data can result in a misallocation of extremely limited conservation dollars. Resource managers must typically make decisions based on incomplete data and information, but some minimal data standard may be reasonable to expect.

Gaps in information are often magnified by the challenges inherent in sharing information across institutions. Multiple agencies and organizations in Hawaiʻi collect and manage data on a variety of species and habitats. This information is often collected in different formats and for different purposes. There are no comprehensive computerized spreadsheets or databases that list even the names of all known Hawaiian aquatic species. Building on existing efforts to centralize information storage in a spatial database could better identify data gaps, provide a more comprehensive view of the status of a particular species or habitat, and allow management decisions to be made using the most up-to-date and accurate information.

Uneven Compliance With Existing Conservation Laws, Rules, and Regulations

Uneven compliance with existing conservation laws stems from two sources: limited capacity for enforcement and lack of respect and understanding for the value of protecting aquatic wildlife. Limited funding restricts the State's capacity to enforce existing laws, rules, and regulations

protecting native wildlife and habitat. The Department of Land and Natural Resources Division of Conservation and Resource Enforcement is understaffed and underfunded. At the same time, the Division is tasked with additional duties beyond resource conservation (e.g., participation in marijuana eradications and in Homeland Security actions). Consequently, public perception is that the State is not able to effectively respond to or enforce laws relating to the conservation of Hawaii's natural resources, such as regulations prohibiting fishing in a certain area. Moreover, penalities for transgressions are often small. As a result, voluntary compliance with conservation laws and regulations decreases as the public sees few consequences for violations. Poaching of aquatic wildlife and other non-compliance with conservation laws, rules, and regulations is a direct threat to aquatic wildlife and their habitat.

The success of voluntary compliance depends heavily on local community involvement. Peer pressure is one form of this involvement. In addition, community-based education and management give the local community an understanding of the importance and values of native wildlife and their habitat and a sense of pride and ownership or stewardship that encourage voluntary compliance. In many locations, this level of community involvement is absent or not encouraged.

Excessive Extractive Use

Bottomfishes, as defined by the Federal government under the Magnuson Stevens Act to include the ulua (*Caranx* spp.) as well as ʻōpakapaka (*Pristipomoides filamentosus*), onaga (*Etelis coruscans*), and hāpuʻu (*Epinephelus quernus*), have been declared in a state of "overfishing," a technical and legal condition in which there is too much fishing effort that will soon lead to a critical drop in the populations of these fishes. As a result, fisheries managers have one year under Federal law to determine how to reduce fishing effort to return these bottomfishes to a healthy state. Other fishes in the State also may be in a state of overfishing, but solid data is lacking to make these technical determinations.

Excessive extractive use constitutes a threat to other aquatic wildlife as well. Certain reef fishes are harvested for sale in the aquarium trade. Many shells are sold locally and in internet shops and auctions. Freshwater and marine fishes and invertebrates are collected for subsistence, recreation, and commercial purposes. These activities are not sustainable on a large scale.

Management Constraints

While more than 31 percent of the land in Hawaiʻi has been set aside for protection by the State or Federal government or is managed as part of a watershed partnership, these lands are subjected to differing levels of conservation or management effort. Additionally, little active conservation of stream wildlife takes places and may be limited by counter-productive laws and policies. A comprehensive vision for this conservation is lacking. DLNR is limited by infrastructural challenges; for example, the difficulty in filling existing vacant positions on a timely basis and the near impossibility of adding personnel to coordinate new conservation actions is a significant constraint on management. Procurement rules and contracting procedures can delay the State's ability to coordinate and carry out needed conservation actions. Other governmental agencies and non-governmental organizations face similar infrastructural challenges.

Unclear or lengthy regulatory processes constitute another management constraint. Research, response, and control of invasive non-native species (particularly animal species) can be delayed by the existing regulatory process. Current State and Federal regulations require more review and approvals of techniques to control invasive species than are required before introduction of the non-native species into the State. As a result, non-native plants and animals too often gain entry and become established because similar burdens of proof and screening requirements are not placed upon key industries, such as shipping and aquaculture. Other management actions can trigger State permitting and environmental review processes. Many species may qualify for listing as threatened or endangered by the Federal government; however, most are not likely to receive additional regulatory protection in the near future due to understaffing and political considerations.

Inadequate Funding

Limited funding to implement identified priority management actions to protect or restore aquatic wildlife and their habitats on Federal, State, and private lands, to hire staff to coordinate these projects, or to conduct research and monitoring is a significant constraint on effective wildlife conservation in Hawai‘i. This is complicated by grant programs that have varying eligibility requirements. Limited State funding can prevent the State from meeting match requirements needed to receive Federal funds that may become available to states for conservation management in the future. These factors contribute to “opportunistic” conservation on a piecemeal basis based on funding availability, rather than addressing needs in order of biological priority.

STATEWIDE CONSERVATION OBJECTIVES

Although Hawaii’s aquatic species and habitats face many threats and are in great need of increased conservation, there are several conservation success stories. For example, the threatened green sea turtle (*Chelonia mydas*) population has been increasing since it was put on the ESA threatened list in 1978 due to effective public education and outreach as well as enforcement of regulations against take and fisheries bycatch. A second success story is that of the Fish Replenishment Areas (FRAs) in West Hawai‘i. FRAs were established in 2000 to address declining aquarium fish populations due to over collection and to reduce multiple use conflicts. A management council that included community members was established to manage the areas. After five years of FRA closure, the overall densities of seven of the ten most collected aquarium fishes have increased and the yellow tang (*Zebrasoma flavescens*), the most collected aquarium species, increased by 49 percent relative to control areas.

Despite these success stories, however, there are limited conservation dollars and resources for conservation; therefore, the goal of this SAWCS is to guide aquatic conservation efforts across the State to ensure further and adequate protection of Hawaii’s Aquatic Species of Greatest Conservation Need and the diverse habitats that support them. Management of habitats to benefit multiple species is the focus of the SAWCS. Hawaii’s SAWCS development process sought to identify major threats affecting aquatic wildlife and their habitats throughout the State and then defined major objectives and strategies to respond to these threats and improve aquatic wildlife conditions. The following seven objectives have been identified as elements necessary for the long-term conservation of Hawaii’s native wildlife:

1) *Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive;*

2) *Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication;*

3) *Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs;*

4) *Strengthen existing and create new partnerships and cooperative efforts;*

5) *Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawai‘i;*

6) *Support policy changes aimed at improving and protecting native species and habitats;*

7) *Enhance funding opportunities to implement needed conservation actions.*

Implementation of these seven objectives will allow aquatic resource managers to address the major conservation needs of Hawaii's aquatic wildlife. The objectives relating to the protection and restoration of habitats and the prevention and control of introduced species address many of the most direct biological threats to native wildlife. The other objectives address somewhat more indirect needs arising from a lack of information, the need for improved coordination of efforts and funding, and management constraints. Because ecological problems are complex, there is overlap among these objectives. For example, much of habitat protection in the State involves invasive species control; more effective invasive species control requires more aggressive policies, cooperation among landowners and regulatory entities, and public support. This overlap underscores the necessity for a multiple-species approach to conservation of Hawaii's aquatic wildlife. These seven objectives address the overall goal of the SAWCS. Future assessment of their effectiveness as conservation tools is discussed in Chapter 8 (Monitoring, Implementation, and Adaptive Management). In the chapters that follow, specific marine and freshwater strategies that encompass multiple direct conservation actions are outlined for each of the above seven objectives.

REFERENCES

Cesar H, Beukering P, Pintz S, Dierking J. 2002. Economic valuation of the coral reefs of Hawai‘i. Hawai‘i Coral Reef Initiative Research Program. Available at: http://www.hawaii.edu/ssri/hcri/rp/cesar/noaa_final_report_0102/cesar_final_report-01-02.htm.

Eldredge LG, Evenhuis NL. 2002. Hawai‘i's Biodiversity: a detailed assessment of the numbers of species in the Hawaiian Islands. Bishop Museum Occasional Papers 76:1-28.

Hawai‘i Coastal Zone Management Program and Department of Health. 2000. Hawai‘i implementation plan for polluted runoff control. Available at: http://www.hawaii.gov/health/environmental/water/cleanwater/reports/reports.html.

Hawai‘i Department of Health. 2004. List of impaired waters. Available at: http://www.hawaii.gov/health/environmental/env-planning/wqm/wqm.html.

Hawaii’s Local Action Strategy to Address Land-Based Pollution Threats to Coral Reefs. 2004. Plan prepared jointly by EPA, USGS, USFWS, NOAA, CZM, DOH, DLNR. Available at: http://www.hawaii.gov/health/environmental/water/cleanwater/reports/reports.html.

Henry AR. 2005. Pacific coast joint venture Hawai‘i: strategic plan for wetland conservation in Hawai‘i review draft. Honolulu, (HI): Pacific Coast Joint Venture.

Juvik JO, Juvik S, editors. 1998. Atlas of Hawai‘i Third Edition. Honolulu: University of Hawai‘i Press.

Loope LL. Status and trends of the nation’s biological resources: Hawai‘i and the Pacific Ocean. U. S. Geological Survey. Available at: http://biology.usgs.gov/s+t/SNT/noframe/pi179.htm (accessed 7 December 2004).

Nature Conservancy of Hawai‘i . 2003. Last Stand: the Vanishing Hawaiian Forest.

Paine JR. 1991. IUCN directory of protected areas in Oceania. Gland: International Union for Conservation of Nature and Natural Resources.

Scott MJ. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. United States Department of Interior, National Biological Survey. Available at: http://biology.usgs.gov/s+t/pdf/Hawai’i .pdf (accessed 3 December 2004).

Stone CP, Pratt LW. 1994. Hawaii’s plants and animals: biological sketches of Hawai’i Volcanoes National Park. Honolulu: Hawai‘i Natural History Association.

Sumiye J. 2002. Ko‘olau Mountains Watershed Partnership management plan. Ko‘olau Mountains Watershed Partnership.

Teel TL, Dayer AA. 2005. Preliminary state-specific results from the research project entitled “Wildlife values in the west 2004.” Fort Collins: Human Dimensions in Natural Resources Unit, Colorado State University.

Titcomb M. 1972. Native use of fish in Hawai‘i. Honolulu: University of Hawai‘i Press.

Titcomb M. 1978. Native use of marine invertebrates in old Hawai‘i. Pacific Science 32:325-386.

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2003. 2001 National survey of fishing, hunting, and wildlife-associated recreation. Available at: http://www.census.gov/prod/2003pubs/01fhw/fhw01-hi.pdf (May 24, 2005).

Yamamoto M, Tagawa A. 2000. Hawai‘i’s native and exotic freshwater animals. Honolulu, (HI): Mutual Publishing. 200 pp.

Ziegler AC. 2002. Hawaiian Natural History, Ecology, and Evolution. Honolulu: University Press, 157 pp.

CHAPTER 4
MARINE CONSERVATION NEEDS

Due to the large number and the varied geology of the islands, Hawai‘i has diverse marine habitats, which range from estuaries, tidepools, sandy beaches, and seagrass beds to nearshore deep waters, extensive fringing and atoll reef systems, and smaller barrier reef systems. Anchialine pond habitats and species are discussed in Chapter 5 as their management is more closely tied to terrestrial land ownership and management, despite their marine or brackish waters. Because of Hawaii's geographical isolation, many of its coastal and marine species are endemic. Approximately 15 to 20 percent of the marine species are endemic, one of the largest proportions of marine endemism for any island chain in the world. Yet because of the isolation, Hawai‘i has relatively low marine species richness, with approximately 580 different shallow reef fish in contrast to areas of the Pacific further west with thousands of species. In total though, Hawai‘i still has over 6,000 marine species.

The distribution of marine ecosystems in Hawai‘i is a result of island age, reef growth, water depth, exposure to wave action, geography, and latitude. The marine habitats found on each island depend on the type of island: large and young, mature, or drowned islands. Large and young islands such as the island of Hawai‘i have recent lava flows and few, living structural coral reefs. Beaches are rocky except around bays, and drowned reefs may be found in deep waters or off parts of the east coast of Maui. Mature islands, such as O‘ahu and Kaua‘i in the Main Hawaiian Islands (MHI) and Nihoa and Necker in the Northwestern Hawaiian Islands (NWHI) are the most diverse, with habitat types ranging from estuaries and sandy beaches to rocky beaches and fringing and barrier reefs to lagoons with patch or pinnacle reefs. Drowned islands, such as atolls in the rest of the NWHI, are the remains of volcanic islands with habitats ranging from coral islets and benches to caves and terraces along the slope of the atoll.

OVERVIEW

Geology

The Hawaiian Archipelago consists of eight large islands and approximately 124 small islands. Many smaller sandy islands in the northwest are intermittent, depending on storms, waves, and currents for their existence and are now threatened by climate change and associated rising sea levels. The MHI are high islands, meaning they are mountainous with rocky headlands, narrow coastal plains, and ringed by beaches or rocky coastline. These high islands are often surrounded by fringing coral reefs with barrier-like reefs off small sections of the coast of O‘ahu and Kaua‘i. The NWHI are low islands, worn down by subsidence and erosion. They remain only as rings of reef that encircle a lagoon. Although the State of Hawai‘i is forty-ninth in size, it has approximately 1,336 kilometers (830 miles) of coastline, giving it the fourth highest length of coastline among all the coastal states in the United States. Coastline length for each of the islands is as follows: Hawai‘i 428 kilometers (266 miles), Maui 193 kilometers (120 miles), Kaho‘olawe 47 kilometers (29 miles), Lāna‘i 76 kilometers (47 miles), Moloka‘i 142 kilometers (88 miles), O‘ahu 180 kilometers (112 miles), Kaua‘i 145 kilometers (90 miles), Ni‘ihau 72 kilometers (45 miles), and NWHI 50 kilometers (30 miles).

Climate and Oceanography
The waters surrounding Hawai‘i are affected by seasonal variations in climate and ocean circulation. The surface temperature of the oceans around Hawai‘i follow a north-south gradient and range from 24 ˚C (75 ˚F) in the MHI to 20 ˚C (68 ˚F) to 22 ˚C (72 ˚F) in the NWHI in winter and spring to 26 ˚C (79 ˚F) to 27 ˚C (81 ˚F) throughout all the islands in the late summer and fall. The depth of the thermocline, where water temperature reaches ten degrees Celsius (50 ˚F), is 450 meters (1,500 feet) northwest of the islands and 300 meters (1,000 feet) off the island of Hawai‘i. Surface currents generally move east to west and increase in strength moving southward. The seas are rougher between islands than in the open ocean, because wind and water are funneled through the channels. Waves are larger in the winter months than in the spring and are generally bigger on the northern shores of the islands than the southern shores. Marine organisms have adapted to these general climatological and oceanographic conditions.

Land and Water Use
Most waters and submerged land from the shore out to at least three miles (five kilometers) are technically owned by the State with some authority exercised by the Federal government. Offshore waters out to 12 to 200 miles (19 to 322 kilometers) are regulated by a variety of Federal agencies. The Hawai‘i Department of Land and Natural Resources (DLNR) Division of Conservation and Resource Enforcement is responsible for enforcing many of the State’s marine laws while Federal enforcement authority is granted to the U. S. Coast Guard, the U. S. Navy, the U. S. Marines, and the National Oceanic and Atmospheric Administration (NOAA) Office for Law Enforcement. The DLNR Division of Boating and Ocean Recreation regulates boating and commercial tourism activity.

Management authority for the nearshore marine waters is the responsibility of a variety of State and Federal agencies including the Hawai‘i DLNR, the Hawai‘i Department of Transportation (DOT), the Hawai‘i Department of Health (DOH), NOAA’s National Marine Sanctuaries Program, U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), and the U. S. Military. Much of the water surrounding Maui County and smaller areas off Kīlauea Point National Wildlife Refuge on Kaua‘i, parts of the north and southeast coast of O‘ahu, and the northwest coast of the island of Hawai‘i are protected as a part of the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS). The Hawaiian Islands National Wildlife Refuge protects marine species generally out to ten fathoms (18 meters) of depth off the NWHI. The USFWS helps manage hawksbill sea turtle nesting off the Keālia Pond National Wildlife Refuge (NWR) on Maui. The NPS manages marine habitats off Kalaupapa National Historic Park (NHP), Kaloko-Honokōhau NHP, and Hawai‘i Volcanoes National Park. The U.S. Navy is responsible for Pearl Harbor and waters near Kāne‘ohe Marine Corps Base on O‘ahu, the Pacific Missile Range Facility off Kaua‘i, and other smaller training areas. Waters under military jurisdiction provide de-facto protection of species and habitats, because public access is often restricted. The DLNR Division of Aquatic Resources (DAR) manages 11 Marine Life Conservation Districts, 19 Fish Management Areas, nine Fish Replenishment Areas, two Wildlife Sanctuaries, 18 Bottomfish restricted areas, and the South Kona ‘Ōpelu fishing area in addition to implementing general, statewide fishing regulations. The DLNR Division of Forestry and Wildlife (DOFAW) manages the waters of ‘Āhihi Kīna‘u Natural Area Reserve (NAR) on Maui. The Kaho‘olawe Island Reserve Commission manages waters from the shores of

Kahoʻolawe out to two miles (three kilometers). The DOT-Harbors Division controls access to the ten commercial harbors in the State and numerous recreational harbors.

Human Landscape
Much of the State's economy is based on the island's coastal and marine resources. Tourism accounts for the majority of the State's economy, with a significant portion of the tourist activities associated with beaches and marine wildlife. Coastal development and land values have both increased with the growth in tourism. In 2002, the Coral Reef Initiative funded a study regarding the economic valuation of the coral reefs of Hawaiʻi, where the value of coral reefs to the Hawaiʻi economy was estimated to be 380 million dollars a year. Fishing also contributes to the State's economy and commercial landings increased greatly in the 1990s.

The military has a significant presence in Hawaiʻi with large Naval installations located on estuarine and coastal areas such as Pearl Harbor and Kāneʻohe Bay on Oʻahu and the Pacific Missile Range Facility on the south shore of Kauaʻi. Point source pollution in the marine environment originates from a variety of sites including: Pearl Harbor, Hickam Air Force Base, ten oil refineries and terminals, 25 power plants, 1,860 storm drain wells, and 100,000 cesspools. Discharges from cruise ships and tour boats are of current public concern. Hawaii's DOH lowered their permit standards for injection wells, contributing to nutrient increases and algal blooms in some areas. Non-point source pollution from the agricultural sector has decreased as agriculture has declined; however, domestic non-point source pollution has increased.

SPECIES AND HABITATS OF IMPORTANCE

All marine habitats in Hawaiʻi are considered important for conservation, because each habitat has characteristic fish and invertebrate assemblages unique to that habitat. The marine habitats that are represented in Hawaiʻi include: tidepools, rocky beaches, sandy beaches, estuaries where fresh and salt waters mix, seagrass beds, fringing reefs, barrier reefs, atolls, deep reefs, sand, pelagic (open near-surface water), mesopelagic (middle depths with some light and vertical migration of organisms living there), bathypelagic (deeper waters with no light), and deep bottom. A more detailed classification of habitats can be found in Maragos and Gulko (2002). Although outside the marine habitat, adjacent terrestrial habitats along the coast or within *ahupuaʻa* (watersheds) impact the ocean and play a large role in the health of marine habitats and species.

Appendix B provides information on the marine fauna and flora Species of Greatest Conservation Need (SGCN), with more specific taxa information found in Chapter 7. Marine species in Hawaiʻi include over 1,200 species of fishes, with around 500 species adapted to live on coral reefs, and the rest adapted to the pelagic open surface waters, mesopelagic or bathypelagic zones (middle or deep waters), estuaries, or sandy bottoms. At the top of the food chain are the apex predators such as the many sharks of Hawaiʻi. The SGCN list includes 154 marine fishes. Over 5,000 marine invertebrates are known from Hawaiʻi and include over 100 species of hard, soft, and precious corals as well as hundreds of types of snails, crabs, shrimps and small numbers of worms, jellyfish, sponges, starfish, and tunicates. One-thousand and thirty-three species of marine invertebrates are listed in the SGCN list. Six marine reptiles occur in Hawaiʻi. Two sea turtles are common residents that nest here and three others are more

occasional visitors. All sea turtles are listed as threatened or endangered under the Endangered Species Act and are listed on the SGCN list. Approximately 26 species of marine mammals are resident or occasional visitors to Hawai‘i. All are protected by the Marine Mammal Protection Act and are on the SGCN list. These include the migratory humpback whales or koholā (*Megaptera noveangliae*) that breed and give birth during the few months each year they spend in Hawaiian waters, as well as the popular spinner dolphins (*Stenella longirostris*) and bottlenose dolphins (*Tursiops truncatus*). Koholā (humpback whales) and Hawaiian monk seals (*Monachus schauinslandi*) are the only common marine mammals in Hawai‘i listed as endangered by the USFWS. Many of the resident whales and dolphins feed on fishes and squids that occur in the moderately deep waters off Hawaii's coasts. There are 78 species of endemic marine algae, 24 species of endemic freshwater algae, and two aquatic plants on the flora SGCN list.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife and habitats are discussed in Chapter 3 (State of Hawai‘i Overview and Conservation Needs) including a discussion on threats common to both the terrestrial and marine environment. Threats that are more acute or specific to the marine environment are listed below.

- Localized excessive extractive use: technical "overfishing" (i.e., too much fishing effort in the fishery) has been declared for bottomfishes by the Federal government. Data to meet technical determination of overfishing is lacking for most other species, but there are concerns about aquarium species, ‘opihi (limpets), uhu (parrotfishes), and other species. Extraction for research purposes may also lead to localized excessive extractive use;
- Fisheries bycatch, including reef fishes, sea turtles, Hawaiian monk seals (*M. schauinslandi*), other marine mammals, and seabirds caused by actively fished lay (gill) nets, ulua slide-bait fishing, and ghost nets, lines, and traps;
- Effect of fishing on non-targeted species through indirect effects (e.g., human fishing reducing prey for other native species);
- Urbanization and coastal alteration including harbors, seawalls and other structures, land reclamation, beach nourishment, and commercial and residential development too close to streams and beaches;
- Recreational overuse including trampling, anchor damage, watercraft disturbance, and SCUBA;
- Alien species including algae, fishes, and invertebrates as outlined in Hawaii's Aquatic Invasive Species Management Plan;
- Hull fouling of recreational boats and ballast water in commercial vessels that acts as a source of alien species;
- Pollution from upstream sources, as well as oil spills, nearshore sewage, cruise ship wastes, tour boat discharge, and other marine users;
- Sedimentation and eutrophication (water pollution due to too many nutrients) from upstream or coastal land use;
- Noise from boats, sonars, drilling, experiments such as the Acoustic Thermometry of Ocean Climate (ATOC) experiment, and other sources that may disturb or harm marine mammals and other wildlife;

- Light pollution from coastal developments can cause disorientation and fatality for both nesting sea birds (birds fall out of nests) and sea turtles (newly hatched turtles make their way toward light sources, often roadways, instead of to the ocean);
- Marine debris such as nets and plastics that can entangle and harm animals as well as be ingested by them;
- Dolphin and sea turtle watching that may alter species' behavior or habitat use. Shark watching in Federal waters may alter gamefish or shark behavior and distribution;
- Feeding wildlife that may sicken or alter behavior of native wildlife;
- Offshore aquaculture that may harm marine organisms through entanglement, habitat loss, pollution, and escape of genetically modified organisms. Includes deep water species that may be threatened by new Federal proposal to lease areas in U.S. territorial waters;
- Increased interactions with monk seals which are more abundant and now birth on all the MHI;
- Ship strikes that may kill or injure marine mammals or sea turtles;
- Ship groundings that can harm or destroy corals and can result in oil or toxic spills;
- Lack of enforcement of existing regulations and appropriate penalties for violations;
- Lack of adequate funding for conservation and research.

MARINE STRATEGIES

In addition to the statewide seven conservation objectives in Chapter 3 (State of Hawai‘i Overview and Conservation Needs) (main bullet below), specific strategies for marine species and habitats include the following (sub-bullet):

- Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive.
    - Support existing conservation management and implement future needs as identified below in 'Management Needs' section;
    - Develop and implement conservation programs for federally protected marine species in coordination with NOAA and USFWS;
    - Obtain and implement the plans of an Incidental Take Permit for sea turtles and monk seals;
    - Ensure marine noise, ocean-user disturbance, and fish feeding are adequately managed;
    - Review the status of all Marine Managed Areas (MMAs) and consider altering boundaries or adding new MMAs;
    - Develop access and monitoring plans for MMAs;
    - Expand current capability to respond to protected species strandings;
    - Increase efforts to remove marine debris in the MHI;
    - Support development of an expanded SAWCS that fully integrates aquatic algae and plants;
    - Collaborate to better manage development and coastal alteration; oil, boat, and land-based sewage and pollution; light pollution; aquarium fish and invertebrate exports; offshore aquaculture; shark watching; and ship groundings and strikes;
    - Develop a handbook on restoration specific to Hawai‘i;
    - Develop plans to respond to natural disasters and climate change.

- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Support implementation of Hawaii's Aquatic Invasive Species Management Plan and other identified actions;
    - Review and revise existing screening procedures for the introduction of non-native plants and animals to move from a prohibition on specific listed taxa to a general prohibition on introduction except for identified taxa;
    - Increase inspection and other "prevention" measures to prevent high-risk invasive species and diseases from entry into the State, or to islands where they are not currently found;
    - Implement rapid response teams to detect and eradicate invasive species;
    - Monitor for non-native marine algae and respond if detected;
    - Decrease the number of invasive species or the total area of invasive species coverage in aquatic and marine ecosystems;
    - Encourage compliance with upcoming ballast water regulations and support development of similar regulations for hull fouling;
    - Research and employ methods and tools to mitigate threats from invasive species;
    - Support a coordinated statewide invasive species public outreach program with shared resources and responsibilities among cooperating entities.
- Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs.
    - Develop database of all aquatic species in order to track information on biology, ecology, threats, monitoring and conservation actions;
    - Identify priorities for research and monitoring to document distribution, abundance, population trends, limiting factors, demography, and behavior of marine species in order to guide conservation management and recovery programs;
    - Continue the MHI RAMP (Research and Monitoring Program) cruise and other collaborations between NOAA and DAR to monitor windward MHI reefs;
    - Complete Marine Gap Analysis Program (GAP) analysis and integrate into decision-making process of Federal, State, and local agencies, and non-governmental organizations that manage Hawaii's waters;
    - Improve information sharing among agencies, non-governmental organizations, and academia through support of programs such as the Hawai‘i Marine GAP, the Western Pacific Fisheries Information Network, the Pacific Basin Information Node, and the Bishop Museum Hawai‘i Biological Survey;
    - Develop standards for data collection for projects funded by conservation grants, through partnerships and collaboration among funding agencies, to facilitate monitoring of progress and success across the aquatic environment and across funding programs;
    - Seek to expand funding for monitoring of other habitats (e.g., deep waters, sandy habitats, shallow water, and tidepools, etc.).
- Strengthen existing and create new partnerships and cooperative efforts.
    - Expand and strengthen existing partnerships and cooperative efforts by formalizing partnerships or by adding new partners;

- Collaborate with the U.S. government to implement coordinated protections for marine species in a marine protected area in the NWHI and resolve fishing issues there;
- Enhance partnerships with Federal enforcement agencies including the U.S. Marine Corps, U.S. Coast Guard, and NOAA Office for Law Enforcement;
- Support the Local Action Strategies projects in Honolua Bay, Maui; Kawela to Kapualei, Moloka‘i; and Hanalei Bay, Kaua‘i and other watershed management partnerships and groups that seek to decrease non-point source pollution;
- Increase the scope of community involvement in local conservation efforts by consulting with *kupuna*;
- Support community based management programs like the West Hawai‘i Regional Fisheries Management Council;
- Collaborate with other land managers to utilize the *ahupua‘a* approach to better manage freshwater and marine systems in recognition of their connectedness;
- Collaborate with DOH to protect other sensitive marine ecosystems by improving water quality;
- Collaborate to decrease the number of coastal stations listed as impaired for water quality by DOH;
- Continue and enhance partnership among DLNR, HIHWNMS, National Marine Fisheries Service (NMFS) Pacific Island Regional Office and Pacific Islands Fisheries Science Center for marine wildlife conservation;
- Improve coordination among and within funding agencies to strategically select projects for funding based on their contribution to overall marine species and habitat conservation needs..

- Expand and strengthen outreach and educational efforts to improve understanding of our native wildlife resources among the people of Hawai‘i.
  - Increase public understanding of native wildlife by developing and implementing a strategic and comprehensive conservation education program (particularly for Hawaii’s lesser known species) that would include public awareness campaigns and working with potential partners (e.g., Department of Education, and non-governmental organizations).
  - Seek to expand current educational programs to provide the public a sense of individual stewardship responsibility through ocean user’s workshops, newsletters, brochures, posters, school and community group visits, and public service announcements;
  - Include issues of incidental take of marine protected species in educational and outreach programs;
  - Encourage public participation and stewardship by expanding volunteer opportunities to contribute to native wildlife conservation;
  - Encourage and support business sector-led initiatives to effectively incorporate native wildlife considerations into their business models, with a focus on aquaculture, fisheries, and tourism industries;
  - Provide lawmakers and citizens with the information necessary to effectively legislate and provide funding for the conservation of marine species and their habitats;

    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas;
    - Collaborate to increase compliance with existing laws through outreach and educational programs and support for increased enforcement capacity.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Increase the number of species protected in the HIHWNMS by collaborating with NOAA in the ongoing review process;
    - Review fishing regulations to insure they adequately protect game and non-game species;
    - Encourage regulation requiring permits for take of all marine species;
    - Encourage regulation for blanket extractive limits for non-game species extracted for research, recreation, and commerce purposes;
    - Improve management of lay (gill) nets in State waters;
    - Implement new or revised MMA rules and/or boundaries;
    - Collaborate to revise and implement policies on anchor damage and use, watercraft disturbance, recreational overuse, marine debris, use of biodiesel fuels, and boat pump-out stations;
    - Support development and implementation of a comprehensive coastal policy;
    - Increase conservation enforcement efforts on all State-owned waters through increased funding for trained enforcement officers;
    - Administer and award State Wildlife Grant funds through a joint partnership of DOFAW and DAR;
    - Strengthen regulations for import and export of aquatic, non-native species that rely on the precautionary principal.
- Enhance funding opportunities to implement needed conservation actions.
    - Develop new sources of State funding to support and expand conservation management in State waters including identified management actions;
    - Support increased funding for enforcement, education, and outreach;
    - Support lobbying efforts to increase Federal funds to states and to change the formula used to allocate Federal funds to reflect the conservation realities of each state;
    - Organize an interagency and stakeholder task force to examine and implement market-based conservation funding solutions for marine species, including a review of recreational gear taxes, visitor taxes, airport landing fees, and new or expanded license or user fees.

PLANS AND TOOLS TO AID MANAGEMENT

Management plans and tools exist to address some of the threats listed in the Summary of Key Threats to Species and Habitats section. Many apply to the entire marine ecosystem.

- The Ocean Resources Management Plan was developed by a multi-agency effort in order to guide management of ocean resources. There are plans to update it in the near future. (Hawai‘i Department of Business, Economic Development, and Tourism (DBEDT) 1991);

- The Western Pacific Fisheries Management Council has Fisheries Management Plans that guide fishing for Bottomfish and Seamount Fisheries, Precious Corals, Crustaceans, Coral Reef Ecosystems, and Pelagic species. Available at: www.wpcouncil.org;
- The Aquatic Invasive Species Management Plan of DAR addresses prevention and eradication of marine invasive species. Available at: http://www.hawaii.gov/dlnr/dar/pubs/ais_mgmt_plan_final.pdf;
- The Hawaiian Islands Humpback Whale National Marine Sanctuary has a five year management plan. Available at: http://www.hihwnms.nos.noaa.gov/planreview/hihw/sanctuaryrevised.html;
- The Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve has an operations plan. Available at: http://www.hawaiireef.noaa.gov/documents/welcome.html;
- The Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program) initiated the Marine Gap Analysis Program (Marine GAP) for DAR. This program was originally established to identify key areas for protection based on a variety of variables such as biodiversity. Information available at: http://www.hinhp.org/mgap/;
- The Hawaii Biological Survey (HBS) is an ongoing natural history inventory of the Hawaiian Archipelago. It was created to locate, identify, and evaluate all native and non-native fauna and flora within the State, and to maintain the reference collections of that biota for a wide range of uses. It is managed by the Bishop Museum. Information and data available at: http://hbs.bishopmuseum.org/;
- The Western Pacific Fishery Information Network (WPacFIN) is a Federal and State partnership for collecting, processing, analyzing, sharing, and managing fisheries data from American island territories and states in the Western Pacific. Information and data available at: http://www.nmfs.hawaii.edu/wpacfin/;
- NOAA Coastwatch uses a variety of satellite remote sensing datasets in an effort to better monitor and analyze the central Pacific Ocean. Information and data available at: http://coastwatch.nmfs.hawaii.edu/;
- NOAA's Coral Reef Information System (CoRIS) is designed to be a single point of access to NOAA coral reef information and data products, especially those derived from NOAA's Coral Reef Conservation Program. Information and data available at: http://www.coris.noaa.gov/.

MANAGEMENT NEEDS

Current Management of Species and Habitats

Under Hawai‘i Revised Statutes 190-1, all marine waters of the State are a “marine conservation area.” Although this legislation provides no additional protection (beyond authorizing the establishment of MLCDs), it recognizes the importance of marine waters to the well-being of the State and provides DLNR with the authority to manage ocean resources. The following segment addresses the current management actions and future needs of key habitats of Hawaii’s marine environment. Size and owner/manager of each area is listed first, then species and habitats within the area, current management, and future needs are listed in separate sections. The section proceeds from general management laws and then considers managed areas from north to south.

Future activities regarding ocean management are being considered by all agencies with management authority over marine wildlife. Revisions to catch limits, areas, and methods are being considered by DAR. The entire system of State marine managed areas is also being reviewed to ensure consistency in designated use and purpose and to consider additions or modifications to current marine managed areas. The Hawaiian Islands National Wildlife Refuge in the NWHI is updating their management plan. Hawaii's DLNR is moving forward with plans to manage State waters in the NWHI as a Marine Refuge. The NWHI Coral Reef Ecosystem Reserve is being considered for conversion to a National Marine Sanctuary by NOAA that could include co-management with DLNR in State waters there. A bill in Congress proposes setting aside the entire NWHI area as a new form of Federal managed area called a National Marine Refuge. Chapter 3 (State of Hawai'i Overview and Conservation Needs) and Chapter 5 (Freshwater Conservation Needs) address upstream actions that affect coastal water and habitat quality.

***General Fishing Regulations,* DAR**

Species: Marine fishes and invertebrates including black corals.
Habitats: Marine ecosystems.
***Current Management*:** Limited take, gear, size, season, and area restrictions on some reef, bottom, and pelagic fishes, mollusks, crustaceans, and corals.
***Future needs*:** Reevaluate size limits to ensure species have sufficient reproductive potential to ensure species survival in Hawai'i. Review regulations dealing with non-game species, research, and other commercial uses.

***Fishing Regulations in Federal Waters,* Western Pacific Fishery Management Council and NOAA**

Species: Marine fishes and invertebrates including black and other precious corals.
Habitats: Marine ecosystems.
***Current Management*:** Limited take, gear, size, season, and area restrictions on some coral reef organisms, bottomfish, pelagic fishes, crustaceans, and precious corals as outlined in Fishery Management Plans for these groups.
***Future needs*:** Collaborate on management of fisheries in the NWHI; fully comply with Federal regulations and guidelines on developing and implementing Fishery Management Plans; establish workshop to evaluate management needs for precious corals; and respond to the declaration of bottomfish as being in a state of "overfishing."

***Hawaiian Islands National Wildlife Refuge* (610,000 acres of marine habitat), USFWS**

***Species*:** 18 seabirds, Hawaiian monk seals, green sea turtles or hōnu (*Chelonia mydas*), endemic coral reef organisms including some endemic only to NWHI, pelagic fishes, bottomfishes, sandy habitat organisms, spinner dolphins, and other marine mammals.
Habitats: Marine and coastal ecosystems (please refer to Chapter 6 Northwestern Hawaiian Islands for more detail).
***Current Management*:** Limited access, limited take, reef monitoring, and turtle monitoring; collaboration with other marine researchers; and research and education.
***Future needs*:** Update management plan. Coordinate actions with the State and the Coral Reef Reserve or Sanctuary, and additional monitoring.

***NWHI Marine Refuge,* DAR <u>Proposed</u>**

Species: Hawaiian monk seals, green sea turtles, endemic coral reef organisms including some endemic only to NWHI, pelagic fishes, bottomfishes, sandy habitat organisms, spinner dolphins and other marine mammals.

Habitats: Marine ecosystems.

***Current Management*:** Limited access and take; no anchoring or any other activities that can damage coral; and no discharge from boats.

***Future needs*:** Create refuge, develop and implement a management plan.

***NWHI Coral Reef Ecosystem Reserve*, NOAA**

Species: Hawaiian monk seals, green sea turtles, endemic coral reef organisms including some endemic only to NWHI, pelagic fishes, bottomfishes, sandy habitat organisms, spinner dolphins and other marine mammals.

Habitats: Marine ecosystems.

***Current Management*:** Operation plan in place. Limited access and take; no anchoring or any other activities that can damage coral; and no discharge from boats.

***Future needs*:** Potential transition to a National Marine Sanctuary.

***Hawaiian Islands Humpback Whale National Marine Sanctuary* (about 900,000 acres), Co-Managed by NOAA and DLNR**

***Species*:** Humpback whale.

Habitats: Marine ecosystems.

***Current Management*:** Management Plan exists. Humpback whale 100 yard (91 meter) approach rule and other regulations protecting humpback whales and their habitat, increased fines for violating provisions of the Endangered Species Act, lead agency for the MHI component of the Structure of Populations, Levels of Abundance and Status of Humpbacks (SPLASH) project to determine population size, volunteer whale counts and other community events, and other educational activities, research support, and enforcement.

***Future needs*:** Review other marine species, including seabirds, and habitats for inclusion in Sanctuary and increase research, education, and enforcement actions.

***Marine Life Conservation Districts*, DAR (11 Areas – Oʻahu: Hanauma Bay, Pūpūkea, Waikīkī; Lānaʻi: Mānele-Hulopoʻe; Maui: Honolua-Mokulēʻia, Molokini Shoal; Hawaiʻi: Kealakekua Bay, Lapakahi, Old Kona Airport, Wailea Bay, Waiʻōpae Tidepools)**

***Species*:** Species associated with shallow coral reef, sandy beach, and rocky habitats, Hawaiian monk seals, green sea turtles, spinner dolphins and other marine mammals.

Habitats: Marine ecosystems including shallow coral reef, sandy beach, rocky habitats.

***Current Management*:** Limited access in most MLCDs, eight MLCD include at least some No Take areas; Mānele, Old Kona Airport, and Waialea Bay all allow fishing throughout the MLCD; and fish monitoring.

***Future needs*:** Evaluate all MLCDs for purpose and management effectiveness and consider need for new marine protected areas.

***Fishery Management Areas*, DAR (19 Areas – Kauaʻi: Hanamāʻulu Bay, Nāwiliwili Harbor, Port Allen, Waimea Bay; Oʻahu: Heʻeia Kea Wharf, Honolulu Harbor, Pōkaʻi Bay,**

Waialua Bay; Waikīkī-Diamond Head Shoreline; Molokaʻi: Kaunakakai Harbor; Lānaʻi: Mānele Harbor; Maui: Kahului Harbor; Hawaiʻi : Hilo Harbor, Kailua Bay, Kawaihae Harbor, Keauhou Bay, Kīholo Bay, Kona Coast Puakō Bay and Reef)

***Species*:** Some or all regulated fish species.
Habitats: Marine and estuary ecosystems.
***Current Management*:** Waikīkī-Diamond Head Shoreline is no take. Limited take, gear, size, season, and/or area restrictions in other Fishery Management Areas (FMAs).
***Future needs*:** Evaluate the purpose and management effectiveness for all FMAs and consider need for new marine protected areas.

***Bottomfish Restricted Areas,* DAR (18 Areas – Niʻihau (1), Kauaʻi (2), Oʻahu (4), Penguin Banks (2), Molokaʻi (1), Maui (2), Maui Nui (1), Hawaiʻi (5). See references for resource listing exact coordinates)**

***Species*:** Seven bottomfish species.
Habitats: Marine ecosystems.
***Current Management*:** No take of bottomfish.
***Future needs*:** Evaluate the purpose and management effectiveness for all Bottomfish Restricted Areas and consider need for new or revised protected areas.

***Wildlife Sanctuaries,* DAR (2 Areas – Oʻahu: Coconut Island, Paikō Lagoon)**

***Species*:** Species associated with shallow coral reef, sandy beach, and rocky habitats.
Habitats: Marine ecosystems including shallow coral reef, sandy beach, and rocky habitats.
***Current Management*:** Limited access and no take.
***Future needs*:** Evaluate the purpose and management effectiveness for all Sanctuaries and consider need for new marine protected areas.

***Keʻehi Lagoon*, State Department of Health**

***Species*:** All resident aquatics.
Habitats: Estuary.
***Current Management*:** Phytoremediation (a plant based clean-up method) to remove nutrients and pollutants.
***Future needs*:** Additional monitoring and expansion to other areas if successful.

***Kalaupapa National Historic Park* (10,779 acres), NPS**

***Species*:** Invertebrates and fishes associated with shallow coral reef and rocky habitats, monk seals, and sea turtles.
Habitats: Shallow coral reefs, sandy beaches, and rocky habitats.
***Current Management*: ʻ**Opihi and reef monitoring and research, marine fish inventory, monk seal monitoring and protection, and coral recruitment project. Planning underway for expanded marine biological monitoring (of benthic invertebrates, fish, and fisheries) and water quality monitoring.
***Future needs*:** Establish monitoring program for nesting sea turtles, establish program to study oceanographic currents and marine water quality, and continue monitoring coral reef fishes and benthic fishes and invertebrates.

***Keālia Pond National Wildlife Refuge* (700 acres), USFWS**

***Species*:** Hawksbill sea turtle.

Habitats: Sandy beach (used for nesting by sea turtle).

***Current Management*:** Support monitoring and protection for nesting hawksbill turtles on Sugar Beach; fencing to prevent turtles from moving onto major roadway; and dune restoration.

***Future needs*:** Maintain existing management.

***ʻĀhihi-Kīnaʻu Natural Area Reserve* (2,045 acres), DOFAW**

***Species*:** Species associated with shallow coral reef, sandy beach, and rocky habitats, spinner dolphins, and green sea turtles.

Habitats: Marine ecosystems including shallow coral reef, sandy beach, and rocky habitats.

***Current Management*:** Limited access and no take.

***Future needs*:** Additional enforcement capacity, additional research and monitoring, evaluate purpose and management effectiveness and consider need to integrate aquatic components with other DAR marine protected areas.

***Kahoʻolawe Island Reserve,* Kahoʻolawe Island Reserve Commission**

***Species*:** Species associated with shallow coral reef, sandy beach, and rocky habitats, pelagic fishes, Hawaiian monk seals, green sea turtles.

Habitats: Marine ecosystems including shallow and deep coral reef, sandy beach, and rocky habitats.

***Current Management*:** Limited access and take, no commercial activity, monitoring, and water quality improvements.

***Future needs*:** Additional monitoring, marine debris removal.

***Fishery Replenishment Areas,* DAR (9 Areas - all on the Kona Coast of Hawaiʻi and part of the West Hawaiʻi Regional Fishery Management Area)**

***Species*:** Species associated with shallow coral reef, sandy beach, and rocky habitats.

Habitats: Marine ecosystems including shallow coral reef, sandy beach, and rocky habitats.

***Current Management*:** No aquarium fish fishing or fish feeding.

***Future needs*:** Evaluate the purpose and management effectiveness for all Fishery Replenishment Areas and consider need for new marine protected areas.

***South Kona ʻŌpelu Fishing Area,* DAR**

Species: ʻŌpelu.

Habitats: Marine ecosystems.

***Current Management*:** No take of ʻōpelu.

***Future needs*:** Evaluate purpose and management effectiveness and consider need for new marine protected areas.

***Koloko-Honokōhau National Historic Park* (1,161 acres), NPS**

***Species*:** Species associated with shallow coral reef and rocky habitat species, green sea turtle.

Habitats: Shallow coral reef and rocky habitats and sandy beach (used for basking by turtles).
***Current Management*:** Reef and sea turtle monitoring and research; underwater sounds inventory.
***Future needs*:** Continue existing management, implement biological and water quality monitoring.

***Hawai'i Volcanoes National Park* (323,431 acres), NPS**

***Species*:** Species associated with shallow coral reef and rocky habitat, hawksbill sea turtle.
Habitats: Shallow coral reef and rocky habitats and sandy beach (used for nesting hawksbill sea turtle).
***Current Management*:** Sea turtle research, monitoring, education, and protection.
***Future needs*:** Continue existing management, secure stable funding for sea turtle work, increase understanding of adjacent nearshore marine habitat to better evaluate impacts occurring adjacent to the park on the park.

REFERENCES

Brown E. Personal communication, Marine Ecologist, Kalaupapa National Historic Park.

Cesar H, Beukering P, Pintz S, Dierking J. 2002. Economic valuation of the coral reefs of Hawai'i. Hawai'i Coral Reef Initiative Research Program. Available at: http://www.hawaii.edu/ssri/hcri/rp/cesar/noaa_final_report_01-02/cesar_final_report-01-02.htm.

Hawai'i Department of Business, Economic Development, and Tourism (DBEDT). 1991. Hawai'i ocean resources management plan. Honolulu, (HI): DBEDT. 50 pp.

Hawai'i Department of Business, Economic Development, and Tourism. 2003. State of Hawai'i data book. Available at: http://www3.Hawai'i .gov/DBEDT/index.cfm?section=READ_Databook1075. (accessed 28 March 2005).

Hawai'i Department of Land and Natural Resources (DLNR). 2003. Ahihi-Kinau NAR/Keoneo'io plan of action draft for discussion purposes.

Hawai'i Department of Land and Natural Resources and Division of Aquatic Resources (DAR). 2005. Marine protected areas in Hawai'i. Honolulu, (HI): DAR. 14pp. Available at: http://www.hawaii.gov/dlnr/dar/pubs/M(PA)pub.pdf.

Hawai'i Division of Aquatic Resources; Bottomfish fishing regulations. 2002. Available at: http://www.hawaii.gov/dlnr/dar/bottomfish/index.htm.

Hawai'i Division of Aquatic Resources. 2004. Fishing regulations. Available at: http://www.hawaii.gov/dlnr/dar/fish_regs/index.htm.

Hawai'i Division of Aquatic Resources. Hawaii's marine life conservation districts. Available at: http://www.hawaii.gov/dlnr/dar/mlcd/index.htm.

Hawai'i Division of Aquatic Resources. 1992. Marine life conservation district plan. Honolulu, (HI): DAR. 18 pp.

Hawai'i Division of Aquatic Resources. 2003. State of Hawai'i aquatic invasive species management plan. Honolulu, (HI): DAR. 205 pp. Available at: http://www.hawaii.gov/dlnr/dar/pubs/ais_mgmt_plan_final.pdf.

Hawai‘i Division of Forestry and Wildlife. 1992. ‘Ahihi-Kinau NAR management plan. Draft. Honolulu, (HI): DOFAW. 18 pp.

Hawai‘i Division of Forestry and Wildlife. Ahihi-Kinau Natural Area Reserve. Available at: http://www.dofaw.net/nars/images.php?reserve=010.

Juvik JO, Juvik S, editors. 1998. Atlas of Hawai‘i Third Edition. Honolulu: University of Hawai‘i Press.

Kaho‘olawe Island Reserve Commission. 1997. Ocean resources management plan. Available at: http://kirc.state.hi.us/public/komp.doc.

Maragos J, Gulko D, editors. 2002. Coral reef ecosystems of the Northwestern Hawaiian Islands: interim results emphasizing the 2000 surveys. Honolulu, (HI): U. S. Fish and Wildlife Service and Hawai‘i Department of Land and Natural Resources. 46 pp.

Mundy BC, Everson AR. Marine resources. *In* Status and trends of the nation’s biological resources. U.S. Geological Service. Available at: http://biology.usgs.gov/s+t/SNT/noframe/mr181.htm.

National Atlas of the United States. First.gov. Available at: http://nationalatlas.gov/articles/mapping/a_general.html#six accessed 11 July 2005.

National Oceanic and Atmospheric Administration (US) [NOAA]. 2004. Hawaiian Islands Humpback Whale National Marine Sanctuary. Available at: http://hawaiihumpbackwhale.noaa.gov/about/about_sanctuary.html.

National Park Service (US) [NPS]. Hawai‘i Volcanoes National Park. Available at: http://www.nps.gov/havo/index.htm.

National Park Service (US) [NPS]. Kalaupapa National Historic Park. Available at: http://www.nps.gov/kala/index.htm.

National Park Service (US) [NPS]. Koloko-Honokohau Hawai‘i Volcanoes National Historic Park. Available at: http://www.nps.gov/kaho/index.htm.

TenBruggencate J. 2005 July 11. New coastal guidelines sought. Honolulu Advertiser. Available at: http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20050711/NEWS11/507110333/1021/NEWS

U.S. Fish and Wildlife Service. 1986. Hawaiian Islands National Wildlife Refuge master plan, Environmental Impact Statement. Honolulu, (HI): U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. Kealia Pond National Wildlife Refuge. Available at: http://refuges.fws.gov/profiles/index.cfm?id=12531.

CHAPTER 5
FRESHWATER AND ANCHIALINE CONSERVATION NEEDS

Hawaii's freshwater ecosystems consist of hundreds of streams, four natural lakes, and many man-made reservoirs and ditches. Stream types are diverse; there are perennial (flowing year-round), intermittent (flowing only at certain times of the year), blackwater, and underground streams. However, relatively few native freshwater species occur in Hawai'i.

Hawai'i also has unique anchialine pond habitats that will be considered in this chapter because their biology and management is more closely tied to single islands and land ownership concerns than is the case for marine ecosystems that were considered in Chapter 4.

OVERVIEW

Hydrology

Hawaiian watersheds differ from continental watersheds in that they are generally short and steep, and they have small drainage basins and minimal channel storage of water. They can rise or fall rapidly depending on rainfall with pulses of water called freshets moving quickly downstream. They are thus considered to be "flashy" and flash-flooding is a common threat to animals and nearby human residents in some areas. Hawai'i has large numbers of both perennial and intermittent stream sections on the main islands because the islands tend to have lots of rainfall on their windward sides, but much less rainfall on leeward sides. Perennial streams or stream sections flow year-round. Perennial streams are found only on the wetter areas of Kaua'i, O'ahu, Moloka'i, Maui, and the island of Hawai'i. Intermittent streams or sections do not flow all year round. Intermittent streams are found on all islands. Many streams only have certain sections that are perennial, often in the upper sections, while lower down the stream bed dries out seasonally or the stream flows underground through lava tubes or other geological spaces. The majority of the streams however are continuous, that is they flow consistently from origin to the ocean.

Streams in Hawai'i vary somewhat by island. Lower sections of streams on older, more weathered islands such as Kaua'i tend to be wider and relatively slower moving, when there are no heavy rainfalls; while streams on younger islands such as the island of Hawai'i are faster moving with narrower channels . However, many streams on all the main islands end in terminal waterfalls because of the presence of large sea cliffs, even on Kaua'i. Non-terminal waterfalls in upstream areas are characteristic of many streams as well. Stream habitats vary from pristine stream reaches in forested habitats that have riparian cover, heterogeneous substrate (boulders, stones), and runs, riffles, and pools to stream reaches in urban areas that often have concrete bottoms and wider channels. Thus, stream sections in urban areas have slower moving water and higher temperatures. Of the four natural lakes in Hawai'i one is intermittent and one is an alpine lake.

The following paragraph summarizes the stream types and features on the main islands. Niʻihau has no perennial streams but has Halulu Lake, a natural freshwater lake covering approximately 74 hectares (182 acres), and Halāliʻi Lake, an intermittent lake covering approximately 340 hectares (841 acres). Kauaʻi has 61 perennial streams, 45 of which are continuous. Wailua and Hanalei streams have the largest discharges, 200 and 140 million gallons per day (mgd), respectively. Oʻahu has 57 perennial streams, 29 of which are continuous. Kahana and Waikele streams have the largest discharges, 35 and 27 mgd, respectively. Molokaʻi has 36 perennial streams, 16 of which are continuous. Wailau-Pulena and Pelekunu streams have the largest discharges, 27 and 25 mgd, respectively. There are no perennial streams or natural lakes on Lānaʻi. Maui has 90 perennial streams, 56 of which are continuous. Waiheʻe and ʻĪao streams have the largest discharges - 60 and 43 mgd respectively. Other major streams on Maui include Palikea (the second largest perennial stream in the State), Kalialinui-waialae gulch (the State's second longest stream), and Honokohau stream (the longest stream channel in west Maui). Kanahā Pond, historically a natural freshwater lake, is approximately one meter (three feet) in depth and 16 hectares (41 acres) in size and is located wholly within the Kahului Airport boundary area. There are no perennial streams or natural lakes on Kahoʻolawe. The island of Hawaiʻi has 132 perennial streams, 70 of which are continuous. Wailuku River has the largest discharge at 250 mgd. Waiākea Pond is a natural freshwater lake that is over 2.3 meters (seven feet) deep and 11 hectares (27 acres) in area, and Lake Waiau, at 4,300 meters (13,020 feet), is the only alpine lake in the State. There are no large freshwater habitats in the Northwestern Hawaiian Islands, but small ponds and seeps and the hypersaline lake on Laysan island are important to terrestrial wildlife.

Anchialine ponds are found in geologically young lava fields and only occur on Oʻahu, Maui and the island of Hawaiʻi, with an artifical pond on Kahoʻolawe. The lava in these areas has fissures that connect the ponds to the ocean. The subterranean water system reaches the surface through natural or man-made connections and where the salinity of seawater intrudes to at least some degree. Thus these ponds are always close to the sea and have varying salinity levels and tidal influence. Most ponds are less than 100 square meters in size and less than 1.5 meters in depth. Anchialine ponds are home to numerous animals. Anchialine pond shrimp are found in the water column and on the substrate of anchialine ponds as well as in the interstitial spaces that are part of the system linking the pond's water to oceanic influences. Amphipods, ostracods, snails, worms, and various fishes can also be found in the pools. Eight species of anchialine shrimps are hypogeal, which means they live in subterranean aquatic habitats in the water that occurs in cracks and slits between rocks. Six of these species are candidates for listing under the Endangered Species Act. It is not clear whether anchialine ponds are necessary for the survival of any of the eight shrimp species, as one shrimp has also been found in the open ocean, and many species have been found in artificially created ponds, some many miles from the nearest naturally formed pond. However, the importance of the little-understood hypogeal system is clear, and the anchialine ponds may greatly increase the amount of energy in the hypogeal systems because of the access to photosynthetic organisms in the pools. Anchialine ponds are also home to eleven species of amphipods, two of which have also been found in the open ocean. Little is known about their biology or ecology. One snail species is also often commonly found in anchialine ponds and other estuarine habitats. Many other marine species can be occasionally found in anchialine ponds.

Climate
The windward side of the high islands of Hawai‘i have orographic rain, which is due to the trade winds that blow across the eastern Pacific Ocean. Some areas can receive over ten meters (400 inches) of rainfall annually, while rainfall amounts above 250 centimeters (100 inches) are not uncommon. Areas on the leeward side of islands behind the mountain peaks are in the rain shadow of these peaks and can receive less than 40 centimeters (15 inches) of rainfall annually. All of this rain feeds Hawaii's major streams and also recharges groundwater storage that is the source of many springs in the State.

Water Use
Agricultural, industrial and residential development on the islands has resulted in various patterns and structures to move or retain water for human uses in the islands. The following paragraph summarizes the number of streams (and percentage of total perennial streams) on each island that are partially or entirely diverted for human use as well as the most recent number of streams that have been declared impaired under the U. S. Environmental Protection Agency (EPA) standards under the Clean Water Act. Kaua‘i has 25 diverted streams (41 %) and 12 have altered channels. Kaua‘i has 11 impaired streams under the EPA standards. The Wailua canal system is the largest man-made stream system. Waita Reservoir is a significant man-made lake that is seven meters (23 feet) deep and 171 hectares (424 acres) in size. Oahu has 31 diverted streams (54 %) and 31 have altered channels. O‘ahu has 34 impaired streams under EPA standards. The largest altered stream is Waikele, and the Waiāhole Ditch system is the largest man-made stream system. Wahiawā Reservoir (including Lake Wilson) and Nu‘uanu Reservoir are significant freshwater lakes on the island. Moloka‘i has one stream (Kamalo) that has an altered channel. The Waikolu canal in the northeast is the largest man-made stream system at five mgd. Kualapu‘u Reservoir is a significant man-made lake at 15 meters (50 feet) deep and 40 hectares (100 acres) in area. Maui has 57 diverted streams (63 %) and seven have altered channels. Maui has the highest diversion of natural stream flow volume in the State. ‘Īao is the largest altered stream. The East Maui canal system in Central Maui is the largest man-made stream system in the state at 164 million gallons per day. Maui has ten impaired streams under EPA standards. The island of Hawai‘i has 74 diverted streams (56 %) and four have altered channels. The largest altered stream is Wailoa. The Lower Hāmākua Ditch system in Kohala is the largest man-made stream system at 32 mgd. The island of Hawai‘i has 15 impaired streams under EPA standards.

Human Landscape
Urbanization, agricultural development, and population increases throughout Hawai‘i have led to stream habitat alterations such as channelizations, dams, and diversions. These alterations can cause increased water temperatures, decreased or increased water flow rates, and decreased water flows, which prevent o‘opu and invertebrate larvae from reaching the ocean; thus, reducing their ability to survive. Dams and some diversions can prevent migration of adults up or downstream.

Pollution of streams comes from both point and non-point sources such as industries and government, as well as from generalized runoff of fertilizers, pesticides, industrial and home chemicals, etc. Although agricultural sector non-point source (NPS) pollution is decreasing, development is increasing, resulting in increased residential and commercial non-point source

pollution and sedimentation in streams. U.S. Clean Water Act standards first addressed point source pollution many years ago and more recently have instituted more stringent NPS regulations.

Excessive harvest of freshwater fauna, such as hihiwai, may have also led to their decline. Introduction of non-native freshwater fauna for fishing purposes or accidentally as unwanted aquarium pets, etc also has negatively impacted freshwater organisms through direct predation or competition for food or shelter.

SPECIES AND HABITATS OF IMPORTANCE

All freshwater streams are important, especially because of their unique characteristics and species assemblages. Because there are so few and such small naturally occurring lakes there are no freshwater organisms specially adapted to living only in those systems. Continuous perennial streams are the most important habitat to Hawaii's native freshwater fauna because these species depend on the ocean for part of their larval life stage and would not survive without this connection to the sea. Thus discontinuous or intermittent streams are only suitable for temporary residence or for invertebrates that do not require the ocean for part of their life cycle. Intermittent stream fauna thus primarily consists of oligochaete worms, several crustaceans, and algae.

Appendix B provides information on the freshwater Species of Greatest Conservation Need (SGCN), with more specific taxa information found in Chapter 7. Species include the four freshwater endemic gobies and eleotrid and one indigenous goby, and 35 freshwater invertebrate species including the federally endangered Newcomb's snail, other molluscs, shrimps, rotifers, a sponge, and a worm.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife and habitats are discussed in Chapter 3 (Statewide Conservation Needs). Threats that are more acute or specific to the freshwater environment are listed below.

- Stream diversions, dams, channelizations, and road impacts (islands affected: Kauaʻi, Oʻahu, Maui, and Hawaiʻi);
- Insufficient in-stream flows to insure the biological integrity of many stream systems (islands affected: Kauaʻi, Oʻahu, Maui, and Hawaiʻi);
- Development of formerly undeveloped areas and increased urbanization leading to loss and degradation of freshwater habitat (e.g., sedimentation from development near stream corridors) (islands affected: Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi);
- Land-based sources of pollution (islands affected: all);
- Increased stream sediment load resulting from forestry and pasture agriculture (island affected: Maui and Hawaiʻi);
- Introduced freshwater fishes and invertebrates have adverse effects on native stream species (islands affected: Kauaʻi, Oʻahu, Maui, and Hawaiʻi);
- Entry of new aquatic invasive species into the State (islands affected: all);

- Human impacts on anchialine ponds including filling, development, introduced fishes and shrimps, potential overharvesting, (islands affected: O‘ahu, Maui, Kaho‘olawe and Hawai‘i);
- Excessive harvesting for fishes and invertebrates for consumption, shell leis, retail sale (islands affected: all);
- Lack of zoning and other protections for highly impacted middle reaches of streams;
- Human uses in streams including tourism and trampling;
- Populations of ungulates that eat, trample, or uproot plants, degrading habitat, contributing to soil erosion, and impairing stream quality (islands affected: all).

FRESHWATER STRATEGIES

In addition to the seven statewide conservation objectives in Chapter 3 (Statewide Conservation Needs) (main bullet below), specific strategies for freshwater species and habitats include the following (sub-bullet):

- Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive.
    - Support existing conservation management and implement future needs as identified below in ‘Management Needs’ section;
    - Decrease number of stream diversions and channelized streams;
    - Work with Commission on Water Resource Management to ensure net increase in number of streams with biological integrity and Instream Flow Standards sufficient to sustain viable native fish and invertebrate populations;
    - Protect remaining anchialine ponds from loss, disturbance, development, and invasives;
    - Develop plans to respond to natural disasters and climate change;
    - Determine need for expanded riparian buffer zones;
    - Assess affect of roads on freshwater ecosystems in Hawai‘i;
    - Increase active management in, or acquisition of, extremely rare or threatened aquatic habitats (e.g., middle sections of streams) on all islands.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Continue research on effective management methods and tools for introduced predatory fishes and invertebrates in freshwater and anchialine systems;
    - Increase inspection and implement other “prevention” measures to identify and prevent high-risk invasive species and disease;
    - Review and revise existing screening procedures for the introduction of non-native plants and animals to move from a prohibition on specific listed taxa to a general prohibition on introduction except for identified taxa;
    - Work with pet industry to increase knowledge of the threat and compliance with rules;
    - Decrease in the overall number of streams, lakes and anchialine ponds negatively impacted by invasive species.
- Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs.
    - Improve dissemination of research and data regarding aquatic populations and

habitat condition;
    - Identify priorities for research and monitoring to document distribution, abundance, population trends, limiting factors, demography, and behavior of freshwater species in order to guide conservation management and recovery programs;
    - Develop a stream GAP analysis program that quantifies stream habitats and organisms and adjacent land uses and management;
    - Continue to conduct surveys and inventories for freshwater fishes and invertebrates and improve efforts to make surveys more systematic and comprehensive.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Establish new partnerships with private landowners, non-traditional partners, and with community groups to share information and facilitate implementation of identified conservation actions;
    - Increase the scope of community involvement in local conservation efforts by identifying areas for community based management (e.g., West Hawai‘i Regional Fisheries Management Council);
    - Formalize partnerships with military agencies to manage areas (including State land) for habitat conservation where freshwater species occur;
    - Support ongoing and future projects to deal with non-point source pollution;
    - Support community based management of freshwater habitats on Moloka‘i and look to expand to other islands;
- Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawai‘i.
    - Maintain existing outreach and educational programs for freshwater species;
    - Increase public understanding of native wildlife by developing and implementing a strategic and comprehensive conservation education program (particularly for Hawaii’s lesser known species) that would include public awareness campaigns and working with potential partners (e.g., Department of Education and non-governmental organizations);
    - Provide lawmakers and citizens with the information necessary to effectively legislate and provide funding for the conservation of native species and their habitats;
    - Collaborate to increase compliance with existing laws through outreach and educational programs and support for increased enforcement capacity;
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats.
- Support policy changes aimed at improving and protecting freshwater species and habitats.
    - Increase conservation enforcement efforts on all State-owned land and waters through increased funding for trained enforcement officers;
    - Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
    - Evaluate current management of State lands and waters and identify priority areas for changes in current use (e.g., unencumbered State lands of conservation quality or restoration potential);

- Review and revise existing rules and regulations dealing with extractive uses of aquatic animals, plants, and terrestrial snails;
- Administer and award State Wildlife Grant funds through a joint partnership of DOFAW and DAR;
- Improve integration of policies to address linkages between terrestrial, freshwater, and marine habitats and their shared conservation threats and needs.

- Enhance funding opportunities to implement needed conservation actions.
  - Organize an interagency and stakeholder task force to examine and implement market-based conservation funding solutions, including review of recreational gear taxes, visitor taxes, airport landing fees, new or expanded license or user fees, and targeted tax breaks for conservation activities;
  - Support lobbying efforts to increase Federal funds to states and to change the formula used to allocate Federal funds to reflect the conservation realities of each State;
  - Secure permanent dedicated funding for native wildlife conservation education and outreach;
  - Secure additional funding dedicated to recovery priorities for listed species.

MANAGEMENT NEEDS

Current Areas Managed for Species and/or Habitats

The following section addresses the current management actions and future needs of freshwater SGCN species. All managed areas listed below include streams in their boundaries; however, no area actively manages to protect and conserve freshwater fauna. The discussion of future management needs is highlighted within each currently managed area. Size and owner/manager of each area is listed first, then species and habitats within the area, current management, and future needs are listed in separate sections. The section proceeds from the northernmost main island to the south.

Kaua‘i

Hono o Na Pali Natural Area Reserve (3,150 acres), DOFAW
***Species*:** ‘O‘opu (freshwater fishes), freshwater invertebrates.
Habitats: Streams.
***Current Management*:** Management plan exists. Ungulate control through public hunting year-round, invasive weed species removal, monitoring.
Future Needs: Update management plan. Increased ungulate (particularly goat) control, increased invasive weed monitoring and control, baseline survey work in Waiahuakua stream, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

***Kaua‘i Watershed Alliance* (142,000 acres), Public-Private Partnership**
***Species*:** O‘opu, freshwater invertebrates.
Habitats: *S*treams.
***Current Management*:** Management plan exists. Planned management includes fencing, ungulate control, weed control, monitoring (ungulate activity, weed distribution, vegetation cover, stream turbidity).

***Future Needs*:** Adequate funding to implement management plan, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

O‘ahu

***Ko‘olau Mountain Watershed Partnership* (97,760 acres), Public-Private Partnership**
***Species*:** O‘opu, freshwater invertebrates.
Habitats: *S*treams.
***Current Management*:** Management plan exists. Fencing, ungulate control, invasive weed control.
***Future needs*:** Funding to implement management plan, fencing, ungulate control, invasive weed control, outplanting, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

***Kawai Nui and Hāmākua Marsh Complex* (850 acres), DOFAW**
***Species*:** ‘O‘opu, ‘ōpae kala‘ole (shrimp).
Habitats: Non-stream wetlands.
***Current Management*:** Hydrologic studies, habitat restoration including invasive plant removal and native wetland planting.
***Future Needs*:** Continue existing management, secure adequate funding to support expanded management, increased invasive weed removal, habitat restoration, educational opportunities, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

***James Campbell NWR* (222 acres), USFWS**
***Species*: A**nchialine pond fauna.
Habitats: Anchialine ponds.
***Current Management*:** Habitat restoration, predator control, weed control, monitoring.
***Future Needs*:** Continue existing management. Increase anchialine protections.

Moloka‘i

***Kalaupapa National Historic Park* (10,779 acres, in addition 2 offshore islets), NPS**
Species: ‘O‘opu, native shrimp.
Habitats: Streams.
***Current Management*:** Management plan exists.
***Future Needs*:** Continue existing management, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

***Pelekunu Preserve* (5,714 acres), TNC**
Species: ‘O‘opu, freshwater invertebrates.
***Habitats*:** Streams.
***Current Management*:** Management plan exists. Ungulate control, invasive plant monitoring and control, natural resource and water quality monitoring.
***Future Needs*:** Continue existing management.

Maui

East Maui Watershed Partnership **(100,000 acres), Public-Private Partnership**
Species**:** Oʻopu, freshwater invertebrates.
Habitats**:** Streams.
Current Management**:** Management plan exists. Monitoring for stream and water quality, continue fencing across East Maui, ungulate control, invasive weed control, education and outreach.
Future Needs**:** Secure funding to implement management plan. Expand management into other native-dominated forests within the partnership boundaries (e.g., Makawao Forest Reserve), aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

West Maui Mountains Watershed Partnership **(52,940 acres), Public-Private Partnership**
Species: ʻOʻopu, freshwater invertebrates.
Habitats: Streams.
Current Management**:** Management plan exists. Fencing, ungulate control, reduction of invasive alien weeds.
Future Needs**:** Secure funding to implement management plan. Identification of areas in need of active management and/or fencing to protect quality native forests and streams, expand management into other native-dominated forests within the partnership boundaries (e.g., West Maui Forest Reserve), aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

West Maui NARS **(6,702 acres-3 parcels), DOFAW**
Species: ʻOʻopu, freshwater invertebrates.
Habitats: Streams.
Current Management**:** Management plans exist. Fencing, ungulate control, resource monitoring, non-native plant control, public education, and volunteer recruitment.
Future Needs**:** Continue existing management, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

ʻĀhihi Kīnaʻu NAR **(2,045 acres including marine), DOFAW**
Species: Anchialine pond fauna, marineorganisms.
Habitats: Anchialine ponds, marine systems.
Current Management: Management plan exists. Resource monitoring (particularly for any illegal takings), rangers hired for enforcement and education, public education and sign postings, restricting certain areas from public over use. Fencing of anchialine pools has been proposed but not implemented.
Future Needs: Management of human activity, monitoring, education, and outreach.

Puʻu Kukui Preserve **(8,661 acres), Maui Land and Pineapple, Inc.**
Species: ʻOʻopu, freshwater invertebrates.
Habitats: Streams.
Current Management**:** Management plan exists. Fencing, ungulate removal, small mammal and non-native invertebrate control.

***Future Needs*:** Continue existing management, aquatic wildlife management, better integrate terrestrial and freshwater wildlife needs.

Hawai'i

***Hawai'i Volcanoes National Park* (323,431 acres), NPS**
Species: Anchialine pond fauna.
Habitats: Anchialine ponds.
Current Management: Management plan exists. Fencing and ungulate control, habitat restoration, eradication of priority non-native plants, propagation and outplanting of native plant species, monitoring, education. One-time inventory for anchialine pond fauna. Monitoring protocols are under development.
Future Needs: Continue existing management. Expand protection for anchialine pond fauna.

***Kaloko-Honokohau National Historic Park* (1,161 acres), NPS**
Species: Anchialine pond fauna.
Habitats: Anchialine ponds.
Current Management: Management plan exists. Protection of anchialine habitats.
Future Needs: Continue existing management. Expand protection for anchialine pond fauna.

***Manukā NAR* (25,550 acres), DOFAW**
Species: Anchialine pond fauna.
Habitats: Anchialine ponds.
Current Management: Management plan exists. Removal of feral pigs and goats, invasive non-native plant (e.g., fountain grass) control, fencing around rare communities, monitoring.
Future Needs: Continue existing management. Expand protection for anchialine pond fauna.

Potential for Enhanced Conservation Management

In addition to maintaining and enhancing existing conservation actions in managed areas, additional efforts are likely needed for the long-term conservation of native freshwater species. The Division of Aquatic Resources feels freshwater aquatic resources are in need of internal and external policy analysis and visioning. DAR also believes that the needs of freshwater species have not been fully integrated with the management that is occurring in watersheds throughout the State that are managed by DOFAW or are part of watershed partnerships. The Comprehensive Wildlife Conservation Strategy details many potential future conservation actions in wetlands that are considered important to DOFAW's management of birds and terrestrial invertebrates and may also contain important habitat for freshwater species. In addition, other areas may need special protection for freshwater organisms, fishing regulations may need to be modified to adapt to current threats, and the rules and policies of other state and federal agencies (e.g., DOFAW, DOH, DOCARE, the Water Commission) may need to be altered to meet the needs of freshwater organisms or their habitats. On all islands, the middle

reaches of streams are often in need of conservation management. DAR hopes that a comprehensive visioning and policy analysis process that involves these partners as well as the public is necessary to successful freshwater wildlife management in the future.

REFERENCES

Brasher AM. 2003. Impacts of human disturbances on biotic communities in Hawaiian Streams. BioScience 53 (11): 1052-1060.

McDowall RM. 2003. Hawaiian biogeography and the Islands' freshwater fish fauna. Journal of Biogeography 30: 703-710.

Mitchell C, Meadows DW, et al. 2005. Hawaii's comprehensive wildlife conservation strategy. Honolulu, HI: Hawai'i Department of Land and Natural Resources.

Tate DC. 1997. The Role of behavorial interactions of immature Hawaiian stream fishes (Pisces: Gobiodei) in population dispersal and distribution. Micronesica 30 (1): 51-70.

Yamamoto MN and AW Tagawa. 2000. Hawaii's native and exotic freshwater animals. Honolulu, HI: Mutual Publishing. 200 pp.

CHAPTER 6
NORTHWESTERN HAWAIIAN ISLANDS CONSERVATION NEEDS

The Northwestern Hawaiian Islands (NWHI) extend approximately 1,600 kilometers (1,000 miles) from Niʻihau and Kauaʻi to Kure Atoll in the north. They consist of ten main atoll systems, each of which has one or more islands. The total number of islands varies as storms and climate change affect the presence of some small, sandy islands. These islands and atolls are remnants of earlier volcanic high islands in the Hawaiian chain that pre-date the Main Hawaiian Islands (MHI) in the southeast. Most of the NWHI islands, except those in the extreme southeast, have little vertical relief and only sandy soils with little forest development. This reduced habitat variability means there are far fewer natural habitats and lower species diversity than found in the MHI. However, there is a high abundance of endemic species and other significant animal populations in the region because of the less intensive historical human impact. The rocky islands in the southeast make excellent nesting areas for some cliff-nesting and other seabirds. Laysan Island has a large euryhaline lake that helps support the endemic and endangered Laysan ducks as well as some possibly unique aquatic fauna.

Many of the islands serve as nesting or pupping grounds for honu (*Chelonia mydas* [green sea turtles]) and ʻīlio-holo-i-ka-uaua (*Monachus schauinslandi* [Hawaiian monk seals]), both of which are protected by the ESA. Marine habitat here is dominated by atoll reef systems and thus differs from the MHI, which mostly have fringing coral reefs. The NWHI have extensive atoll formations with large lagoons and patch reef complexes separated from the open ocean in many areas. Many endemic marine species occur only in the NWHI. The communities here are also less impacted by humans and invasive species and are dominated by large numbers of predatory sharks and jacks and a higher diversity of stony corals than in the MHI. Significant cultural resources in the form of Native Hawaiian archaeological sites and historic ship and airplane wrecks occur in the area.

All of the islands support large nesting populations of various seabird species. In total, approximately 14 million individuals from 18 species of seabirds nest in the NWHI (ʻakēʻakē (*Oceanodroma castro* [band-rumped storm petrel]), noio (*Anous minutus* [black noddy]), kaʻupu (*Phoebastria nigripes* [black-footed albatross]), blue-gray noddy (*Procelsterna cerulean)*, Bonin petrel (*Pterodroma hypoleuca*), ʻā (*Sula leucogaster* [brown booby]), noio-kōhā (*Anous stolidus* [brown noddy]), ʻou (*Bulweria bulwerii* [Bulwer's petrel]), Christmas shearwater (*Puffinus nativitatis*), ʻuaʻu (*Pterodroma sandwichensis* [Hawaiian petrel]), pākalakala (*Sterna lunata* [gray-backed tern]), ʻiwa (*Fregata minor* [great frigatebird]), mōlī (*Phoebastria immutabilis* [Laysan albatross]), ʻā (*Sula dactylatra* [masked booby]), ʻā (*Sula sula* [red-footed booby]), koaʻe ʻula (*Phaethon rubricauda* [red-tailed tropicbird]), ʻewaʻewa (*Sterna fuscata* [sooty tern]), ʻuaʻu kani (*Puffinus pacificus* [wedge-tailed shearwater]), manu-o-Kū (*Gygis alba* [white tern]), and koaʻe kea (*Phaethon lepturus* [white-tailed tropicbird])). The area is significant for having the majority of the worldwide breeding population of Laysan albatross (93%), black-footed

albatross (95%), Bulwer's petrels and Bonin petrels, and 25 percent of the worldwide population of wedge-tailed shearwaters.

OVERVIEW

Geology and Oceanography

The total coastline of all islands in the NWHI measures approximately 50 kilometers (30 miles) and total land area, excluding Midway Atoll, is about 8 square kilometers (3.1 square miles). The age of the various islands and atolls ranges from 7.2 million year old Nihoa to 27.7 million year old Midway Atoll. Because of the age of the islands, they have undergone extensive erosion and subsidence of their basaltic rock foundations. Only Mokumanamana Island (Necker), Nihoa, La Perouse Pinnacle, and Gardner Pinnacles have substantial exposed basaltic rock substrate. Further to the northwest, the islands consist of sandy substrates derived from reef formations overlaying the original basalt. There are about 2,220 square kilometers (860 square miles) of coral reefs in State waters around the NWHI, and about 6,300 square kilometers (2430 square miles) of reef in Federal Exclusive Economic Zone waters around the atolls and reefs that are part of Hawai‘i (i.e., not including Midway Atoll and the submerged banks). Therefore, approximately 26 percent of the coral reefs of these areas are under State jurisdiction and management.

Climate

Rainfall and temperature are more consistent across and within these islands because of their small size. The winter season brings much larger sea swell. Precipitation averages about 50 to 75 centimeters (20 to 30 inches) per year.

Land and Water Use

All of the land in the NWHI is part of the Hawaiian Islands National Wildlife Refuge (HINWR), except Midway Atoll, which is managed as a separate National Wildlife Refuge, and Kure Atoll which is managed by the Hawai‘i Department of Land and Natural Resources as a State Seabird Sanctuary. All the islands are part of the County of Honolulu, except Midway Atoll which is not part of the State of Hawai‘i at all as it is a territory of the U.S. government. Waters out to ten fathoms (18.3 meters) deep around most of the islands (except to 20 fathoms deep around Mokumanamana Island (Necker)) are also part of the HINWR, so there is unique Federal-State co-management of the inshore waters. Federal waters from three miles (five kilometers) offshore to 50 miles (80 kilometers) offshore are part of the NWHI Coral Reef Ecosystem Reserve managed by the National Oceanic and Atmospheric Administration (NOAA).

Human Landscape

There is no real resident population besides a few HINWR staff on Sand Island at Midway, Laysan Island, and Tern Island at French Frigate Shoals. Historical occupation of Tern Island and Green Island at Kure Atoll by the Coast Guard, and Midway Atoll by the Navy, ended in the past 20 years, but left various environmental problems. Archaeological sites point to pre-historical occupation of Mokumanamana Island (Necker) and Nihoa. The principal economic driving forces in the NWHI today are bottomfishing (one-third of the State's bottomfish come from the NWHI), the Wildlife Refuge and Coral Reef Ecosystem Reserve operations, and scientific research.

ISLAND AND ATOLL SUMMARIES

The following are brief summaries of the various island and atoll systems, from north to south.

Kure Atoll, at the northwestern end of the archipelago, is the world's northernmost coral atoll. About ten kilometers (six miles) in diameter and one square kilometer (0.4 square miles) in land area, Kure is a typical atoll comprising one major island, Green Island, and one or more smaller, intermittent sand spits. Maximum elevation is six meters (20 feet). It has about 32,375 hectares (80,000 acres) of reef habitat. Kure is approximately 2,100 kilometers (1,300 miles) northwest of Honolulu. The U.S. Coast Guard closed the LORAN navigation station on Green Island and left the site in 1992. Since then, the atoll has only been occupied during National Marine Fisheries Service (NMFS) and State of Hawai'i summer field camps. Kure Atoll is managed as a State of Hawai'i Seabird Sanctuary. Bird and dolphin surveys, marine debris removal, and invasive vegetation control and native plant species replanting are the main management actions. Toxic chemicals have been detected that are likely from the Coast Guard occupation. Hawaiian grouper are more abundant here in shallow water than in other parts of the NWHI. A large group of spinner dolphins lives in the atoll.

Midway Atoll, located approximately 2,040 kilometers (1,270 miles) northwest of Honolulu, consists of two major islands (Sand and Eastern), small sand islets, and a fringing coral reef. It is about ten kilometers (six miles) in diameter and 6.5 square kilometers (2.5 square miles) in land area. Maximum elevation is four meters (12 feet). It has about 36,000 hectares (89,000 acres) of reef habitat. Midway was discovered in 1859 and claimed by the United States. Since that time, there have been considerable activities that have resulted in significant alteration of the physical environment. Projects have included blasting a ship channel through the coral reef, the installation in 1902 of a cable station, and the construction of an airport in 1935 by Pan American Airways. Midway also played a critical role in WWII. USFWS established the Midway Atoll National Wildlife Refuge as an overlay refuge in 1988 through a cooperative agreement with the U.S. Navy, and the atoll was transferred from the Navy to USFWS in 1996. Midway is managed as the Midway Atoll National Wildlife Refuge and is not technically part of the State of Hawai'i. The world's largest breeding colony of mōlī (Laysan albatross) nests here, as does the second largest colony of ka'upu (black-footed albatross). The Refuge also contains important habitat for the monk seals, green sea turtles, and spinner dolphins. The Refuge is currently closed to visitation.

Pearl and Hermes Reef, is a low coral atoll made up of as many as eight islets, five of which are permanent. The reef encloses an elliptical lagoon, approximately 32 kilometers by 18 kilometers (20 miles by 11 miles) in size and has 0.3 square kilometers (0.1 square miles) of land area. Maximum elevation is three meters (ten feet). It has about 121,400 hectares (300,000 acres) of reef habitat. The reef was unknown prior to 1822 when two British whaling ships, the *Pearl* and the *Hermes*, ran aground there on the same day. These wrecks were likely discovered in 2004. From 1926 to 1930, fishing operations for pearl oysters led to the construction of several buildings on the atoll's Southeast Island. This base was abandoned in October 1931 and U.S. forces destroyed the buildings during World War II. The atoll is unoccupied except for NMFS and USFWS summer field camps. Significant seabird, green sea turtle, and monk seal nesting or pupping occur here. About 160,000 seabirds from 17 species nest here, including about 20

percent of the world population of ka‘upu (black-footed albatross). The Atoll is also an important nesting site for Tristram’s storm-petrels. NMFS has removed over 300 tons of marine debris from the beaches and reefs over the past few years. Pearl oysters were historically far more common here than anywhere else in Hawai‘i and have recovered somewhat from the overfishing.

Lisianski Island, is a low, sandy island measuring approximately 1.6 kilometers (one mile) long and one kilometer (0.6 mile) wide, with a land area of 1.5 square kilometers (0.6 square miles). Maximum elevation is 12 meters (40 feet). It lies near the north edge of Neva Shoal, a large area varying in depth to 18 meters (60 feet). It has about 125,400 hectares (310,000 acres) of reef habitat. The island was discovered in 1805 by Captain Urey Lisianski, a Russian explorer. During the same period, Lisianski was visited by expeditions harvesting fish, turtles, guano, bêche-de-mer (sea cucumbers), and sharks, as well as monk seals. The atoll is unoccupied except for NMFS and USFWS summer field camps. There is significant seabird nesting including the largest bonin petrel colony in the world.

Laysan Island, the largest land area in the NWHI at four square kilometers (1.6 square miles), is a coral-sand island enclosing a hyper-saline lake of about 0.5 square kilometers (0.2 square miles) in area. The island is about three kilometers (two miles) long and 1.6 kilometers (one mile) wide and is partially surrounded by a fringing reef. Maximum elevation is 12 meters (40 feet). It has about 40,500 hectares (100,000 acres) of reef habitat. The first well-documented visit was by the Russian ship *Moller* in 1828. The biota of the island remained relatively undisturbed until the late 19th century. By the turn of the century, the activities of sealers and guano miners had seriously affected the Laysan monk seal population, nearly eliminating it. The island has been occupied continuously since 1991 by USFWS volunteers attempting to eradicate invasive weeds and during the summer months by a NMFS field camp. About two million individuals from 17 seabird species nest on the island. Laysan has the State’s biggest nesting colonies of mōlī (Laysan albatross) and ka‘upu (black-footed albatross) (Midway has the largest colonies in all of the NWHI). Laysan also has the largest colonies of ‘ua‘u kani (wedge-tailed shearwaters) and Christmas shearwaters and a significant colony of koa‘e ‘ula (red-tailed tropicbirds). It is the northernmost area where *Acropora* corals occur in the NWHI.

Maro Reef is an irregular reef network with no distinct atoll or fringing reef. It is approximately 19 kilometers by ten kilometers (12 miles by six miles) in size. It has about 202,300 hectares (500,000 acres) of reef habitat. There is only a small awash rock and no terrestrial wildlife. Marine areas have unique reef development with no consistent fringing reef, only intertwined reef spurs radiating out and encompassing several relatively isolated lagoons. High vertical relief and algal cover on the reefs are also atypical for the NWHI. Few monk seals or sea turtles occur or give birth here because of the lack of haul-out spots. There are unusually large populations of galapagos and other sharks that seem to occupy some of the predatory niche occupied by ulua (jacks) at the other atolls.

French Frigate Shoals, a crescent shaped coral atoll about 19 kilometers by 28 kilometers (12 miles by 18 miles) in size, is open to the west and partially enclosed by a crescent-shaped reef to the east. The largest land area in the shoals is Tern Island; a number of smaller islets are scattered along the westerly reef of the crescent. There are two exposed volcanic rocks called La

Perouse Pinnacles. Total land area is about 0.3 square kilometers (0.1 square miles); maximum elevation is 36 meters (120 feet) at La Perouse Pinnacle. It has about 93,000 hectares (230,000 acres) of reef habitat. The shoals were discovered by the French in 1786 and claimed by the United States in 1859. In 1882, a vessel chartered by a U.S. company visited the atoll and departed with a cargo of shark (flesh, fins, and oil), turtle (shells and oil), bêche-de-mer (sea cucumber), and bird down. During the 1930s, the U.S. Navy used the area extensively for training exercises. Following the Battle of Midway during World War II, an airbase was established on Tern Island, and construction of a LORAN navigation station was begun in 1944 on East Island. When the airbase was closed in 1946, fishermen from Hawai‘i began to use the facilities. The East Island LORAN navigation station was in operation until 1952. At that time a new LORAN navigation station at Tern Island was activated and was operated by the USCG until mid-1979. The USFWS have occupied the facility since that date with a small staff, which is augmented by other agencies and private projects throughout the year. It has the highest breeding populations of monk seals and green sea turtles and the highest coral diversity in the NWHI. There is a landfill that is contaminated with Poly-Chlorinated Biphenols (PCBs) and lead that has been proposed for removal from Tern Island. Reconstruction of the seawall is a priority ongoing project as the dilapidated wall can trap and harm seals and other wildlife. This is the only spot in the NWHI where all 18 species of seabirds known to nest in the NWHI nest.

Gardner Pinnacles has a total land area of 0.03 square kilometers (0.01 square miles) and a maximum elevation of 57 meters (190 feet). It has about 242,800 hectares (600,000 acres) of reef habitat. The two volcanic rocks serve as roosting and breeding sites for smaller populations of 12 species of seabirds, including blue-gray noddies. A few monk seals haul out there. Coral diversity is high but abundance is low because of the lack of shallow water habitat and the predominance of high wave energy from the exposure to the open sea on all sides.

Mokumanamana Island (Necker Island), about 1.4 kilometers (0.7 miles) long by 0.2 kilometers (0.2 miles) wide, is a rocky, J-shaped island consisting of two parts connected by a low isthmus. Total land area is 0.6 square kilometers (0.07 square miles) and maximum elevation is 82 meters (276 feet). It has about 153,800 hectares (380,000 acres) of reef habitat. Its European discovery is credited to a French navigator, La Perouse, in 1786, but prehistoric habitation of the island was noted about 1879 by one of the early landing parties. Ships periodically visited the island during the mid- and late-1800s, but heavy seas often thwarted landings. About 60,000 seabirds from 16 species nest or roost on the island. There is a large colony of blue-gray noddies. Observations of monk seals at the island suggest that the species has occurred there regularly for at least a century, although likely for much longer. Mokumanamana Island is uninhabited and only rarely visited by humans. Both Mokumanamana and Nihoa have low coral diversity (less than 20 species) because of high wave action and scour.

Nihoa Island, the easternmost point of the NWHI, is a precipitous remnant of a volcanic peak, about 450 meters (1,500 feet) long and ranging in width from roughly 90 to 320 meters (300 to 1,000 feet). Total land area is 0.6 square kilometers (0.3 square miles); maximum elevation is 269 meters (903 feet). It has about 57,500 hectares (142,000 acres) of reef habitat. Nihoa was discovered by Europeans in 1779, though, like Mokumanamana Island (Necker Island), there is evidence of prehistoric human occupation. Over the years, difficulties in landing on the steep slopes of Nihoa have restricted visits. During the 1960s, military personnel occupied Nihoa

briefly. This island is rarely visited and only by USFWS staff, other researchers, and Native Hawaiians on cultural expeditions. Over 500,000 seabirds nest on the island. The island supports the largest known colony of ‘ou (Bulwer’s petrel) in the world. It also supports the largest Hawaiian colonies of ‘iwa (great frigatebirds), ‘ā (brown boobies), ‘ā (red-footed boobies), noio (black noddies), blue-gray noddies, noio-kōhā (brown noddies) and manu-o-Kū (white terns).

SPECIES AND HABITATS OF IMPORTANCE

Laysan, Lisianski, Nihoa, and Mokumanamana (Necker) Islands are the most important islands for arthropods, seabirds, the endangered passerines (Laysan finch, Nihoa finch, and Nihoa millerbird), and Laysan duck. Data on seabird numbers is available through the Federal Pacific Seabird Monitoring Database. Green sea turtles and monk seals have their largest reproductive groups at French Frigate Shoals. Data are maintained by NMFS Pacific Islands Fisheries Science Center. Critical habitat for the monk seal was designated by NMFS in 1988 out from shore to 20 fathoms around the named islands (from Nihoa to Kure).

For marine species there is a peak in diversity of species in the middle of the NWHI, near French Frigate Shoals. The extreme north has cooler water temperatures that may limit some coral species and geographic isolation that may limit dispersal and recruitment of some species. The middle islands are also closer to Johnston Atoll and other Central Pacific Islands that may serve as stepping stones for recruitment of species from the south. In particular, some fishes and acroporid corals appear to exist in the NWHI for this reason. Abundance of species is good in most places, and historical damage from recent human occupation on Kure, Midway, and French Frigate Shoals is now reduced with the removal of military and Coast Guard facilities. A few endemic marine species only occur in the NWHI. They are: *Synchiropus kinmeiensis* (a dragonet fish) which has been collected from Maro Reef through Kure Atoll; *Scorpaenopsis pluralis* (a scorpionfish), known only from the holotype (original described specimen) collected off Laysan; *Epigonius devaneyi* (a deep water cardinalfish) which has been found from Necker Island to Maro Reef; and *Nerita plicata*, a shallow water snail that is found only in the NWHI. Biological data are gathered by USFWS, NMFS, National Ocean Service, and Division of Aquatic Resources (DAR) research programs as well as collaborative research cruises among these agencies.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife are discussed in Chapter 3 (State of Hawai‘i Overview and Conservation Needs) and Chapter 4 (Marine Conservation Needs). Threats more acute or specific to the NWHI are listed below.

- Unknown factors leading to decline in monk seals, especially at French Frigate Shoals, possibly related to changes in ocean productivity;
- Pollution (PCB and lead contamination on Tern Island; PCB’s, pesticides, and copper at Kure);
- Marine debris;
- Introduced species;

- Seabirds and marine mammals are threatened by longline fishery interactions outside State jurisdiction;
- Climate change leading to loss of islands from storms and sea-level change and alteration to food webs;
- Natural disasters.

NWHI STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 3 (State of Hawai‘i Overview and Conservation Needs) (main bullet below), NWHI specific strategies include the following (sub-bullet):

- Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive.
    - Support existing conservation management and implement future needs as identified below in ‘Management Needs’ section;
    - Implement Recovery Plans for honu (green sea turtle) and monk seal;
    - Collaborate with Federal government and encourage residents to take steps that would reduce factors leading to climate change;
    - Establish year round presence on Kure with expanded research, management, and education activities;
    - Develop access and monitoring plan for the Marine Managed Areas (MMAs);
    - Mitigate pollution at Kure atoll.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Monitor for non-native marine algae and other invaders and respond if detected.
- Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs.
    - Improve dissemination of research and data regarding native species populations and habitat condition;
    - Identify priorities for research and monitoring to document distribution, abundance, population trends, limiting factors, demography, and behavior of species in order to guide conservation management and recovery programs;
    - Better understand the population dynamics and important ecological factors explaining declines in Hawaiian monk seals in some areas, especially at French Frigate Shoals. Research feeding ecology, distribution, life history and threats.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Coordinate with U.S. government to implement coordinated protections for marine species in an MMA in the NWHI and resolve fishing issues there;
    - Enhance partnerships with Federal enforcement agencies including the U.S.Coast Guard and NOAA Office of Law Enforcement.
- Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawai‘i.
    - Increase public understanding of native wildlife by developing and implementing a strategic and comprehensive conservation education program (particularly for Hawaii’s lesser known species) that would include public awareness campaigns

and working with potential partners (e.g., Department of Education and non-governmental organizations).

- Support policy changes aimed at improving and protecting native species and habitats.
    - Determine whether the marine areas are best protected by a Federal refuge, State refuge, and/or National Marine Sanctuary designation;
    - Secure adequate funding for management of the MMA(s);
    - Assess ways to support increased enforcement capacities, including cross-deputization between Federal (including military) and State agencies.
- Enhance funding opportunities to implement needed conservation actions.
    - Secure additional funding dedicated to recovery priorities for listed species.

PLANS AND TOOLS TO AID MANAGEMENT

Management plans and tools exist to address some of the threats listed in the Summary of Key Threats to Species and Habitats section. Many apply to the entire marine ecosystem and thus are placed here.

- The Hawaiian Islands National Wildlife Refuge. Management Plan. Fish and Wildlife Service (1986);
- The Western Pacific Fisheries Management Council has Fisheries Management Plans that guide fishing for Bottomfish and Seamount Fisheries, Precious Corals, Crustaceans, Coral Reef Ecosystems, and Pelagic species. Available at: www.wpcouncil.org;
- Species Conservation Plans prepared by the USFWS and NMFS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), Recovery Plan for the Hawaiian Monk Seal (2004); and Recovery Plans for the U.S. Pacific populations of the green sea turtle, hawksbill sea turtle, leatherback turtle, loggerhead turtle, and olive ridley turtle (1998);
- The Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve has an operations plan. Available at: http://www.hawaiireef.noaa.gov/documents/welcome.html;
- NOAA Coastwatch uses a variety of satellite remote sensing datasets in an effort to better monitor and analyze the central Pacific Ocean. Information and data available at: http://coastwatch.nmfs.hawaii.edu/;
- NOAA's Coral Reef Information System (CoRIS) is designed to be a single point of access to NOAA coral reef information and data products, especially those derived from NOAA's Coral Reef Conservation Program. Information and data available at: http://www.coris.noaa.gov/.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key species and habitats of the NWHI. Future needs are being considered by all agencies with management authority over NWHI wildlife. Currently managed areas consist of a State Seabird Sanctuary, Federal wildlife refuge, and a Federal reserve. Hawaii's Statewide Aquatic Wildlife Conservation Strategy recognizes the importance of the ongoing actions in these managed areas and considers these actions a priority.

In addition to currently managed areas, other conservation actions for NWHI are being considered. Revisions to catch limits, areas, and methods are being considered by DAR. The entire system of State Marine Managed Areas is also being reviewed to ensure consistency in designated use and purpose and to consider adding to or modifying current Marine Managed Areas. The Hawaiian Islands National Wildlife Refuge in the NWHI is developing an updated management plan for terrestrial and marine areas. The State is moving forward with plans to manage State waters in the NWHI as a Marine Refuge. The NWHI Coral Reef Ecosystem Reserve is being considered for conversion to a National Marine Sanctuary that could include co-management with Department of Land and Natural Resources (DLNR) in State waters. A bill in Congress proposes setting aside the entire NWHI area as a new form of Federal managed area called a National Marine Refuge. The discussion of future management needs is also highlighted within each current managed area.

Kure Atoll State Seabird Sanctuary **(260 acres), DOFAW**

Species: Seabirds, spinner dolphin.
***Habitats*:** Coastal system. Marine ecosystems including shallow coral reef, sandy beach, and rocky habitats.
***Current Management*:** Limited access, invasive introductions control and precautions, bird, monk seal, dolphin and marine debris monitoring. Marine debris removal.
***Future Needs*:** Additional monitoring, year round presence. Develop management plan.

Hawaiian Islands National Wildlife Refuge **(620,000 acres), USFWS**

***Species*:** Birds, Hawaiian monk seals, green sea turtles, endemic coral reef organisms including some endemic only to NWHI, pelagic fishes, bottomfishes, sandy habitat organisms, spinner dolphins, and other marine mammals.
Habitats: Coastal system, hypersaline lake, marine ecosystems.
***Current Management*:** Limited access, limited take, strict quarantine procedures to limit the immigration or emigration of non-native species or diseases, invasive species control and removal, endangered species monitoring; coral reef monitoring and research. NMFS conducts research and monitoring on green sea turtles and monk seals and leads a multi-partner effort to remove marine debris from the beaches and reefs of the NWHI, collaboration with other marine researchers, and research and education.
***Future needs*:** Update management plan. Coordinate actions with the State and the Coral Reef Reserve or Sanctuary, and additional monitoring.

NWHI Marine Refuge, **DAR <u>Proposed</u>**

Species: Hawaiian monk seals, green sea turtles, endemic coral reef organisms including some endemic only to NWHI, pelagic fishes, bottomfishes, sandy habitat organisms, spinner dolphins, and other marine mammals.
Habitats: Marine ecosystems.
***Current Management*:** Limited access and take, no anchoring or any other activities that can damage coral, and no discharge of pollutants.
***Future needs*:** Develop and implement a management plan.

***NWHI Coral Reef Ecosystem Reserve*, NOAA**

Species: Hawaiian monk seals, green sea turtles, endemic coral reef organisms including some endemic only to NWHI, pelagic fishes, bottomfishes, sandy habitat organisms, spinner dolphins, and other marine mammals.
Habitats: Marine ecosystems.
***Current Management*:** Operation plan in place. Limited access and take, no anchoring or any other activities that can damage coral, and no discharge of pollutants.
***Future needs*:** Possible transition to a National Marine Sanctuary.

REFERENCES

Evenhuis NL, Eldredge LG, editors. 2004. Natural history of Nihoa and Necker Islands. Honolulu, (HI): Bishop Museum Press. 222 pp.

Hawai‘i Department of Business, Economic Development, and Tourism. 2003. State of Hawai‘i data book. Available at: http://www3.Hawai'i .gov/DBEDT/index.cfm?section=READ_Databook1075. (accessed 28 March 2005).

Juvik JO, Juvik S, editors. 1998. Atlas of Hawai‘i Third Edition. Honolulu: University of Hawai‘i Press.

Maragos J, Gulko D, editors. 2002. Coral reef ecosystems of the Northwestern Hawaiian Islands: interim results emphasizing the 2000 surveys. Honolulu, (HI): U. S. Fish and Wildlife Service and Hawai'i Department of Land and Natural Resources. 46 pp.

National Oceanic and Atmospheric Administration (US) [NOAA]. 1988. Critical habitat, Hawaiian monk seal, Endangered Species Act. Federal Register 53(102):18988-18998.

National Oceanic and Atmospheric Administration. (US) [NOAA]. 2005. NWHI Coral Reef Ecosystem Reserve. Final Reserve Operations Plan. Honolulu, (HI).

Rauzon M. 2001. Isles of refuge: wildlife and history of the Northwestern Hawaiian Islands. Honolulu: University of Hawai'i Press.

U.S. Fish and Wildlife Service. Hawaiian Islands National Wildlife Refuge. Available at: http://refuges.fws.gov/profiles/index.cfm?id=12526.

U.S. Fish and Wildlife Service. 1986. Hawaiian Islands National Wildlife Refuge master plan, Environmental Impact Statement. Honolulu, (HI): U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 2005. Regional seabird conservation plan, Pacific Region. U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs, Pacific Region. Portland, (OR): U.S. Fish and Wildlife Service.

CHAPTER 7
SPECIES OF GREATEST CONSERVATION NEED

In order to address U.S. Fish and Wildlife Service required elements 1 through 5, Hawaii's Statewide Aquatic Wildlife Conservation Strategy (SAWCS) presents information on the Species of Greatest Conservation Need through fact sheets on various taxonomic groups available at: http://www.state.hi.us/dlnr/dofaw/cwcs/Conservation_need.htm (hold CTRL key and click mouse to go to the site). Each fact sheet provides information related to the status of the taxa, general taxa information, distribution, abundance, location and condition of key habitats, threats, conservation actions, monitoring, and research priorities.

Given the large number of species, similarity of threats and needed actions, and lack of information on many species comprising Hawaii's Species of Greatest Conservation Need (SGCN), taxa and related fact sheets were divided into manageable groupings in the following major categories: freshwater fishes, freshwater invertebrates, anchialine pond fauna, marine mammals, marine reptiles, marine fishes, and marine invertebrates. The fact sheets occur in this order and are titled with these category headings in their upper right corner for ease in locating specific fact sheets. Appendix B provides a comprehensive list of Hawaii's Wildlife Species of Greatest Conservation Need and identifies the fact sheet where information on that species may be found.

CHAPTER 8
MONITORING, IMPLEMENTATION, AND ADAPTIVE MANAGEMENT

The need for monitoring is a consistent theme throughout Hawaii's Statewide Aquatic Wildlife Conservation Strategy (SAWCS) and is referenced in several previous chapters. Chapter 8 addresses monitoring specifically in the following ways: it provides a summary of current monitoring efforts at both the taxa and habitat levels; it outlines monitoring needs and recommendations; it discusses the implementation, monitoring, and evaluation of statewide conservation objectives as defined in Chapter 4, including adaptive management; and it outlines processes for the ten year revision of the SAWCS and the Comprehensive Wildlife Conservation Strategy (CWCS). In doing so, this Chapter addresses U.S. Fish and Wildlife Service required elements 5 through 7.

PURPOSE AND VALUE OF MONITORING

A well planned and executed monitoring program is key to the success of conservation efforts, especially in light of the scarcity of personnel and funds needed to protect and recover native wildlife resources in Hawai‘i. Monitoring programs are essential to guide plans and implement adaptive changes to those plans, and for management and recovery programs to be most cost-effective and achieve their goals. Monitoring does this by providing ways to track population trends, to assess threats and limiting factors, and to evaluate progress of actions to improve native wildlife status. Monitoring programs are also tools with which to communicate conservation achievements, helping to develop support for conservation actions with decision-makers such as legislators, funding organizations, non-profit organizations, and the general public.

CURRENT ASSESSMENT OF MONITORING

Monitoring is integral to most existing conservation programs and partnerships in Hawai‘i. Monitoring protocols are varied and depend upon the nature of the resource being monitored, set objectives and goals, and staff and funding capabilities and commitments. This assessment distinguishes between taxa-based programs and habitat-based programs and identifies the current monitoring programs and plans that are in place.

Monitoring in Hawai‘i is conducted at multiple scales by various entities and at differing levels of frequency and quality. Monitoring, both at the taxa and habitat levels, is conducted by State and Federal agencies. Monitoring of taxa and habitats by State and Federal agencies also occurs on a program or area specific level and often as part of the management plan for managed areas. Examples include monitoring in Natural Area Reserves, National Parks, National Wildlife Refuges, military lands, marine managed areas, the National Marine Sanctuary, and the Coral Reef Ecosystem Reserve. Private landowners involved with conservation also conduct monitoring on their lands. Examples include private preserves managed by the Nature

Conservancy of Hawai‘i. Public-private partnerships such as the watershed partnerships also conduct monitoring. All of these areas are considered managed lands. Additionally, monitoring is conducted by academic researchers as well as organizations such as the island invasive species committees.

Species-specific monitoring in the State generally takes place as a part of implementing USFWS and National Marine Fisheries Service recovery plans for endangered species or as part of management plans for both listed and non-listed species (usually for State, Federal, private, and public-private partnership lands and waters mentioned previously). Often, these plans are developed for five to ten year cycles, with mid-term evaluation points for assessments and adaptive management purposes.

Finally, there are also citizen monitoring programs. Examples include the yearly whale counts conducted by the Hawaiian Islands Humpback Whale National Marine Sanctuary and the Pacific Whale Foundation during the months of January-March, and the monitoring of reef fishes by Reefcheck.

The challenges facing implementation of effective monitoring are similar to those challenges faced in implementing conservation actions as discussed in Chapter 3: inadequate funds, lack of trained personnel to carry out monitoring, insufficient tools for monitoring (e.g., practical or standardized monitoring protocols), inability to use the information collected (e.g., survey forms are never entered into a database for later data analysis), and gaps in information sharing. The biggest challenge to monitoring, however, is being able to balance staff effort, cost, and issues of what to monitor in order to best measure the effectiveness of conservation actions and achieve objectives and goals. For example, while monitoring relatively populous species can be fairly straightforward, the cost and difficulty of monitoring rare or highly fluctuating populations presents difficult trade-offs between money applied toward gaining precise knowledge of population status and money needed for species and habitat improvement or restoration.

Current Taxon and Habitat Monitoring

Most monitoring in the State consists of counting individuals or biomass or monitor for area coverage and quality of habitat. For many taxa, appropriate monitoring programs are specified in recovery or management plans. The level of detail of management recommendations provided in the plans varies among taxa. The following outlines existing monitoring efforts and resources and identifies gaps.

Plants and algae

Marine algae are only systematically monitored in the Northwestern Hawaiian Islands by the National Oceanic and Atmospheric Administration (NOAA). There is no monitoring for the two marine plants or freshwater algae.

Freshwater species

The State Division of Aquatic Resources (DAR) monitors some taxa and habitat variables in streams and lakes across Hawai‘i. The State Department of Health and the U.S. Environmental Protection Agency monitor water quality. Surveys include information on native and non-native

species of fish, crustaceans, mollusks, insects and algae. However, there is no systematic survey of freshwater species.

Anchialine-pond fauna
Although assessments of many anchialine pond fauna and habitat have occurred over the years, no systematic monitoring takes place.

Marine species
Sea turtle nesting and monk seal pupping are monitored by NOAA. The Hawaiian Islands Humpback Whale National Marine Sanctuary is responsible for long-term monitoring of humpback whales in Hawai‘i. NOAA and the Western Pacific Fisheries Management Council monitor commercial fisheries species. NOAA and the Western Pacific Fisheries Management Council must ensure areas designated as "Essential Fish Habitat" for managed commercial fisheries are not harmed. Monitoring programs are beginning for this relatively new legislative requirement. DAR monitors fishes in Marine Life Conservation Districts and other marine managed areas and surveys people for gamefish catch. Species-specific programs are in place for ulua, bottomfishes, and precious corals. NOAA monitors coral reefs in the Northwestern Hawaiian Islands and collaborates with DAR to monitor less accessible areas of the Main Hawaiian Islands. The Coral Reef Assessment and Monitoring Program (CRAMP), a multi-agency and University of Hawai‘i collaboration, monitors other coral reef areas. Reefcheck and other volunteer organizations gather data on reef fishes. However, no systematic monitoring exists for non-commercially regulated marine invertebrates, deep water species, estuaries, sandy bottom habitats, and pelagic habitats.

MONITORING NEEDS AND RECOMMENDATIONS

Though Hawai‘i has a foundation for monitoring of species and habitats, this foundation needs to be expanded by strengthening existing efforts and developing new ones. Specific monitoring needs at the taxa level are identified in Chapter 7 and at the ecosystem level in Chapters 4, 5, and 6 in the Management Needs sections. Additionally, monitoring needs are also outlined in Chapter 4 in the threats and statewide objectives and strategies sections.

However, this section addresses specific monitoring gaps for species groupings as well as statewide initiatives. Where new efforts are required, the approach will be to focus on relevant, realistic, and effective monitoring and evaluation that is cost-effective, sustainable, and has minimal adverse impacts on native ecosystems. The recommendations are as follows:

Develop Monitoring Working Group
The establishment of a statewide monitoring working group to facilitate the development and implementation of recommended monitoring actions will provide a valuable vehicle to guide monitoring of species and habitats in the State. The statewide monitoring working group would be responsible for identifying monitoring gaps, prioritizing needs, developing strategies and recommended actions to address monitoring issues, and guiding implementation of monitoring actions.

Improve Monitoring For All Taxa and Habitats
The following monitoring needs, based on the species' groupings discussed in the taxon monitoring section, are listed in order from those groups with no systematic monitoring to those needing improved monitoring efforts. Coordinated efforts are needed to develop and implement plans to increase inventory and monitoring statewide. Taxa requiring these efforts include anchialine pond species, non-coral and non-regulated marine invertebrates, pelagic, sandy habitat, and deep water species. For the freshwater fishes and invertebrates, systematic monitoring needs to be expanded to all important watersheds and areas. All important coral reef areas should be systematically monitored. For anchialine pond fauna, monitoring of populations and distribution in known and likely habitats should continue as well as development of quantitative survey methods and methods to monitor associated interstitial and hypogeal habitats. For migratory species such as marine mammals and reptiles, monitoring needs to be coordinated at regional and international levels.

Development of standardized survey methods, particularly for inadequately monitored species, should explore the use of cost-effective partnerships with landowners, volunteers, and citizen monitoring programs.

Priority habitat monitoring needs are to support monitoring efforts already underway, to identify additional informational needs, and to expand resources for increased monitoring at appropriate geographic and spatial levels. Additionally, for habitats in less-managed areas, mechanisms need to be identified to monitor the quantity and quality of these habitats and the importance of these habitats to species' survival. Other habitats that need consistent monitoring include anchialine pools, tidepools, sandy bottom habitats, and deep water habitats. Monitoring of land use adjacent to stream channels is also needed.

Improve Ecosystem Monitoring
One goal for managers is to go beyond post-hoc monitoring towards ecological prediction and forecasting. Though most monitoring is conducted on a species and habitat level, some additional monitoring occurs for abiotic factors and the emergent properties of ecosystems. More attention needs to be focused on these levels, integrating information from different sources to evaluate trends and assess threats or conservation actions. For example, comprehensive habitat monitoring will need to consider integration of indicators of global climate change, El Niños, etc. Similarly, the use of remote sensing and indicators of ecosystem properties needs to be better utilized. Collaboration with the earth Observing Systems projects and the proposed National Ecological Observatory Network may be helpful in this area.

Develop Standardized Monitoring Protocols
Due to insufficient coordination, non-standardized monitoring efforts exist that affect comparisons among sites and the ability to estimate the size and trend of species' abundance. There is a lack of appropriate data management at relevant geographic scales, and monitoring at the island and statewide levels is inadequate. The first step is to develop standardized monitoring protocols that will allow data collected by researchers, managers, and landowners to analyze island and statewide trends.

Effective monitoring of species or habitats often requires cooperation between adjacent landowners to determine what is happening to the population without regard to property boundaries. Support and participation in existing forums, such as the Hawai‘i Conservation Conference, the biennial aquatics conference, and the annual Watershed Partnership Symposium, and the development of new forums on specific topics as needed provide opportunities for the sharing of information and enhance the ability for adaptive management.

IMPLEMENTATION OF HAWAII'S SAWCS

Implementation of certain elements of Hawaii's SAWCS has already begun. As outlined in Chapters 4, 5, and 6 in the discussion on current management of species and habitats, multiple partners in conservation are already taking actions that protect Hawaii's Species of Greatest Conservation Need. These efforts will be continued and enhanced where possible during implementation of the SAWCS using a variety of funding sources. Hawaii's SAWCS will be incorporated into overall DAR management as part of implementation. Additionally, in evaluating potential DAR funded projects outside of SWG, Hawaii's SAWCS will be incorporated as an evaluation criteria (e.g., will this project accomplish one or more objectives as outlined by the SAWCS?) to further enable effective implementation of the strategy.

Adaptive Management

Evaluation of Hawaii's SAWCS is linked to practicing adaptive management. Adaptive management results in effective monitoring and evaluation of the Strategy because it allows for structured learning by doing and altering strategies in response to changing circumstances (e.g., political, environmental, economic, etc.) to ensure success in achieving conservation objectives. It is also important to recognize that there are barriers to implementation that must be accounted for as part of adaptive management. Institutional barriers include the slow nature of changing policy and regulations, difficulties in getting conservation tools approved in a timely manner, and special interests preventing implementation of needed conservation actions.

As a part of the adaptive management process, DAR will conduct annual reviews to assess Hawaii's SAWCS and determine if any changes need to be made. This review will include consideration of potential additions or removals to the list of Species of Greatest Conservation Need, identification of new or altered threats, review of recent surveys, data, research, evaluation of the effectiveness of conservation actions, and consideration of issues that are preventing implementation of the SAWCS. This annual review will also include the annual process of determining priorities for utilizing SWG funding. The CWCS and SAWCS website and partner contact database are tools that will be used to update and continue the engagement of partners in implementing, monitoring, and evaluating Hawaii's SAWCS.

The Ten-year Revision

Part of measuring the success of and adaptively managing Hawaii's SAWCS and CWCS also includes the formal ten-year revision. The ten-year review and revision will be initiated by the Department of Land and Natural Resources and will involve many of the same steps as the first iteration of the Strategy - comprehensive review of management plans and research, working closely with partners, and engaging the public. In addition, ongoing monitoring and the annual reviews by DAR will assist in identifying necessary revisions. The ten-year revision should

begin no later than fall 2013, with one year devoted to a full review of the Strategy, first internally then with partners and interested parties. This review will consist of analyzing the strengths and weaknesses of the initial SAWCS and CWCS, identifying barriers that prevented successful implementation, updating species and habitat information, assessing and updating the primary threats, and evaluating the continued viability of the identified conservation objectives and strategies. The second year should focus on revising the Strategy, again with partners and interested parties. The ten-year revision will provide the opportunity for continued adaptive management to ensure preservation of Hawaii's Species of Greatest Conservation Need and native habitats and to expand the vision of *malama ʻāina* (protecting the land) for future generations.

REFERENCES

Dresler P. General concepts for a monitoring program. US Geological Service.

East Maui Watershed Partnership 2005. Draft East Maui Watershed monitoring review and recommendations.

International Association of Fish and Wildlife Agencies. 2005. Comprehensive wildlife conservation strategies: monitoring and evaluation.

Jacobi J. 2005. Preliminary draft overview of species and habitat monitoring. U.S. Geological Survey.

Margoluis R, Salafsky N. 1998. Measures of success: designing, managing, and monitoring conservation and development projects. Washington DC: Island Press.

National Park Service. Inventory and monitoring program. Available at: http://science.nature.nps.gov/im/monitor/index.htm.

Pacific Basin Information Node. Available at: http://pbin.nbii.gov/.

Salafsky N, et al. 2003. Draft conventions for defining, naming, measuring, combining, and mapping threats in conservation: an initial proposal for a standard system.

Schoonmaker P, Luscome W. 2005. Habitat monitoring: an approach for reporting status and trends for state comprehensive wildlife conservation strategies.

Teaming with Wildlife. Monitoring, evaluation, and performance measurement. Available at: http://www.teaming.com/cwcs_monitoring.htm (accessed 5 August 2005).

Teaming with Wildlife. State wildlife strategy drafts and outline. Available at: http://www.teaming.com/cwcs_drafts.htm (accessed 4 August 2005).

APPENDIX A
GLOSSARY

Ahupua'a: land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (*ahu*) of stones surmounted by the image of a pig (*pua'a*), or because the pig or other tribute was laid on the altar as a tax to the chief.

Ballast Water: water carried in ballast tanks in the hold of ships to help keep the ship stable. Water is usually discharged and taken up in port, which can facilitate the spread of invasive species.

Biological Diversity or Biodiversity: the variety of all biological life – plants, animals, fungi, and microorganism – and the ecosystems on land or in water where they live; the diversity of life on earth or in a particular location.

Biological Integrity: defined by the Environmental Protection Agency as "the ability of an aquatic ecosystem to support and maintain a balanced, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region."

Congener: belonging to the same genus.

Conspecific: belonging to the same species.

Critical Habitat: term defined in the Endangered Species Act. Critical habitat is defined as (1) the specific areas within the geographic area occupied by a species at the time it is listed, on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations and (2) specific areas outside the geographical area occupied by the species at the time it is listed upon a determination that such areas are essential for the conservation of the species. Section 7 of the Endangered Species Act prohibits the destruction or adverse modification of critical habitat with regard to actions carried out, funded, or authorized by a Federal agency.

Ecosystem: an ecological unit that is composed of interacting organisms in their environment.

Endemic: adjective used to describe species found only within a specified region or locality and thus unique to that area.

Euryhaline: adjective indicating ability to tolerate a large range of salinities.

Eutrophication: water pollution caused by excessive nutrients that stimulate excessive plant growth.

Extant: alive, existing, not extinct.

Extirpate: not existing, extinct, wipe out or destroy completely.

Feral: adjective used to describe domesticated animal that has reverted to an untamed state.

Habitat: the area or type of environment where an organism or a biological population lives or occurs.

Holotype: the single specimen for which a species is named and described.

Hull Fouling: the attachment and/or colonization of ship hulls by organisms such as barnacles and mussels; can be a major vector for invasive species introduction.

Hypogeal: underground. Used to describe the underground, water-filled spaces where anchialine fauna live in addition to anchialine ponds.

Indigenous: species that occur naturally in a particular area (e.g., not introduced by humans or human activity). All endemic species are considered indigenous species; however, the term "indigenous" is often used to describe native species that are not endemic or whose endemic status is unknown.

Interstitial: space between structures. Used to refer to the spaces where anchialine fauna are found in the hypogeal environment.

Introduced species: species that do not arrive into ecosystems through natural means (e.g., air, wind, water, animals), but through human-assisted activities. The terms "alien," "non-native," or "exotic" species may also be used interchangeably with introduced species.

Indigenous: species that occur naturally in a particular area (e.g., not introduced by humans or human activity). The term "indigenous" is commonly used to describe both endemic and non-endemic species and thus is synonymous with "native".

Invasive species: an animal pest or weed that negatively impacts indigenous species and ecosystems.

Kupuna: grandparent, ancestor, relative or close friend of the grandparent's generation, grandaunt, granduncle.

Maui Nui: the islands of Molokaʻi, Lānaʻi, Maui, and Kahoʻolawe.

Native: species that occur naturally in a particular area (e.g., not introduced by humans or human activity). The term "native" is commonly used to describe both endemic and non-endemic species and thus is synonymous with indigenous.

Niche: the function or role of an organism in an ecosystem or the habitat an organism occupies in the ecosystem.

Non-Point Source Pollution: water pollution that comes from many diffuse sources rather than from a specific point, such as an outfall pipe, and is often the result of human activities.

Phenology: temporal aspects of a species' biology (e.g., timing of a species' reproductive cycle).

Philopatry: the characteristic of remaining near or returning to a particular area (e.g., natal territory). Used to describe species that tend to remain in, or return to, their home area.

Phytophagous: same as herbivorous (plant eating), but often associated with insects that pierce and suck liquids from plants.

Phytoremediation: the process of cleaning up pollutants especially in water or soil using plants.

Point Source Pollution: pollution from any discernible, confined, or discrete conveyance from which pollutants are or may be discharged, including, (but not limited to) pipes, ditches, channels, tunnels, conduits, wells, containers, rolling stock, concentrated animal feeding operations, or vessels.

Recovery Habitat: term used by the U.S. Fish and Wildlife Service for areas identified in Recovery Plans and determined to be necessary for long-term survival and recovery of endangered species.

Shield Volcano: defined by the U.S. Geological Service to refer to volcanoes with broad, gentle slopes, built by the eruption of fluid basalt lava.

Species: a group of closely related, interbreeding organisms that produce fertile offspring.

Stochastic: unpredictable or by chance.

Subsidence: the downward movement of the earth's surface in relation to a reference point such as sea level.

Taxa (plural of taxon): groupings of organisms given formal taxonomic names such as species, genus, family, etc.

Ungulates: hooved animals such as cattle, goats, deer, sheep, and pigs.

REFERENCES

Hawai‘i Coastal Zone Management Program and Department of Health. 2000. Hawai‘i implementation plan for polluted runoff control. Available at: http://www.hawaii.gov/health/environmental/water/cleanwater/reports/reports.html.

Pukui MK, Elbert SH. 1986. Hawaiian dictionary revised and enlarged edition. Honolulu: University of Hawai’i Press.

U.S. Environmental Protection Agency; Biocriteria [Internet]. 2005 May 9; Available from: www.epa.gov/waterscience/biocriteria/glossary.html.

U.S. Geological Service; Volcano Hazards Program- Reducing Volcanic Rick [Internet]. Menlo Park, CA: USGS; 4 Sept 2000. Available from: http://volcanoes.usgs.gov/Products/Pglossary/ShieldVolcano.html.

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Fishes	F	*Awaous guamensis*	ʻōʻopu nākea	ʻOʻopu nākea	Awaous guamensis	X	X	X		X	X
Fishes	F	*Eleotris sandwicensis*	ʻōʻopu akupa	Hawaiian sleeper	Eleotris sandwicensis	X	X	X		X	X
Fishes	F	*Lentipes concolor*	ʻōʻopu alamoʻo	ʻOʻopu alamoʻo	Lentipes concolor	X	X	X		X	X
Fishes	F	*Sicyopterus stimpsoni*	ʻōʻopu nōpili	ʻOʻopu nōpili	Sicyopterus	X	X	X		X	X
Fishes	F	*Stenogobius hawaiiensis*	ʻōʻopu naniha	ʻOʻopu naniha	Stenogobius	X	X	X		X	X
Crustaceans	F	*Atyoida bisulcata*	ʻōpae kalaʻole	Mountain ʻōpae	Mountain Shrimp	X	X	X		X	X
Crustaceans	F	*Macrobrachium grandimanus*	ʻōpae ʻoehaʻa	Hawaiian prawn	HI Prawn	X	X	X		X	X
Molluscs	F	*Clithon cariosus*	pipiwai	none	Clithon Neritilia	X	X	X		X	X
Molluscs	F	*Clithon neglectus*	hihiwai, pipipi, pipipi kai, pipipi wai	none	Clithon Neritilia	X	X	X		X	X
Molluscs	F	*Erinna aulacospira*	none	none	Erinna Lymnaea	X		X		X	X
Molluscs	F	*Erinna newcombi*	none	Newcomb's snail	Newcomb's Snail	X					
Molluscs	F	*Ferrissia sharpi*	none	none	Ferressia	X	X				
Molluscs	F	*Lymnaea producta*	none	none	Erinna Lymnaea	?	?	?		?	?
Molluscs	F	*Lymnaea rubella*	none	none	Erinna Lymnaea	?	?	?		?	?
Molluscs	F	*Neritina granosa*	hīhīwai or wi	none	Neritina Snails	X	X	X		X	X
Molluscs	F	*Neritina vespertina*	hapawai or Hapakai	none	Neritina Snails	X	X	X		X	X
Flatworm	F	*Oahuhawaiiana kazukolinda*	none	none	Worms		X				
Sponge	F	Heteromyenia baileyi	none	none	Freshwater Sponge		X				
Rotifera	F	Aspelta sp.	none	none	Rotifers						
Rotifera	F	Cephalodella sp. 1	none	none	Rotifers						
Rotifera	F	Cephalodella sp. 2	none	none	Rotifers						
Rotifera	F	Cephalodella sp 3	none	none	Rotifers						
Rotifera	F	Cephalodella sp 4	none	none	Rotifers						
Rotifera	F	Cephalodella sp 5	none	none	Rotifers						
Rotifera	F	Lecane sp. 1	none	none	Rotifers						
Rotifera	F	Lecane sp 2	none	none	Rotifers						
Rotifera	F	Lepadella sp 1	none	none	Rotifers						
Rotifera	F	Monommata sp 1	none	none	Rotifers						
Crustaceans	A	*Calliasmata pholidota*	none	none	Anchialine Shrimp					X	X
Crustaceans	A	*Carnarimelita janstocki*	none	none	Anchialine Amphipod						X

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Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Crustaceans	A	*Grandidierella koa*	none	none	Anchialine Amphipod					X	X
Crustaceans	A	*Grandidierella palama*	none	none	Anchialine Amphipod					X	
Crustaceans	A	*Halocaridina palahemo*	none	none	Anchialine Shrimp						X
Crustaceans	A	*Halocaridina rubra*	‘ōpae ‘ula, ‘ōpae hiki none		Anchialine Shrimp		X	X		X	X
Crustaceans	A	*Liagoceradocus lonomaka*	none	none	Anchialine Amphipod					X	X
Crustaceans	A	*Metabetaeus lohena*	none	none	Anchialine Shrimp					X	X
Crustaceans	A	*Gammarella amikai* Barnard, 1970 used to be Nuuanu	none	none	Anchialine Amphipod						
Crustaceans	A	*Palaemonella burnsi*	none	none	Anchialine Shrimp					X	X
Crustaceans	A	*Paramoera lokowai*	none	none	Anchialine Amphipod						X
Crustaceans	A	*Paramoera paakai*	none	none	Anchialine Amphipod						X
Crustaceans	A	*Paramoera rua*	none	none	Anchialine Amphipod					X	
Crustaceans	A	*Parhyale hawaiensis*	none	none	Anchialine Amphipod					X	X
Crustaceans	A	*Procaris hawaiiana*	none	none	Anchialine Shrimp					X	X
Crustaceans	A	*Rotomelita ana*	none	none	Anchialine Amphipod					X	
Crustaceans	A	*Rotomelita lokoa*	none	none	Anchialine Amphipod						X
Crustaceans	A	*Vetericaris chaceorum*	none	none	Anchialine Shrimp						X
Crustaceans	A	*Antecardina lauensis*	none	none	Anchialine Shrimp					X	X
Molluscs	A	*Neritilia hawaiiensis*	none	Anchialine pond snail	Clithon Neritilia	?	?	?		X	X
Mammals	M	*Balaenoptera acutorostrata*	none	Minke whale	Baleen Whales						
Mammals	M	*Balaenoptera borealis*	none	Sei whale	Baleen Whales						
Mammals	M	*Balaenoptera edeni*	none	Bryde's whale	Baleen Whales						
Mammals	M	*Balaenoptera musculus*	none	Blue Whale	Baleen Whales						
Mammals	M	*Balaenoptera physalus*	none	Fin whale	Baleen Whales						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

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Mammals	M	*Eubaleana japonica*	none	Northern right whale	Baleen Whales						
Mammals	M	*Feresa attenuata*	none	Pygmy killer whale	Toothed Whales						
Mammals	M	*Globicephala macrorhynchus*	none	Short-finned pilot whale	Pilot Whale						
Mammals	M	*Grampus griseus*	none	Risso's dolphin	Toothed Whales						
Mammals	M	*Indopacetus pacificus*	none	Longman's beaked whale	Toothed Whales						
Mammals	M	*Kogia breviceps*	none	Pygmy sperm whale	Toothed Whales						
Mammals	M	*Kogia sima*	none	Dwarf sperm whale	Toothed Whales						
Mammals	M	*Lagenodelphis hosei*	none	Fraser's dolphin	Toothed Whales						
Mammals	M	*Megaptera novaeangliae*	koholā	Humpback whale	Humpback Whale						
Mammals	M	*Mesoplodon densirostris*	Blainesville's beaked whale or densebeaked whale	none	Toothed Whales						
Mammals	M	*Monachus schauinslandi*	'īlio-holo-i-ka-uaua	Hawaiian monk seal	Monk Seal						
Mammals	M	*Orcinus orca*	none	Killer whale	Toothed Whales						
Mammals	M	*Peponocephala electra*	none	Melon-headed whale	Toothed Whales						
Mammals	M	*Physeter macrocephalus*	none	Sperm whale	Toothed Whales						
Mammals	M	*Pseudorca crassidens*	none	False killer whale	False Killer Whale						
Mammals	M	*Stenella attenuata*	nai'a	Spotted dolphin	Spotted Dolphin						
Mammals	M	*Stenella coeruleoalba*	none	Striped dolphin	Toothed Whales						
Mammals	M	*Stenella longirostris*	nai'a	Spinner dolphin	Spinner Dolphin						
Mammals	M	*Steno bredanensis*	nai'a	Rough-toothed dolphin	Toothed Whales						
Mammals	M	*Tursiops truncatus*	nai'a	Pacific bottlenose dolphin	Bottlenose Dolphin						
Mammals	M	*Ziphius cavirostris*	none	Cuvier's beaked whale	Toothed Whales						
Reptiles	M	*Caretta caretta*	none	Loggerhead sea turtle	Loggerhead turtle						
Reptiles	M	*Chelonia mydas agassizi*	none	Green sea turtle	Green sea turtle						

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Reptiles	M	*Dermochelys coriacea*	none	Leatherback sea turtle	Leatherback turtle						
Reptiles	M	*Eretmochelys imbricata*	none	Hawksbill sea turtle	Hawksbill turtle						
Reptiles	M	*Lepidochelys olivacea*	none	Olive Ridley Sea Turtle	Olive Ridley Turtle						
Reptiles	M	*Pelamis platurus*	none	Yellow-bellied sea snake	Sea snake						
Sharks	M	*Rhincodon typus*	lele wa'a	Whale shark	Sharks and Rays						
Sharks	M	*Carcharodon carcharias*	niuhi	Great white shark	Sharks and Rays						
Rays	M	*Manta alfredi or birostris*	none	Manta Ray	Sharks and Rays						
Fishes	M	*Acromycter alcocki*	none	none	Eels						
Fishes	M	*Ammodytoides pylei*	none	Pyle's sand lance	Active Reef Fishes						
Fishes	M	*Ammolabrus dicrus*	none	Sand wrasse	Sex Changers						
Fishes	M	*Anampses chrysocephalus*	none	Psychedelic wrasse	Sex Changers						
Fishes	M	*Antennarius commerson*	none	Commerson's frogfish	Cryptic Reef Fishes						
Fishes	M	*Aphareus rutlians*	none	Lehi	Bottomfishes						
Fishes	M	*Apogon maculiferus*	'upāpalu	Spotted cardinal fish	Cryptic Reef Fishes						
Fishes	M	*Apolemichthys arcuatus*	none	Bandit angelfish	Active Reef Fishes						
Fishes	M	*Aprion virescens*	uku	Green jobfish	Bottomfishes						
Fishes	M	*Araiophos gracilis*	none	none	Deep Fishes						
Fishes	M	*Argyripnus brocki*	none	none	Deep Fishes						
Fishes	M	*Aseraggodes borehami*	none	Boreham's sole	Flatfishes						
Fishes	M	*Aseraggodes holcomi*	none	none	Flatfishes						
Fishes	M	*Aseraggodes therese*	none	Therese's sole	Flatfishes						
Fishes	M	*Atherinomorus insularum*	'iao	Hawaiian silverside (FAO; Randall, 1996a), Togoro (DLNR)	Baitfishes						
Fishes	M	*Aulotrachichthys heptalepis*	none	none	Deep Fishes						
Fishes	M	*Bathycongrus aequorea*	none	none	Eels						
Fishes	M	*Bathygadus bowersi*	none	none	Deep Fishes						
Fishes	M	*Bothus thompsoni*	none	none	Flatfishes						
Fishes	M	*Cabillus caudimacula*	none	none	Cryptic Reef Fishes						
Fishes	M	*Caelorinchus doryssus*	none	none	Deep Fishes						
Fishes	M	*Caelorinchus gladius*	none	none	Deep Fishes						

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Fishes	M	*Callechelys lutea*	pūhi	Yellowspotted snake eel	Eels						
Fishes	M	*Callionymus caeruleonotatus*	none	Bluespotted dragonet	Cryptic Reef Fishes						
Fishes	M	*Callionymus comptus*	none	Ornamented dragonet	Cryptic Reef Fishes						
Fishes	M	*Callionymus decoratus*	none	Decorated dragonet	Cryptic Reef Fishes						
Fishes	M	*Calotomus zonarchus*	uhu	Yellowbar parrotfish	Parrotfishes						
Fishes	M	*Cantherhines verecundus*	ʻoʻili	Shy filefish	Active Reef Fishes						
Fishes	M	*Caracanthus typicus*	none	Hawaiian orbicular velvetfish	Cryptic Reef Fishes						
Fishes	M	*Caranx ignobilis*	ulua aukea	Giant Ulua or Trevally	Bottomfishes						
Fishes	M	*Caranx lugubrius*	gunkan	Black ulua	Bottomfishes						
Fishes	M	*Cataetyx hawaiiensis*	none	none	Deep Fishes						
Fishes	M	*Centropyge fisheri*	none	Orange angelfish (AFS), Fisher's angelfish (Hoover, 1993; Randall, 1996a)	Active Reef Fishes						
Fishes	M	*Centropyge loricula*	none	Hawaiian flame angelfish	Active Reef Fishes						
Fishes	M	*Chaetodon fremblii*	kīkākapu	Bluestriped butterflyfish	Active Reef Fishes						
Fishes	M	*Chaetodon tinkeri*	none	Tinker's butterflyfish	Active Reef Fishes						
Fishes	M	*Champsodon fimbriatus*	none	none	Deep Fishes						
Fishes	M	*Cheilodactylus vittatus*	kīkākapu	Hawaiian morwong	Active Reef Fishes						
Fishes	M	*Chlorurus perspicilatus*	uhu	Spectacled parrtofish	Parrotfishes						
Fishes	M	*Chromis hanui*	none	Chocolate-dip chromis	Active Reef Fishes						
Fishes	M	*Chromis ovalis*	none	Oval chromis	Active Reef Fishes						

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Fishes	M	*Chromis struhsakeri*	none	Struhsaker's chromis	Active Reef Fishes						
Fishes	M	*Cirripectes obscurus*	pāo'o	Gargantuan blenny	Cryptic Reef Fishes						
Fishes	M	*Coris flavovittata*	hilu	Yellowstripe coris	Sex Changers						
Fishes	M	*Coris venusta*	none	Elegant coris	Sex Changers						
Fishes	M	*Cosmocampus balli*	none	Ball's pipefish	Syngnathiformes						
Fishes	M	*Cymolutes lecluse*	none	Slender razorfish, Hawaiian knifefish (Randall, 1996a; Hoover, 2003), Slender sand wrasse (Hoover, 1993, 2003)	Sex Changers						
Fishes	M	*Doryrhamphus baldwini*	none	Redstripe pipefish	Syngnathiformes						
Fishes	M	*Doryrhamphus excisus excisus*	none	Bluestripe pipefish (FAO; Hoover, 1993, 2003; Randall, 1996a), Fantail pipefish	Syngnathiformes						
Fishes	M	*Draculo pogognathus*	none	none	Cryptic Reef Fishes						
Fishes	M	*Elops hawaiensis*	awa 'aua	Hawaiian ladyfish	HI Ladyfish						
Fishes	M	*Enchelycore pardalis*	pūhi-kauila	Dragon eel	Eels						
Fishes	M	*Enchelyurus brunneolus*	none	none	Cryptic Reef Fishes						
Fishes	M	*Encrasicholina purpurea*	nehu	Hawaiian anchovy	Baitfishes						
Fishes	M	*Engyprosopon hawaiiensis*	none	none	Flatfishes						
Fishes	M	*Engyprosopon xenandrus*	none	none	Flatfishes						
Fishes	M	*Enneapterygius atriceps*	none	Hawaiian triplefin	Cryptic Reef Fishes						
Fishes	M	*Entomacrodus marmoratus*	pāo'o	Marbled blenny	Cryptic Reef Fishes						
Fishes	M	*Entomacrodus strasburgi*	none	Strasburg's blenny	Cryptic Reef Fishes						
Fishes	M	*Epigonus devaneyi*	none	none	Deep Fishes						
Fishes	M	*Epigonus glossodontus*	none	none	Deep Fishes						
Fishes	M	*Epinephelus lanceolatus*	none	Giant grouper	Bottomfishes						
Fishes	M	*Epinephelus quernus*	hāpu'u	Hawaiian grouper	Bottomfishes						
Fishes	M	*Etelis carbunculus*	ula'ula	Ehu	Bottomfishes						
Fishes	M	*Etelis coruscans*	ula'ula koa'e	Onaga	Bottomfishes						
Fishes	M	*Eurypegasus papilio*	none	Hawaiian sea moth	Syngnathiformes						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Fishes	M	*Eustomias albibulbus*	none	none	Deep Fishes						
Fishes	M	*Eustomias bulbiramis*	none	none	Deep Fishes						
Fishes	M	*Eustomias magnificus*	none	none	Deep Fishes						
Fishes	M	*Eviota rubra*	none	none	Cryptic Reef Fishes						
Fishes	M	*Eviota susanae*	none	none	Cryptic Reef Fishes						
Fishes	M	*Festucalex erythraeus*	none	Red pipefish	Syngnathiformes						
Fishes	M	*Gadella molokaiensis*	none	none	Deep Fishes						
Fishes	M	*Genicanthus personatus*	none	Masked angelfish	Active Reef Fishes						
Fishes	M	*Glossanodon struhsakeri*	none	none	Deep Fishes						
Fishes	M	*Gonorynchus moseleyi*	none	salmon (AFS), Beaked sandfish (FAO)	Deep Fishes						
Fishes	M	*Gorgasia hawaiiensis*	pūhi	Hawaiian garden eel	Eels						
Fishes	M	*Grammonus waikiki*	none	none	Deep Fishes						
Fishes	M	*Gymnothorax nuttingi*	none	Nutting's moray	Eels						
Fishes	M	*Gymnothorax polyspondylus*	none	Manyvertebrae moray	Eels						
Fishes	M	*Gymnothorax steindachneri*	pūhi	Steindachner's moray	Eels						
Fishes	M	*Halicampus edmondsoni*	none	Edmondson's pipefish	Syngnathiformes						
Fishes	M	*Halieutaea retifera*	none	none	Deep Fishes						
Fishes	M	*Hippocampus fisheri*	none	Fisher's seahorse	Syngnathiformes						
Fishes	M	*Hippocampus histrix*	none	Spiny seahorse	Syngnathiformes						
Fishes	M	*Hippocampus kuda*	none	Yellow seahorse	Syngnathiformes						
Fishes	M	*Hymenocephalus antraeus*	none	none	Deep Fishes						
Fishes	M	*Hymenocephalus tenuis*	none	none	Deep Fishes						
Fishes	M	*Ichthyapus platyrhynchus*	none	none	Eels						
Fishes	M	*Ijimaia plicatellus*	none	none	Deep Fishes						
Fishes	M	*Iniistius umbrilatus*	lae-nihi	Blackside razorfish (Hoover, 1993, 2003; Randall, 1996a), Nabeta (DLNR)	Sex Changers						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					***Island Distribution: Feshwater only***					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Fishes	M	*Iso hawaiiensis*	none	Hawaiian surf sardine	Baitfishes						
Fishes	M	*Istiblennius zebra*	pāo'o	Zebra blenny	Cryptic Reef Fishes						
Fishes	M	*Kuhlia xenura*	āholehole	Hawaiian flagtail (Hoover, 1993, 2003; Randall, 1996a), Mountain bass (DLNR)	Flagtail						
Fishes	M	*Kumba hebetata*	none	none	Deep Fishes						
Fishes	M	*Lepidammodytes macrophthalmus*	none	none	Active Reef Fishes						
Fishes	M	*Linophryne escaramosa*	none	none	Deep Fishes						
Fishes	M	*Liopropoma aurora*	none	Sunset bass (Hoover, 1994)	Sex Changers						
Fishes	M	*Lophiodes bruchius*	none	none	Deep Fishes						
Fishes	M	*Luciobrotula lineata*	none	none	Deep Fishes						
Fishes	M	*Malacocephalus hawaiiensis*	none	Hawaiian softhead grenadier	Deep Fishes						
Fishes	M	*Microbrotula rubra*	none	none	Deep Fishes						
Fishes	M	*Nezumia ectenes*	none	none	Deep Fishes						
Fishes	M	*Nezumia holocentra*	none	none	Deep Fishes						
Fishes	M	*Ophichthus fowleri*	none	Fowler's snake eel	Eels						
Fishes	M	*Ophichthus kunaloa*	none	none	Eels						
Fishes	M	*Osopsaron incisum*	none	none	Deep Fishes						
Fishes	M	*Ostracion whitleyi*	none	Whitley''s boxfish	Active Reef Fishes						
Fishes	M	*Oxyurichthys heisei*	none	Ribbon goby	Cryptic Reef Fishes						
Fishes	M	*Oxyurichthys lonchotus*	none	none	Cryptic Reef Fishes						
Fishes	M	*Parabothus chlorospilus*	none	none	Flatfishes						
Fishes	M	*Parupeneus porphyreus*	kūmū	Whitesaddle goatfish (AFS; Hoover, 1993, 2003; Randall, 1996a), Red goat fish (DLNR)	Kumu						
Fishes	M	*Physiculus cynodon*	none	none	Deep Fishes						
Fishes	M	*Physiculus sterops*	none	none	Deep Fishes						
Fishes	M	*Plagiotremus ewaensis*	none	Ewa blenny	Cryptic Reef Fishes						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Fishes	M	*Plagiotremus goslinei*	none	Scale-eating blenny	Cryptic Reef Fishes						
Fishes	M	*Plectroglyphidodon sindonis*	none	Hawaiian rock damselfish	Active Reef Fishes						
Fishes	M	*Pleurosicya larsonae*	none	none	Cryptic Reef Fishes						
Fishes	M	*Poecilopsetta hawaiiensis*	none	none	Flatfishes						
Fishes	M	*Priacanthus meeki*	‘āweoweo	Hawaiian bigeye	Active Reef Fishes						
Fishes	M	*Pristipomoides auricillia*	kali kali	Glodflag jobfish	Bottomfishes						
Fishes	M	*Pristipomoides filamentosus*	none	‘Ōpakapaka	Bottomfishes						
Fishes	M	*Pristipomoides sieboldi*	none	Kalekale	Bottomfishes						
Fishes	M	*Pristipomoides zonatus*	ukikiki	Gindai	Bottomfishes						
Fishes	M	*Pseudanthias thompsoni*	none	Hawaiian anthias	Sex Changers						
Fishes	M	*Pseudocaranx dentex*	butaguchi	Thick or Pig Ulua	Bottomfishes						
Fishes	M	*Pseudogramma polyacanthum hawaiiensis*	none	Palespotted podge	Sex Changers						
Fishes	M	*Psilogobius mainlandi*	none	Mainland's goby	Cryptic Reef Fishes						
Fishes	M	*Pterois sphex*	nohu pinao	Hawaiian turkeyfish (AFS; Randall, 1996a; Hoover, 2003), Hawaiian lionfish (Hoover, 1993, 2003)	Cryptic Reef Fishes						
Fishes	M	*Pycnocraspedum armatum*	none	none	Deep Fishes						
Fishes	M	*Saccogaster hawaii*	none	none	Deep Fishes						
Fishes	M	*Samariscus corallinus*	none	Coralline-red flounder	Flatfishes						
Fishes	M	*Scolecenchelys puhioilo*	none	none	Eels						
Fishes	M	*Scorpaena pele*	none	none	Cryptic Reef Fishes						
Fishes	M	*Scorpaenopsis altirostris*	none	none	Cryptic Reef Fishes						
Fishes	M	*Scorpaenopsis brevifrons*	none	Bigmouth scorpionfish (FAO), Shortnose scorpionfish (Randall, 1996a)	Cryptic Reef Fishes						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Fishes	M	*Scorpaenopsis cacopsis*	nohu	Titan scorpionfish (Hoover, 1993, 2003; Randall, 1996a), Hogo (DLNR)	Cryptic Reef Fishes						
Fishes	M	*Scorpaenopsis pluralis*	none	none	Cryptic Reef Fishes						
Fishes	M	*Seriola dumerili*	kahala	Amberjack	Bottomfishes						
Fishes	M	*Solocisquama erythrina*	none	none	Deep Fishes						
Fishes	M	*Sphagemacrurus gibber*	none	none	Deep Fishes						
Fishes	M	*Synagrops argyreus*	none	none	Deep Fishes						
Fishes	M	*Synchiropus hawaiiensis*	none	none	Cryptic Reef Fishes						
Fishes	M	*Synchiropus kinmeiensis*	none	none	Cryptic Reef Fishes						
Fishes	M	*Synodus falcatus*	none	none	Cryptic Reef Fishes						
Fishes	M	*Synodus janus*	none	none	Cryptic Reef Fishes						
Fishes	M	*Taeniopsetta radula*	none	none	Flatfishes						
Fishes	M	*Thamnaconus garretti*	none	None	Active Reef Fishes						
Fishes	M	*Torquigener randalli*	none	Randall's puffer	Active Reef Fishes						
Fishes	M	Undescribed *Anarchias* species	none	none	Eels						
Fishes	M	Undescribed *Bodianus* species	none	Hawaiian Pigfish	Sex Changers						
Fishes	M	Undescribed *Prognathodes* species	none	Orange-margin butterflyfish	Active Reef Fishes						
Fishes	M	*Ventrifossa ctenomelas*	none	Hawaiian grenadier	Deep Fishes						
Sponge	M	Leucosolenia vesicula Haeckel,	none	none	Sponge						
Sponge	M	Leuconia kaiana de Laubenfels, 1951	none	none	Sponge						
Sponge	M	Sycandra parvula	none	none	Sponge						
Sponge	M	Sycandra staurifera	none	none	Sponge						
Sponge	M	Asteropus kaena de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Rhabdastrella pleopora (de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Zaplethea digonoxea de Laubenfels, 1950	none	none	Sponge						
Sponge	M	Erylus rotundus Lendenfeld, 1910	none	none	Sponge						
Sponge	M	Geodia gibberella de Laubenfels, 1951	none	none	Sponge						
Sponge	M	Anthosigmella valentis de Laubenfels 1957	none	none	Sponge						
Sponge	M	Spirastrella keaukaha de Laubenfels, 1951	none	none	Sponge						
Sponge	M	Prosuberites oleteira de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Tethya ornata Sara et al 2000	none	none	Sponge						
Sponge	M	Timea xena de Laubenfels, 1954	none	none	Sponge						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Sponge	M	Clathria (Microciona) haematodes (de Laube	none	none	Sponge						
Sponge	M	Clathria (Microciona) kilauea de Laubenfels,	none	none	Sponge						
Sponge	M	Clathria (Microciona) maunaloa (de Laubenf	none	none	Sponge						
Sponge	M	Axechina lissa de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Eurypon nigra Bergquist, 1967	none	none	Sponge						
Sponge	M	Lissodendoryx hawaiiana (de Laubenfels, 19	none	Hawaiian Lissodendoryx	Sponge						
Sponge	M	Naniupi ula de Laubenfels, 1950	none	none	Sponge						
Sponge	M	Iotrochota protea (de Laubenfels, 1950)	none	Staining sponge	Sponge						
Sponge	M	Strongylacidon kaneohe (de Laubenfels, 195	none	none	Sponge						
Sponge	M	Strongylacidon meganese (de Laubenfels, 19	none	none	Sponge						
Sponge	M	Xytopsues zukerani de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Stylinos rhoda (de Laubenfels, 1957)	none	none	Sponge						
Sponge	M	Axinella solenoides de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Homaxinella anamesa de Laubenfels, 1957	none	none	Sponge						
Sponge	M	Halichondria coerulea Bergquist, 1967	none	none	Sponge						
Sponge	M	Halichondria distincta (de Laubenfels, 1957)	none	none	Sponge						
Sponge	M	Hymeniacidon chlorida (de Laubenfels, 195(	none	none	Sponge						
Sponge	M	Haliclona myxa (de Laubenfels, 1951)	none	none	Sponge						
Sponge	M	Petrosia puna de Laubenfels, 1951	none	none	Sponge						
Sponge	M	Hippospongia densa	none	none	Sponge						
Sponge	M	Spongia oceania de Laubenfels, 1950	none	Black reef sponge	Sponge						
Sponge	M	Pleraplysilla hyalina de Laubenfels, 1950	none	none	Sponge						
Cnidaria	M	Antennella complexa	none	none	Hydrazoa						
Cnidaria	M	Lytocarpia niger (Nutting, 1905)	none	Black Hydroid	Hydrazoa						
Cnidaria	M	Plumularia buski Bale	none	none	Hydrazoa						
Cnidaria	M	Distichopora anceps (Cairns, 1978)	none	none	Hydrazoa						
Cnidaria	M	Distichopora coccinea Gray	none	none	Hydrazoa						
Cnidaria	M	Distichopora nitida Verrill	none	none	Hydrazoa						
Cnidaria	M	Distichopora violacea (Pallas)	none	none	Hydrazoa						
Cnidaria	M	Distichopora asulcata Cairns 2005	none	none	Hydrazoa						
Cnidaria	M	Stylaster griigi Cairns 2005	none	none	Hydrazoa						
Cnidaria	M	Stylaster infundibuliferous Cairns 2005	none	none	Hydrazoa						
Cnidaria	M	Stylaster sanguineus Valeniennes, Milne Edw	none	none	Hydrazoa						
Cnidaria	M	Hydrodenrium gorgonides	none	none	Hydrazoa						
Cnidaria	M	Corydendrium minor	none	none	Hydrazoa						

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Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cnidaria	M	Halecium scandens	none	none	Hydrazoa						
Cnidaria	M	Campanularia eloisa	none	none	Hydrazoa						
Cnidaria	M	Stegopoma gilberti	none	none	Hydrazoa						
Cnidaria	M	Stegopoma gracilis	none	none	Hydrazoa						
Cnidaria	M	Stegopoma plumicola	none	none	Hydrazoa						
Cnidaria	M	Opercularella longicauda	none	none	Hydrazoa						
Cnidaria	M	Lafoea contorta now Cryptolarella genus	none	none	Hydrazoa						
Cnidaria	M	Cryptolaria symmetrica	none	none	Hydrazoa						
Cnidaria	M	Sertularia snyderi	none	none	Hydrazoa						
Cnidaria	M	Sertularella crenulata	none	none	Hydrazoa						
Cnidaria	M	Diphasia palmata	none	none	Hydrazoa						
Cnidaria	M	Plumularia jordani	none	none	Hydrazoa						
Cnidaria	M	Plumularia milleri	none	none	Hydrazoa						
Cnidaria	M	Lytocarpus hawaiiensis	none	none	Hydrazoa						
Cnidaria	M	Lytocarpus similis	none	none	Hydrazoa						
Cnidaria	M	Halicornaria flava	none	none	Hydrazoa						
Cnidaria	M	Halicornaria bryani	none	none	Hydrazoa						
Cnidaria	M	Lepidisis olapa Merzik, 1978	none	Bamboo coral	Octocorals						
Cnidaria	M	Candidella helminthopora	none	none	Octocorals						
Cnidaria	M	Acanella dispar	none	none	Octocorals						
Cnidaria	M	Acabaria bicolor Nutting, 1908	none	Bicolor Gorgonian	Octocorals						
Cnidaria	M	Irridogorgia bella	none	none	Octocorals						
Cnidaria	M	Irridogorgia superba	none	none	Octocorals						
Cnidaria	M	Narella ornata Bayer 1995	none	none	Octocorals						
Cnidaria	M	Narella bowersi	none	Gold coral	Octocorals						
Cnidaria	M	Narella nuttingi bayer 1997	none	Gold coral	Octocorals						
Cnidaria	M	Corallium regale	none	Pink coral	Octocorals						
Cnidaria	M	Corallium secundum	none	Pink coral	Octocorals						
Cnidaria	M	Paragorgia n. sp.?	none	none	Octocorals						
Cnidaria	M	Villogorgia sp new?	none	none	Octocorals						
Cnidaria	M	Villogorgia sp 2 new?	none	none	Octocorals						
Cnidaria	M	Paramuricea hawaiiensis	none	none	Octocorals						
Cnidaria	M	Swiftia sp	none	none	Octocorals						
Cnidaria	M	Swiftia sp 2	none	none	Octocorals						
Cnidaria	M	Anthomuricea tenuispina	none	none	Octocorals						
Cnidaria	M	Eumicella sp	none	none	Octocorals						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cnidaria	M	Keratoisis sp.	none	none	Octocorals						
Cnidaria	M	Callogorgia gilberti	none	Gold coral	Octocorals						
Cnidaria	M	Callogorgia sp	none	none	Octocorals						
Cnidaria	M	Plumarella sp	none	none	Octocorals						
Cnidaria	M	Calyptrophora sp	none	Gold Coral	Octocorals						
Cnidaria	M	Calyptrophora wyvillei	none	none	Octocorals						
Cnidaria	M	Sinularia molokaiensis Verseveldt, 1983	none	Hawaiian Leather Coral	Octocorals						
Cnidaria	M	Bellonella molokaiensis	none	none	Octocorals						
Cnidaria	M	Anthelia edmondsoni (Verrill, 1928)	‘Okole	Blue soft coral	Octocorals						
Cnidaria	M	Calibelemnon symmetricum	none	none	Octocorals						
Cnidaria	M	Anemonia mutabilis Verrill, 1928	none	none	Other Anthozoans						
Cnidaria	M	Anthopleura sp. a	none	none	Other Anthozoans						
Cnidaria	M	Anthopleura sp. b	none	none	Other Anthozoans						
Cnidaria	M	Cladactella manni (Verrill, 1899)	‘Okole, ‘okola	Mann's Anemone	Other Anthozoans						
Cnidaria	M	Cladactella obscura Verrill, 1928	none	none	Other Anthozoans						
Cnidaria	M	Epiphellia humilis (Verrill, 1928)	none	none	Other Anthozoans						
Cnidaria	M	Heteractis malu (Haddon & Shachleton, 189	none	HI sand anemone	Other Anthozoans						
Cnidaria	M	Epiphellia pusilla (Verrill, 1928)	none	none	Other Anthozoans						
Cnidaria	M	Palythoa psammophilia Walsh & Bowers, 19	none	Toadstool Zoanthid	Other Anthozoans						
Cnidaria	M	Palythoa toxica Walsh & Bowers, 1971	none	Toadstool Zoanthid	Other Anthozoans						
Cnidaria	M	Zoanthus kealakekuaensis Walsh & Bowers,	none	Green mat Zoanthid	Other Anthozoans						
Cnidaria	M	Parazoanthus sp.	none	Gold Coral	Other Anthozoans						
Cnidaria	M	Corynactis sp.	none	none	Other Anthozoans						
Cnidaria	M	Acropora cytherea (Dana, 1848)	none	Table coral	Stony Corals						
Cnidaria	M	Acropora echinata (Dana, 1846)	none	none	Stony Corals						
Cnidaria	M	Acropora humilis (Dana, 1846)	none	Finger staghorn coral	Stony Corals						
Cnidaria	M	Acropora paniculata Verrill, 1902	none	Fuzzy table coral	Stony Corals						
Cnidaria	M	Acropora sp.	none	none	Stony Corals						
Cnidaria	M	Acropora valida (Dana, 1846)	none	Bushy Staghorn coral	Stony Corals						
Cnidaria	M	Montipora capitata (Dana, 1846)	none	Rice Coral	Stony Corals						
Cnidaria	M	Montipora dilatata Studer, 1901	none	Irregular rice coral	Stony Corals						
Cnidaria	M	Montipora flabellata Studer, 1902	none	Blue Rice Coral	Stony Corals						
Cnidaria	M	Montipora patula Verrill, 1864	none	Spreading Coral	Stony Corals						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cnidaria	M	Montipora studeri Vaughan, 1907	none	Branching rice coral	Stony Corals						
Cnidaria	M	Montipora tuberculosa (Lamarck, 1816)	none	none	Stony Corals						
Cnidaria	M	Montipora turgescens Bernard, 1897	none	Lumpy rice coral	Stony Corals						
Cnidaria	M	Montipora venosa (Ehrenberg, 1834)	none	none	Stony Corals						
Cnidaria	M	Montipora verrilli Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Montipora verrucosa (Lamarck,1816)	none	none	Stony Corals						
Cnidaria	M	Gardineroseris planulata (Dana, 1846)	none	Honeycomb coral	Stony Corals						
Cnidaria	M	Leptoseris hawaiiensis Vaughan, 1907	none	Hawaiian plate coral	Stony Corals						
Cnidaria	M	Leptoseris incrustans (Quelch, 1886)	none	Swelling coral	Stony Corals						
Cnidaria	M	Leptoseris mycetoseroides Wells, 1954	none	Ridge coral	Stony Corals						
Cnidaria	M	Leptoseris papyracea (Dana, 1846)	none	Papyrus coral	Stony Corals						
Cnidaria	M	Leptoseris scabra Vaughan, 1907	none	Rough plate coral	Stony Corals						
Cnidaria	M	Leptoseris tubulifera Vaughan, 1907	none	Tube coral	Stony Corals						
Cnidaria	M	Pavona duerdeni Vaughan, 1907	none	Flat Lobe Coral	Stony Corals						
Cnidaria	M	Pavona maldivensis (Gardiner, 1905)	none	none	Stony Corals						
Cnidaria	M	Pavona pallicata Wells, 1954	none	none	Stony Corals						
Cnidaria	M	Pavona varians Verrill, 1864	ʻākoʻakoʻa	Corrugated coral	Stony Corals						
Cnidaria	M	Anthemiphyllia dentata (Alcock, 1902)	none	none	Stony Corals						
Cnidaria	M	Anthemiphyllia pacifica Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Balanophyllia cornu Moseley, 1881	none	none	Stony Corals						
Cnidaria	M	Balanophyllia desmophyllioides Vaughan, 19	none	none	Stony Corals						
Cnidaria	M	Balanophyllia diomedeae Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Balanophyllia laysanensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Balanophyllia n.sp.	none	Oval cup coral	Stony Corals						
Cnidaria	M	Balanophyllia sp. cf affinis (Semper, 1872)	none	none	Stony Corals						
Cnidaria	M	Anomocora sp.	none	none	Stony Corals						
Cnidaria	M	Caryophyllia atlantica (Duncan, 1873)	none	none	Stony Corals						
Cnidaria	M	Caryophyllia cf. ambrosia Alcock, 1898	none	none	Stony Corals						
Cnidaria	M	Caryophyllia hawaiiensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Caryophyllia marmorea Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Caryophyllia octopali Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Caryophyllia rugosa Moseley, 1881	none	none	Stony Corals						
Cnidaria	M	Ceratotrochus laxus Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Coenosmilia inordinata Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Conotrochus funicolumna (Alcock, 1902)	none	none	Stony Corals						
Cnidaria	M	Cyathoceras diomedeae Vaughan, 1907	none	none	Stony Corals						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cnidaria	M	Cyathoceras rubescens Moseley, 1881	none	none	Stony Corals						
Cnidaria	M	Deltocyathus andamanicus Alcock, 1898	none	none	Stony Corals						
Cnidaria	M	Deltocyathus stellulatus Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Desmophyllum cristagalli Milne Edwards &	none	none	Stony Corals						
Cnidaria	M	Paracyathus molokensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Peponocyathus orientalis (Duncan, 1876)	none	none	Stony Corals						
Cnidaria	M	Trochocyathus burchae Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Trochocyathus aithoseptatus Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Trochocyathus gardineri (Vaughan, 1907)	none	none	Stony Corals						
Cnidaria	M	Trochocyathus mauiensis (Vaughan, 1907)	none	none	Stony Corals						
Cnidaria	M	Trochocyathus oahuensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Trochocyathus tenuicalyx (Vaughan, 1907)	none	none	Stony Corals						
Cnidaria	M	Bathyactis hawaiiensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Cladopsammia echinata Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Dendrophyllia gaditana (Duncan, 1873)	none	none	Stony Corals						
Cnidaria	M	Dendrophyllia oahuensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Dendrophyllia serpentina Vaughan, 1907	none	Serpentine cup coral	Stony Corals						
Cnidaria	M	Enallopsammia amphelioides Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Enallopsammia rostrata (Pourtales, 1878)	none	none	Stony Corals						
Cnidaria	M	Endopachys grayi Milne Edwards & Haime,	none	none	Stony Corals						
Cnidaria	M	Endopachys oahuense Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Stenocyanthus vermiformis (Pourtaler, 1868)	none	none	Stony Corals						
Cnidaria	M	Tubastrea coccinea Lesson, 1829	none	Colonial Cup Coral	Stony Corals						
Cnidaria	M	Stephanophyllia formosissima Moseley, 187	none	none	Stony Corals						
Cnidaria	M	Cyphastrea ocellina (Dana, 1846)	ʻākoʻakoʻa	Ocellated coral	Stony Corals						
Cnidaria	M	Favia hawaiiensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Favia hombroni (Rousseau, 1854)	none	none	Stony Corals						
Cnidaria	M	Favia rudis Verrill, 1866	none	none	Stony Corals						
Cnidaria	M	Goniastria tenuis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Leptastrea bottae Milne Edwards & Haime, 1	ʻākoʻakoʻa	none	Stony Corals						
Cnidaria	M	Leptastrea purpurea Dana, 1846	none	Crust coral	Stony Corals						
Cnidaria	M	Flabellum deludens von Marenzeller, 1848	none	none	Stony Corals						
Cnidaria	M	Flabellum marcus Keller, 1974	none	none	Stony Corals						
Cnidaria	M	Flabellum pavonium Lesson, 1831	none	none	Stony Corals						
Cnidaria	M	Flabellum vaughani Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Gardineria hawaiiensis Vaughan, 1907	none	none	Stony Corals						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					***Island Distribution: Feshwater only***					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cnidaria	M	Javania insignis Duncan, 1876	none	none	Stony Corals						
Cnidaria	M	Javania lamprotichum (Moseley, 1880)	none	none	Stony Corals						
Cnidaria	M	Placotrochus fuscus Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Cycloseris fragilis (Alcock, 1893)	none	Fragile mushroom coral	Stony Corals						
Cnidaria	M	Cycloseris tenuis (Dana, 1846)	none	none	Stony Corals						
Cnidaria	M	Cycloseris vaughani (Boschma, 1923) or C. h	none	Humpback Coral	Stony Corals						
Cnidaria	M	Diaseris distorta (Michelin, 1843)	none	Distorted mushroom c	Stony Corals						
Cnidaria	M	Diaseris fragilis (Alcock, 1893)	none	none	Stony Corals						
Cnidaria	M	Fungia echinata (Pallas, 1766)	none	none	Stony Corals						
Cnidaria	M	Fungia patelliformis Boshma, 1925	none	none	Stony Corals						
Cnidaria	M	Fungia scutaria Lamarck, 1801	ʻākoʻakoʻakohe	Mushroom coral	Stony Corals						
Cnidaria	M	Fungiacyathus fissilis Cairns, 1984	none	none	Stony Corals						
Cnidaria	M	Fungiacyathus fragilis (Alcock, 1893)	none	none	Stony Corals						
Cnidaria	M	Guynia annulata Duncan, 1872	none	none	Stony Corals						
Cnidaria	M	Letepsammia formosissima Moseley, 1876	none	none	Stony Corals						
Cnidaria	M	Madrepora kauaiensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Madrepora oculata Linnaeus, 1758	none	none	Stony Corals						
Cnidaria	M	Madracis kauaiensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Pocillopora damicornis (Linnaeus, 1758)	ʻākoʻakoʻa	Lace coral	Stony Corals						
Cnidaria	M	Pocillopora eydouxi Milne Edwards & Haim	none	Antler Coral	Stony Corals						
Cnidaria	M	Pocillopora lingulata Dana, 1846	none	Thin cauliflower coral	Stony Corals						
Cnidaria	M	Pocillopora meandrina Dana, 1846	none	Cauliflower coral	Stony Corals						
Cnidaria	M	Pocillopora molokensis Vaughan, 1907	none	Molokai cauliflower coral	Stony Corals						
Cnidaria	M	Alveopora verrilliana Dana, 1872	none	none	Stony Corals						
Cnidaria	M	Porites bernardi Vaughan, 1907	none	False lichen coral	Stony Corals						
Cnidaria	M	Porites brighami Vaughan, 1907	none	Brighams coral	Stony Corals						
Cnidaria	M	Porites compressa Dana, 1846	pō haku puna, ʻāko	Finger Coral	Stony Corals						
Cnidaria	M	Porites discoidea Studer, 1901	none	none	Stony Corals						
Cnidaria	M	Porites duerdeni Vaughan, 1907	none	Thick finger coral	Stony Corals						
Cnidaria	M	Porites evermanni Vaughan, 1907	pō haku puna, ʻāko	Evermann's Coral	Stony Corals						
Cnidaria	M	Porites lanuginosa Studer, 1901	none	none	Stony Corals						
Cnidaria	M	Porites lichen Dana, 1846	none	Lichen coral	Stony Corals						
Cnidaria	M	Porites lobata Dana, 1846	pō haku puna, ʻāko	Lobe Coral	Stony Corals						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
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Cnidaria	M	Porites pukoensis Vaughan, 1907	none	none	Stony Corals						
Cnidaria	M	Porites schauinslandi Studer, 1901	none	none	Stony Corals						
Cnidaria	M	Porites studeri Vaughan, 1907	none	Deep lobe coral	Stony Corals						
Cnidaria	M	Porites (Synaraea) irregularis Verrill, 1864	none	none	Stony Corals						
Cnidaria	M	Porites (Synaraea) rus (Forskal, 1775)	none	Plate and Pillar Coral	Stony Corals						
Cnidaria	M	Culicia sp. cf. tenella Dana, 1846	none	none	Stony Corals						
Cnidaria	M	Coscinaraea wellsi Veron & Pichon, 1979	none	Wells coral	Stony Corals						
Cnidaria	M	Psammocora explanulata Van der Horst, 192	none	Flat coral	Stony Corals						
Cnidaria	M	Psammocora nierstraszi Van der Horst, 1922	none	Nierstrasz's coral	Stony Corals						
Cnidaria	M	Psammocora stellata Verrill, 1864	ʻākoʻakoʻa	Stellar coral	Stony Corals						
Cnidaria	M	Psammocora verrilli Vaughan, 1907	none	Verril's lump coral	Stony Corals						
Cnidaria	M	*Porites annae*	none	Nodule coral	Stony Corals						
Cnidaria	M	*Porites convexa*	none	Plate and knob coral	Stony Corals						
Cnidaria	M	*Porites solida*	none	Solid coral	Stony Corals						
Cnidaria	M	*Psammocora haimeana*	none	Haime's lump coral	Stony Corals						
Cnidaria	M	*Psammocora superficialis*	none	Superficial coral	Stony Corals						
Cnidaria	M	*Rhizopsammia verrilli*	none	Verrill's lump coral	Stony Corals						
Cnidaria	M	*Tethocyathus minor*	none	Tiny cup coral	Stony Corals						
Cnidaria	M	*Tubastraea diaphana*	none	Black cup coral	Stony Corals						
Cnidaria	M	*Madracis pharensis*	none	Hidden orange coral	Stony Corals						
Cnidaria	M	*Leptastrea transversa*	none	Transverse coral	Stony Corals						
Cnidaria	M	*Leptoseris foliosa*	none	Foliose coral	Stony Corals						
Cnidaria	M	*Leptastrea pruinosa*	none	Spotted coral	Stony Corals						
Cnidaria	M	*Leptastrea bewickensis*	none	Bewick coral	Stony Corals						
Cnidaria	M	*Fungia granulosa*	none	Granulated mushroom coral	Stony Corals						
Cnidaria	M	*Caryophyllia alcocki*	none	none	Stony Corals						
Cnidaria	M	*Balanophyllia gigas*	none	none	Stony Corals						
Cnidaria	M	*Anacropora sp.*	none	none	Stony Corals						
Cnidaria	M	*Anisopsammia ampheiliodes*	none	none	Stony Corals						
Cnidaria	M	*Acropora nasuta*	none	Branching staghorn coral	Stony Corals						
Cnidaria	M	*Acropora gemmifera*	none	none	Stony Corals						
Cnidaria	M	Antipathes dichotoma Pallas, 1766	none	Branching Black coral	Black Corals						
Cnidaria	M	Antipathes grandis Verrill, 1928	ʻekaha ku moana	Grand Black coral	Black Corals						

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Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cnidaria	M	Antipathes intermedia (Brook, 1889)	none	Small feathery black c	Black Corals						
Cnidaria	M	Antipathes irregularis	none	none	Black Corals						
Cnidaria	M	Antipathes punctata (Roule, 1905)	none	none	Black Corals						
Cnidaria	M	Antipathes sp.	none	none	Black Corals						
Cnidaria	M	Antipathes subpinnata Ellis & Solander, 178(	none	none	Black Corals						
Cnidaria	M	Myriopathes ulex Ellis & Solander, 1786	none	Feathery Black coral	Black Corals						
Cnidaria	M	Antipathes undulata van Pesch, 1914	none	none	Black Corals						
Cnidaria	M	Cirrhipathes anguina Dana, 1846	none	Common wire coral	Black Corals						
Cnidaria	M	Cirrhipathes spiralis (Linnaeus, 1758)	none	none	Black Corals						
Cnidaria	M	Leiopathes glaberrima (Esper, 1788)	none	none	Black Corals						
Cnidaria	M	Parantipathes sp.	none	none	Black Corals						
Cnidaria	M	Schizopathes conferta Brook, 1889	none	none	Black Corals						
Cnidaria	M	Stichopathes echinulata Brook, 1889	none	Red wire coral	Black Corals						
Cnidaria	M	Stichopathes sp.	none	none	Black Corals						
Cnidaria	M	Myriopathes cf. japonica	none	Dense feathery black coral	Black Corals						
Gnathostomulida	M	Haplognathia rufa	none	none	Worms						
Gnathostomulida	M	Cosmognathia manubrium	none	none	Worms						
Gnathostomulida	M	Pterognathia hawaiiensis	none	none	Worms						
Flat Worm	M	Notocelis maculata Karling et al., 1972	none	none	Worms						
Flat Worm	M	Discostylochus parcus Bock, 1925	none	none	Worms						
Flat Worm	M	Emprosthopharynx rasae Prudhoe, 1968	none	none	Worms						
Flat Worm	M	Euplanoida tropicalis Hyman, 1954	none	none	Worms						
Flat Worm	M	Euplana n. sp.	none	none	Worms						
Flat Worm	M	Planocera hawaiiensis Heath, 1907	none	none	Worms						
Flat Worm	M	Peasia inconspicua Pease, 1860	none	none	Worms						
Flat Worm	M	Peasia irrorata Pease, 1860	none	none	Worms						
Flat Worm	M	Prosthiostomum (Lurymare) katoi Poulter, 1	none	none	Worms						
Flat Worm	M	Prosthiostomum (Prosthiostomum) montipora	none	none	Worms						
Flat Worm	M	Stylochus n. sp.	none	none	Worms						
Flat Worm	M	Ceratoplana hawaiiensis Bock, 1925	none	none	Worms						
Flat Worm	M	Stylochoplana inquilina Hyman, 1950	none	none	Worms						
Flat Worm	M	Pericelis hymanae Poulter, 1974	none	Hyman's Flatworm	Worms						
Flat Worm	M	Pseudobiceros ?kentii Graff in Saville-Kent,	none	Hawaiian Spotted Flatworm	Worms						
Flat Worm	M	Pseudoceros n. sp. 1	none	none	Worms						

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Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Flat Worm	M	Pseudoceros n. sp. 2	none	none	Worms						
Flat Worm	M	Thysanozoon tentaculatum Pease, 1860	none	none	Worms						
Flat Worm	M	Archiloa subtilis Karling et al., 1972	none	none	Worms						
Flat Worm	M	Archimonocelis helfrichi Karling et al., 1972	none	none	Worms						
Flat Worm	M	Duplominona kaneohei Karling et al., 1972	none	none	Worms						
Flat Worm	M	Minona bistylifera Karling et al., 1972	none	none	Worms						
Flat Worm	M	Utelga variodentata Karling et al., 1972	none	none	Worms						
Flat Worm	M	Austrorhynchus hawaiiensis Karling, 1977	none	none	Worms						
Flat Worm	M	Cilionema hawaiiensis Karling et al., 1972	none	none	Worms						
Nemertea	M	Baseodiscus cingulatus (Coe, 1906)	ko'ekai	Banded Ribbon Worm	Worms						
Nemertea	M	Baseodiscus univittatus (Coe, 1906)	none	none	Worms						
Nemertea	M	Lineus albifrons Coe, 1934	none	none	Worms						
Nemertea	M	Lineus hiatti Coe, 1947	none	none	Worms						
Nemertea	M	Nemertopsis exilis Coe, 1947	none	none	Worms						
Nemertea	M	nemertean 1	none	none	Worms						
Nemertea	M	nemertean 2	none	none	Worms						
Nemertea	M	nemertean 3	none	none	Worms						
Nemertea	M	nemertean 4	none	none	Worms						
Nemertea	M	nemertean 5	none	none	Worms						
Nemertea	M	nemertean 6	none	none	Worms						
Nemertea	M	nemertean 7	none	none	Worms						
Nemertea	M	nemertean 8	none	none	Worms						
Nemertea	M	nemertean 9	none	none	Worms						
Nemertea	M	nemertean 10	none	none	Worms						
Nemertea	M	nemertean 11	none	none	Worms						
Nemertea	M	nemertean 12	none	none	Worms						
Nemertea	M	nemertean 13	none	none	Worms						
Nemertea	M	nemertean 14	none	none	Worms						
Nemertea	M	nemertean 15	none	none	Worms						
Nemertea	M	nemertean 16	none	none	Worms						
Nemertea	M	nemertean 17	none	none	Worms						
Nemertea	M	nemertean 18	none	none	Worms						
Nemertea	M	nemertean 19	none	none	Worms						
Nematoda	M	Chromadorella pacifica (Allgen, 1947)	none	none	Worms						
Nematoda	M	Spilophorella campbelli (Allgen, 1928)	none	none	Worms						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Nematoda	M	Dorylaimopsis hawaiiensis Allgen, 1951	none	none	Worms						
Nematoda	M	Acanthonchus (Acanthonchus) californicus (	none	none	Worms						
Nematoda	M	Paracantholaimus tenuispiculum (Allgen, 19	none	none	Worms						
Nematoda	M	Paracanthonchus mortenseni Allgen, 1947	none	none	Worms						
Nematoda	M	Acanthopharyx brachycapitata Allgen, 1947	none	none	Worms						
Nematoda	M	Desmodora (Desmodora) californica Allgen,	none	none	Worms						
Nematoda	M	Desmodora (Zalonema) propinqua Allgen, 1	none	none	Worms						
Nematoda	M	Oxyonchus stateni (Allgen, 1930)	none	none	Worms						
Nematoda	M	Phanoderma (Phanoderma) hawaiiense Allge	none	none	Worms						
Nematoda	M	Phanoderma (Phanoderma) tenuicaudum All	none	none	Worms						
Nematoda	M	Enchelidium brevicaudatum Allgen, 1947	none	none	Worms						
Nematoda	M	Enchelidium microlaimum Allgen, 1951	none	none	Worms						
Nematoda	M	Enchelidium pacificum Allgen, 1951	none	none	Worms						
Nematoda	M	Polygastrophora tenuicollis (Allgen, 1951)	none	none	Worms						
Nematoda	M	Pontonema californicum Allgen, 1947	none	none	Worms						
Nematoda	M	Onchium hawaiiense (Allgen, 1951)	none	none	Worms						
Nematoda	M	Southerniella youngi Murphy, 1964	none	none	Worms						
Nematoda	M	Cephalobus marinus Allgen, 1951	none	none	Worms						
Annelida	M	Arctonoe tuberculata	none	none	Worms						
Annelida	M	Paranothria macrobranchiata	none	none	Worms						
Annelida	M	Lumbrineris dentata Hartmann-Schroder, 19	none	none	Worms						
Annelida	M	Iphione treadwelli	none	none	Worms						
Annelida	M	Iphione henshawii	none	none	Worms						
Annelida	M	Lepidasthenia alba (Treadwell, 1906)	none	none	Worms						
Annelida	M	Lepidasthenia havaicus Kinberg, 1855	none	none	Worms						
Annelida	M	Lepidasthenia lucida (Treadwell, 1906)	none	none	Worms						
Annelida	M	Lepidonototus havaicus	none	none	Worms						
Annelida	M	Panthalis mutilata (Treadwell, 1940)	none	none	Worms						
Annelida	M	Euthalenessa chacei Pettibone, 1970	none	none	Worms						
Annelida	M	Notopygos gregoryi Holly, 1939	none	none	Worms						
Annelida	M	Eulalia havaica Kinberg, 1866	none	none	Worms						
Annelida	M	Eumida caspersi Hartmann-Schroder, 1965	none	none	Worms						
Annelida	M	Phyllodoce (Phyllodoce) hiatti Hartman, 196	none	none	Worms						
Annelida	M	Prophyllodoce hawaiia Hartman, 1966	none	none	Worms						
Annelida	M	Alciopa pacifica Kinberg, 1866	none	none	Worms						
Annelida	M	Myrianida crassicirrata Hartmann-Schroder,	none	none	Worms						

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Annelida	M	Trypanosyllis hawaiiensis Hartmann-Schrod	none	none	Worms						
Annelida	M	Typosyllis microoculata Hartmann-Schroder	none	none	Worms						
Annelida	M	Typosyllis ornata Hartmann-Schroder, 1965	none	none	Worms						
Annelida	M	Ceratonereis pietschmanni Holly, 1935	none	none	Worms						
Annelida	M	Nereis abbreviata Holly, 1935	none	none	Worms						
Annelida	M	Nereis corallina Kinberg, 1866	none	none	Worms						
Annelida	M	Nereis hawaiiensis Holly, 1935	none	none	Worms						
Annelida	M	Nereis mariae Holly, 1935	none	none	Worms						
Annelida	M	Nereis myersi Holly, 1935	none	none	Worms						
Annelida	M	Nereis nigroaciculata Holly, 1935	none	none	Worms						
Annelida	M	Nereis unica Holly, 1935	none	none	Worms						
Annelida	M	Nereis waikikiensis Holly, 1935	none	none	Worms						
Annelida	M	Perinereis curvata Holly, 1935	none	none	Worms						
Annelida	M	Eunice bilobata Treadwell, 1906	none	none	Worms						
Annelida	M	Eunice hawaiensis Treadwell, 1906	none	none	Worms						
Annelida	M	Diopatra n. sp. dexognatha	none	none	Worms						
Annelida	M	Nothria hawaiiensis Pettibone, 1970	none	none	Worms						
Annelida	M	Lumbrineris sarsi (Kinberg, 1865)	none	none	Worms						
Annelida	M	Arabella iridescens Treadwell, 1906	none	none	Worms						
Annelida	M	Australospio mokapu Ward, 1981	none	none	Worms						
Annelida	M	Laonice papillibranchiae Ward, 1981	none	none	Worms						
Annelida	M	Polydora pilikia Ward, 1981	none	none	Worms						
Annelida	M	Pygospio muscularis Ward, 1981	none	none	Worms						
Annelida	M	Cirriformia hawaiensis (Hartman, 1956)	none	none	Worms						
Annelida	M	Notomastus (Clistomastus) anoculatus Hartn	none	none	Worms						
Annelida	M	Pherusa havaica (Kinberg, 1867)	none	none	Worms						
Annelida	M	Phalacrostemma setosa (Treadwell, 1906)	none	none	Worms						
Annelida	M	Melinnexis tentaculata (Treadwell, 1906)	none	none	Worms						
Annelida	M	Lanice expansa Treadwell, 1906	none	none	Worms						
Annelida	M	Terebella parvabranchiata Treadwell, 1906	none	none	Worms						
Annelida	M	Thelepus branchiatus Treadwell, 1906	none	none	Worms						
Annelida	M	Hydroides bannerorum	none	none	Worms						
Annelida	M	Vermiliopsis torquata Treadwell, 1943	none	none	Worms						
Annelida	M	Saccocirrus oahuensis	none	none	Worms						
Annelida	M	Saccocirrus waianaensis	none	none	Worms						
Annelida	M	Saccocirrus alanhongi	none	none	Worms						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Annelida	M	Bathydrilus exilis Erseus and Davis, 1989	none	none	Worms						
Annelida	M	Coralliodrilus aequalis Erseus and Davis, 19	none	none	Worms						
Annelida	M	Inanidrilus dutchae Erseus and Davis, 1989	none	none	Worms						
Annelida	M	Limnodriloides hawaiiensis Erseus and Davi	none	none	Worms						
Annelida	M	Olavius parapellucides Erseus and Davis, 19	none	none	Worms						
Annelida	M	Olavius (Coralliodriloides) mokapuensis Ers	none	none	Worms						
Annelida	M	Olavius (Coralliodriloides) strigosus Erseus	none	none	Worms						
Annelida	M	Phallodrilus ampullarius Erseus and Davis, 1	none	none	Worms						
Annelida	M	Phallodrilus aquilinus Erseus and Davis, 198	none	none	Worms						
Annelida	M	Phallodrilus distinctus Erseus and Davis, 19	none	none	Worms						
Annelida	M	Tubificoides pulvereus Erseus and Davis, 19	none	none	Worms						
Pogonophora	M	Oligobranchia hawaiiensis Southward, 1980			Worms						
Pogonophora	M	Siboglinum ordinatum Southward, 1980			Worms						
Mollusca	M	Mastonia gracilis (Pease, 1871)	none	none	Snails						
Mollusca	M	Triphora thaanumi Kay, 1979	none	none	Snails						
Mollusca	M	Emarginula hawaiiensis Dall, 1895	none	none	Snails						
Mollusca	M	Tugali oblonga (Pease, 1861)	none	none	Snails						
Mollusca	M	Cellana exarata (Reeve, 1854)	ʻopihi makaiauli	black foot limpet	Limpets						
Mollusca	M	Cellana melanostoma (Pilsbry, 1891)	none	Green -foot opihi	Limpets						
Mollusca	M	Cellana sandwicensis (Pease, 1861)	ʻopihi ʻālinalina	yellow foot limpet	Limpets						
Mollusca	M	Cellana talcosa (Gould, 1846)	ʻopihi kōʻele	yellow foot limpet	Limpets						
Mollusca	M	Brookula iki Kay, 1979	none	none	Snails						
Mollusca	M	Calliostoma (Tristichotrochus) doncorni Kay	none	none	Snails						
Mollusca	M	Calliotropis (Solaricida) reticulina (Dall, 18	none	none	Snails						
Mollusca	M	Euchelus fimbriatus (Pease, 1861)	none	none	Snails						
Mollusca	M	Tristichotrochus margaritissimus Habe and K	none	none	Snails						
Mollusca	M	Galleoastrea midwayensis Habe and Kosuge	none	none	Snails						
Mollusca	M	Turbo sandwicensis Pease, 1861	ʻailea	Hawaiian Turban	Snails						
Mollusca	M	Nerita picea (Recluz, 1841)	pipipi, pipipi kai	Black Nerite	Snails						
Mollusca	M	Nerita polita Linnaeus, 1758	kūpʻe	Polished nerite	Snails						
Mollusca	M	Smaragdia bryanae Pilsbry, 1917	none	HI sea grass snail	Snails						
Mollusca	M	Phenacolepas aculeata (Pease, 1868)	none	none	Snails						
Mollusca	M	Cerithium boeticum Pease, 1860	none	none	Snails						
Mollusca	M	Mellitestia scopulorum (Watson, 1886) used	none	none	Snails						
Mollusca	M	Fossarus garrettii Pease, 1868	none	none	Snails						
Mollusca	M	Iniforis hinuhinu Kay, 1979	none	none	Snails						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine — *Island Distribution: Feshwater only*

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	O'ahu	Moloka'i	Lāna'i	Maui	Hawai'i
Mollusca	M	Iniforis perfecta (Pease, 1871)	none	none	Snails						
Mollusca	M	Litharium maculata (Pease, 1871)	none	none	Snails						
Mollusca	M	Viriola fallax Kay, 1979	none	none	Snails						
Mollusca	M	Metaxia albicephala Kay, 1979	none	none	Snails						
Mollusca	M	Metaxia tricarinata (Pease, 1861)	none	none	Snails						
Mollusca	M	Triphora bicolor (Pease, 1868)	none	none	Snails						
Mollusca	M	Triphora chrysolitha Kay, 1979	none	none	Snails						
Mollusca	M	Triphora earlei Kay, 1979	none	none	Snails						
Mollusca	M	Triphora keiki Kay, 1979	none	none	Snails						
Mollusca	M	Triphora laddi Kay, 1979	none	none	Snails						
Mollusca	M	Triphora peasi (Jousseaume, 1884)	none	none	Snails						
Mollusca	M	Triphora pustulosa (Pease, 1871)	none	none	Snails						
Mollusca	M	Nodilittorina hawaiensis	none	none	Snails						
Mollusca	M	Epitonium oahuense (Pilsbry, 1921)	none	none	Snails						
Mollusca	M	Epitonium ulu Pilsbry, 1921	none	Fungiid Wentletrap	Snails						
Mollusca	M	Laeviscala luceo DuShane, 1988 now Epiton	none	none	Snails						
Mollusca	M	Eatoniopsis conica (Kay, 1979) used to be E	none	none	Snails						
Mollusca	M	Eatoniopsis ponderi Kay, 1979 used to be R	none	none	Snails						
Mollusca	M	Eatoniella (Eatoniella) janetaylorae Kay, 197	none	none	Snails						
Mollusca	M	Rastodens brevilabiosa Kay, 1979	none	none	Snails						
Mollusca	M	Rastodens labiosa Kay, 1979	none	none	Snails						
Mollusca	M	Melanella acanthyllis (Watson, 1886) used to	none	none	Snails						
Mollusca	M	Melanella brunnimaculata (Kay, 1979) Balc	none	none	Snails						
Mollusca	M	Melanella bryani (Pilsbry, 1917) used to be	none	none	Snails						
Mollusca	M	Melanella conoidalis (Sowerby, 1865) used t	none	none	Snails						
Mollusca	M	Melanella kanaka (Pilsbry, 1917) used to be	none	none	Snails						
Mollusca	M	Melanella letsonae (Pilsbry, 1917) used to be	none	none	Snails						
Mollusca	M	Melanella solida (Sowerby, 1865) used to be	none	none	Snails						
Mollusca	M	Mucronalia ovata Pease, 1861	none	none	Snails						
Mollusca	M	Pelseneeria hawaiiensis Warén, B. Burch, an	none	none	Snails						
Mollusca	M	Trochostilifer entospinea Warén, B. Burch a	none	none	Snails						
Mollusca	M	Trochostilifer hawaiiensis Warén, B. Burch a	none	none	Snails						
Mollusca	M	Vitreolina chondrocidaricola Warén, B. Burc	none	none	Snails						
Mollusca	M	Vitreolina hawaiiensis Warén, B. Burch and	none	none	Snails						
Mollusca	M	Barleeia caIcarea Kay, 1979	none	none	Snails						
Mollusca	M	Caecum (Caecum) oahuense (Pilsbry, 1921)	none	none	Snails						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Mollusca	M	Caecum (Meioceras) sandwichensis de Folin	none	none	Snails						
Mollusca	M	Strebloceras subannulatum de Folin, 1879	none	none	Snails						
Mollusca	M	Elachisina robertsoni Kay, 1979	none	none	Snails						
Mollusca	M	Pelycidion habei Kay, 1979 used to be Nanr	none	none	Snails						
Mollusca	M	Merelina hewa Kay, 1979	none	none	Snails						
Mollusca	M	Pyramidelloides suta (Pilsbry, 1921)	none	none	Snails						
Mollusca	M	Strombus helli Kiener, 1843	none	none	Snails						
Mollusca	M	Strombus vomer	none	Hawaiian Stromb	Snails						
Mollusca	M	Vanikoro imbricata Pease, 1861	none	none	Snails						
Mollusca	M	Dendropoma psarocephala Hadfield and Kay	none	none	Snails						
Mollusca	M	Dendropoma rhyssoconcha Hadfield and Ka	none	none	Snails						
Mollusca	M	Cypraea burgessi Kay, 1981	none	Burgess' Cowry	Snails						
Mollusca	M	Cribrarula gaskoini Reeve, 1846 used to be	leho	Gaskoin's Cowry	Snails						
Mollusca	M	Cypraea mauiensis Burgess, 1967	leho	Maui Cowry	Snails						
Mollusca	M	Cypraea ostergaardi Dall, 1921	leho	none	Snails						
Mollusca	M	Cypraea rashleighana Melvill, 1888	leho	Rashleigh's Cowry	Snails						
Mollusca	M	Cypraea sulcidentata Gray, 1824	leho	Groove-toothed Cowry	Snails						
Mollusca	M	Cypraea tessellata Swainson, 1822	leho	Checkered Cowry	Snails						
Mollusca	M	Cypraea tigris Linnaeus, 1758	none	Tiger cowry	Snails						
Mollusca	M	Phenacovolva lahainaensis (C.N. Cate, 1969	none	none	Snails						
Mollusca	M	Spiculata michaelkingi C.N. Cate, 1973	none	none	Snails						
Mollusca	M	Euspira sandwichensis (Dall, 1895)	none	none	Snails						
Mollusca	M	Natica sp.	none	none	Snails						
Mollusca	M	Eunaticina margaritaeformis Dall, 1924	none	none	Snails						
Mollusca	M	Bursa luteostoma (Pease, 1861)	none	none	Snails						
Mollusca	M	Phalium (Semicassis) umbilicatum (Pease, 1	none	none	Snails						
Mollusca	M	Distorsio burgessi Lewis, 1972	none	none	Snails						
Mollusca	M	Charonia tritonis (Linnaeus, 1767)	pū	Triton's trumpet	Snails						
Mollusca	M	Fusitron midwayensis Habe and Okutani, 19	none	none	Snails						
Mollusca	M	Cantharus farinosus (Gould, 1850)	none	none	Snails						
Mollusca	M	Engina albocincta Pease, 1860	none	none	Snails						
Mollusca	M	Hirtomurex goodwini Kosuge, 1988	none	none	Snails						
Mollusca	M	Latiaxis cuspidifera (Dall, 1924)	none	none	Snails						
Mollusca	M	Latirulus fasciatus Habe and Okutani, 1968	none	none	Snails						
Mollusca	M	Chicoreus insularum (Pilsbry, 1921)	none	Burnt Murex	Snails						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine

Island Distribution: Feshwater only

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Mollusca	M	Favartia garrettii (Pease, 1869)	none	none	Snails						
Mollusca	M	Trophonopsis kayae Habe, 1981	none	none	Snails						
Mollusca	M	Morula foliacea (Conrad, 1837)	none	none	Snails						
Mollusca	M	Neothais harpa (Conrad, 1837)	none	none	Snails						
Mollusca	M	Vexillum (Costellaria) cosmani Kay, 1979	none	none	Snails						
Mollusca	M	Vexillum (Costellaria) wolfei Cernohorsky,	none	none	Snails						
Mollusca	M	Vexillum (Pusia) oryzum Kay, 1979	none	none	Snails						
Mollusca	M	Harpa goodwini Rehder, 1993	none	none	Snails						
Mollusca	M	Cystiscus huna Kay, 1979	none	none	Snails						
Mollusca	M	Neocancilla waikikiensis Pilsbry, 1921	none	none	Snails						
Mollusca	M	Scabricola (Swainsonia) newcombii (Pease,	none	none	Snails						
Mollusca	M	Subcancilla foveolata (Dunker, 1858)	none	none	Snails						
Mollusca	M	Mitra (Nebularia) earlei Cernohorsky, 1977	none	none	Snails						
Mollusca	M	Oliva richerti Kay, 1979	none	none	Snails						
Mollusca	M	Olivella apicalis Kay, 1979	none	none	Snails						
Mollusca	M	Volutomitra pailoloana (J. Cate, 1963)	none	none	Snails						
Mollusca	M	Conus abbreviatus Reeve, 1843	pū pūʻalā	Abbreviated Cone	Snails						
Mollusca	M	Duplicaria gouldi	pūpū loloa, ʻoiʻoi	Gould's Auger	Snails						
Mollusca	M	Hastula inconstans (Hinds, 1844)	none	none	Snails						
Mollusca	M	Terebra castaneostriata Kosuge, 1979	none	none	Snails						
Mollusca	M	Duplicaria thaanumi Pilsbry, 1921 used to be	none	none	Snails						
Mollusca	M	Ceritoturris bittium Dall, 1924	none	none	Snails						
Mollusca	M	Clavus rissoiniformis Kay, 1979	none	none	Snails						
Mollusca	M	Clavus (Spendrillia) nodilifera (Pease, 1860)	none	none	Snails						
Mollusca	M	Clavus (Tylotiella) mighelsi Kay, 1979	none	none	Snails						
Mollusca	M	Clavus (Tylotiella) powelli Kay, 1979	none	none	Snails						
Mollusca	M	Daphnella sandwicensis Pease, 1860	none	none	Snails						
Mollusca	M	Eucyclostoma albomaculata Kay, 1979	none	none	Snails						
Mollusca	M	Kermia brunnea (Pease, 1860)	none	none	Snails						
Mollusca	M	Kermia cylindrica (Pease, 1860)	none	none	Snails						
Mollusca	M	Kermia producta Pease, 1860	none	none	Snails						
Mollusca	M	Kermia pumilla (Mighels, 1845)	none	none	Snails						
Mollusca	M	Pseudodaphnella pulchella (Pease, 1860)	none	none	Snails						
Mollusca	M	Tritonoturris paucicostata (Pease, 1860)	none	none	Snails						
Mollusca	M	Veprecula brunonia (Dall, 1924)	none	none	Snails						
Mollusca	M	Anacithara perfecta Kay, 1979	none	none	Snails						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine — *Island Distribution: Feshwater only*

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	O'ahu	Moloka'i	Lāna'i	Maui	Hawai'i
Mollusca	M	Eucithara pusilla (Pease, 1860)	none	none	Snails						
Mollusca	M	Glyphostoma hikihiki Kay, 1979	none	none	Snails						
Mollusca	M	Lienardia balteata (Pease, 1860)	none	none	Snails						
Mollusca	M	Paramontana exilis (Pease, 1860)	none	none	Snails						
Mollusca	M	Comitas oahuensis Powell, 1969	none	none	Snails						
Mollusca	M	Gemmula interpolata Powell, 1967	none	none	Snails						
Mollusca	M	Gemmula microscelida (Dall, 1895)	none	none	Snails						
Mollusca	M	Gemmula pseudomonilifera Powell, 1967	none	none	Snails						
Mollusca	M	Gemmula tessellata Powell, 1967	none	none	Snails						
Mollusca	M	Turridrupa weaveri Powell, 1967	none	none	Snails						
Mollusca	M	Lophiotoma castanella (Powell, 1964) used	none	none	Snails						
Mollusca	M	Lophiotoma cerithiformis (Powell, 1964) use	none	none	Snails						
Mollusca	M	Lophiotoma gemmuloides (Powell, 1967) us	none	none	Snails						
Mollusca	M	Evalea waikikiensis (Pilsbry, 1921)	none	none	Snails						
Mollusca	M	Herviera patricia Pilsbry, 1918	none	none	Snails						
Mollusca	M	Koloonela hawaiiensis Kay, 1979	none	none	Snails						
Mollusca	M	Miralda paulbartschi Pilsbry, 1921	none	none	Snails						
Mollusca	M	Nesiodostomia montforti Corgan, 1972	none	none	Snails						
Mollusca	M	Nesiodostomia quarta (Pilsbry, 1918)	none	none	Snails						
Mollusca	M	Nesiodostomia quinta (Pilsbry, 1944)	none	none	Snails						
Mollusca	M	Odostomia margarita Pilsbry, 1944	none	none	Snails						
Mollusca	M	Pyramidella canaliculata Sowerby, 1873	none	none	Snails						
Mollusca	M	Turbonilla thaanumi Pilsbry and Vanatta, 19	none	none	Snails						
Mollusca	M	Atys costulosa Pease, 1869	none	none	Nudibranchs						
Mollusca	M	Atys debilis Pease, 1860	none	none	Nudibranchs						
Mollusca	M	Atys kuhnsi Pilsbry, 1917	none	none	Nudibranchs						
Mollusca	M	Aglaja nuttalli Pilsbry, 1895	none	none	Nudibranchs						
Mollusca	M	Philinopsis speciosa Pease, 1860	none	Blue headshield slug	Nudibranchs						
Mollusca	M	Acteocina hawaiensis Pilsbry, 1921	none	none	Nudibranchs						
Mollusca	M	Cylichna pusilla (Pease, 1860)	none	none	Nudibranchs						
Mollusca	M	Nipponoscaphander takedai Habe, 1981	none	none	Nudibranchs						
Mollusca	M	Scaphander alatus Dall, 1895	none	none	Nudibranchs						
Mollusca	M	Scaphander pustulosus Dall, 1895	none	none	Nudibranchs						
Mollusca	M	Pleurobranchus violaceus Pease, 1864	none	none	Nudibranchs						
Mollusca	M	Lophocercus krohnii A. Adams, 1855	none	none	Nudibranchs						
Mollusca	M	Volvatella fragilis Pease, 1860	none	none	Nudibranchs						

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Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	O'ahu	Moloka'i	Lāna'i	Maui	Hawai'i
Mollusca	M	Berthelinia pseudochloris Kay, 1964	none	none	Nudibranchs						
Mollusca	M	Branchophyllum pellucida (Pease, 1860)	none	none	Nudibranchs						
Mollusca	M	Elysia degenera Ostergaard, 1955	none	none	Nudibranchs						
Mollusca	M	Elysia nealae Ostergaard, 1955	none	none	Nudibranchs						
Mollusca	M	Glossodoris poliahu Bertsch and Gosliner, 19	none	Snow-Goddess Nudibranch	Nudibranchs						
Mollusca	M	Hypselodoris alboterminata	none	none	Nudibranchs						
Mollusca	M	Hypselodoris peasei now not andersoni	none	Anderson's Nudibranch	Nudibranchs						
Mollusca	M	Hypselodoris bertschi (Eydoux and Souleyet	none	none	Nudibranchs						
Mollusca	M	Hypselodoris insulana	none	none	Nudibranchs						
Mollusca	M	Hypselodoris paulinae	none	none	Nudibranchs						
Mollusca	M	Hypselodoris violabranchia	none	none	Nudibranchs						
Mollusca	M	Thorunna kahuna	none	none	Nudibranchs						
Mollusca	M	Archidoris hawaiiensis Kay and Young, 196	none	none	Nudibranchs						
Mollusca	M	Peltodoris fellowsi Kay and Young, 1969	none	Fellow's nudibranch	Nudibranchs						
Mollusca	M	Thordisa setosa (Pease, 1860)	none	none	Nudibranchs						
Mollusca	M	Doriorbis nucleola (Pease, 1860)	none	none	Nudibranchs						
Mollusca	M	Ardeadoris scottjohnsoni Bertsch and Goslin	none	Scott Johnson's Nudibranch	Nudibranchs						
Mollusca	M	Halgerda terramtuentis	none	Gold Lace Nudibranch	Nudibranchs						
Mollusca	M	Halgerda paliensis used to be Sclerodoris	none	Pali Nudibranch	Nudibranchs						
Mollusca	M	Sclerodoris sp. (2 spp.)	none	none	Nudibranchs						
Mollusca	M	Jorunna alisonae Marcus, 1976	none	none	Nudibranchs						
Mollusca	M	Trippa echinata (Pease, 1860)	none	none	Nudibranchs						
Mollusca	M	Trippa scabriuscula (Pease, 1860)	none	none	Nudibranchs						
Mollusca	M	Hexabranchus aureomarginatus Ostergaard,	none	none	Nudibranchs						
Mollusca	M	Hexabranchus pulchellus Pease, 1860	none	none	Nudibranchs						
Mollusca	M	Dermatobranchus rubida Gould, 1852	none	none	Nudibranchs						
Mollusca	M	Tritonia hawaiiensis Pease, 1860	none	none	Nudibranchs						
Mollusca	Supr	Allochroa bronni (Philippi, 1846)	none	none	Snails						
Mollusca	Supr	Blauneria gracilis Pease, 1860 ?	none	none	Snails						
Mollusca	Supr	Pedipes sandwicensis Pease, 1860	none	none	Snails						
Mollusca	M	*Microliotia hawaiiensis Kase*	none	none	Snails						

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Habitat: F = Freshwater, A = Anchialine, M = Marine — *Island Distribution: Feshwater only*

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	O'ahu	Moloka'i	Lāna'i	Maui	Hawai'i
Mollusca	M	Amygdalum newcombi (Dall, Bartsch, and F	none	none	Bivalves						
Mollusca	M	Brachidontes crebristriatus (Conrad, 1837)	nahawele li'i li'i	Hawaiian Mussel	Bivalves						
Mollusca	M	Lithophaga fasciola Dall, Bartsch, and Rehd	none	none	Bivalves						
Mollusca	M	Musculus aviarius Dall, Bartsch, and Rehder	none	none	Bivalves						
Mollusca	M	Septifer rudis Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M	Stenolena hawaiensis Dall, Bartsch, and Reh	none	none	Bivalves						
Mollusca	M	Terua pacifica Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M	Glycymeris arcodentiens (Dall, 1895)	none	none	Bivalves						
Mollusca	M	Glycymeris diomedea Dall, Bartsch, and Rel	none	none	Bivalves						
Mollusca	M	Glycymeris kauaia Dall, Bartsch, and Rehde	none	none	Bivalves						
Mollusca	M	Glycymeris kona Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Glycymeris molokaia Dall, Bartsch, and Reh	none	none	Bivalves						
Mollusca	M	Glycymeris nux Dall, Bartsch, and Rehder, 1	none	none	Bivalves						
Mollusca	M	Bathyarca pisum Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Arca kauaia (Dall, Bartsch, and Rehder, 193	none	none	Bivalves						
Mollusca	M	Barbatia hiloa Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M	Barbatia molokaia Dall, Bartsch, and Rehder	none	none	Bivalves						
Mollusca	M	Barbatia nuttingi (Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Isognomon californicum (Conrad, 1837)	nahawele	Black Purse Shell	Bivalves						
Mollusca	M	Neoaviculovulsa coralicola Okutani and Kus	none	none	Bivalves						
Mollusca	M	Pinctada margaritifera (Linnaeus, 1758)	pa	Black-lipped pearl oyster	Bivalves						
Mollusca	M	Pteria brunnea (Pease, 1836)	none	Winged Pearl Oyster	Bivalves						
Mollusca	M	Lima hawaiana Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M	Lima keokea Dall, Bartsch, and Rehder, 193	none	none	Bivalves						
Mollusca	M	Lima lahaina Dall, Bartsch, and Rehder, 193	none	none	Bivalves						
Mollusca	M	Lima parallela Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M/F	Dendostrea sandvicensis (Sowerby, 1871) O	none	Hawaiian Oyster	Hawaiian Oyster						
Mollusca	M	Dimya mimula Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M	Dimya molokaia Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Chlamys alii Dall, Bartsch, and Rehder, 193	none	none	Bivalves						
Mollusca	M	Chlamys kauaensis Dall, Bartsch, and Rehde	none	none	Bivalves						
Mollusca	M	Haumea juddi Dall, Bartsch, and Rehder, 19	none	Judd's Scallop	Bivalves						
Mollusca	M	Propeamussium diomedeum Dall, Bartsch, a	none	none	Bivalves						
Mollusca	M	Propeamussium kauaium Dall, Bartsch, and	none	none	Bivalves						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Mollusca	M	Propeamussium molokaium Dall, Bartsch, a	none	none	Bivalves						
Mollusca	M	Propeamussium nesiotum Dall, Bartsch, and	none	none	Bivalves						
Mollusca	M	Anomia tyria Reeve, 1859	none	none	Bivalves						
Mollusca	M	Anisodonta angulata Dall, Bartsch, and Reh	none	none	Bivalves						
Mollusca	M	Hitia ovalis Dall, Bartsch, and Rehder, 1938	none	none	Bivalves						
Mollusca	M	Ctena transversa Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Pillucina hawaiiensis (Smith, 1885)	none	none	Bivalves						
Mollusca	M	Gastrochaena (Rocellaria) kanaka Dall, Bart	none	none	Bivalves						
Mollusca	M	Teredo oahuensis Edmondson, 1942	none	none	Bivalves						
Mollusca	M	Gouldia cookei (Dall, Bartsch, and Rehder, 1	none	none	Bivalves						
Mollusca	M	Leiochasmea thaanumi (Pilsbry, 1921)	none	none	Bivalves						
Mollusca	M	Scintilla hiloa Dall, Bartsch, and Rehder, 19	none	none	Bivalves						
Mollusca	M	Kellia hawaiensis Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Kellia rosea (Dall, Bartsch, and Rehder, 193	none	none	Bivalves						
Mollusca	M	Kona symmetrica (Pilsbry, 1921)	none	none	Bivalves						
Mollusca	M	Lasea hawaiensis Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Cardita thaanumi Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Carditella hawaiensis Dall, Bartsch, and Reh	none	none	Bivalves						
Mollusca	M	Solecurtus baldwini Dall, Bartsch, and Rehd	none	none	Bivalves						
Mollusca	M	Lonoa hawaiensis Dall, Bartsch, and Rehder	none	none	Bivalves						
Mollusca	M	Macoma (Scissulina) obliquilineata (Gould,	none	none	Bivalves						
Mollusca	M	Tellina (Angulus) hawaiensis Dall, Bartsch,	none	none	Bivalves						
Mollusca	M	Tellina (Cadella) oahuana Dall, Bartsch, and	none	none	Bivalves						
Mollusca	M	Mactra thaanumi Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Cuspidaria dispar Dall, Bartsch, and Rehder,	none	none	Bivalves						
Mollusca	M	Cuspidaria hawaiensis Dall, Bartsch, and Re	none	none	Bivalves						
Mollusca	M	Cuspidaria pailoloana Dall, Bartsch, and Reh	none	none	Bivalves						
Mollusca	M	Poromya transversa Dall, Bartsch, and Rehd	none	none	Bivalves						
Mollusca	M	Euciroa pacifica Dall, 1895	none	none	Bivalves						
Mollusca	M	Halicardia gouldia Dall, Bartsch, and Rehde	none	none	Bivalves						
Mollusca	M	Policordia diomedea Dall, Bartsch, and Reh	none	none	Bivalves						
Mollusca	M	Nucula hawaiensis Pilsbry, 1921	none	none	Bivalves						
Mollusca	M	Lyonsia oahuensis Dall, Bartsch, and Rehde	none	none	Bivalves						
Mollusca	M	Propeamussium paiololoum Dall, Bartsch, a	none	none	Bivalves						
Mollusca	M	Gastrochaena (Rocellaria) oahuana Dall, Ba	none	none	Bivalves						
Mollusca	M	Cardita excisa Philippi, 1847	none	none	Bivalves						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Cephalopods	M	Octopus hawaiiensis Souleyet, 1852	he'e	Hawaiian Octopus Hawaiian Bobtail	Cephalopods						
Cephalopods	M	Euprymna scolopes Berry, 1913	mū he'e	Squid	Cephalopods						
Tardigrada	M	Echiniscus sp. -	none	none	Tardigrada						
Tardigrada	M	Echiniscus marginatus Binda and Pilato	none	none	Tardigrada						
Tardigrada	M	Ramazzottius horningi Binda and Pilato	none	none	Tardigrada						
Crustaceans	M	Gorgonolaureus muzikae Grygier, 1981	none	none	Other Crustaceans						
Crustaceans	M	Koleolepas tinkeri Edmondson, 1951	none	none	Other Crustaceans						
Crustaceans	M	Griceus buskeyi Ferrari and Markhaseva 200	none	none	Copepods						
Crustaceans	M	Leptocaris itoi Kunz, 1994	none	none	Copepods						
Crustaceans	M	Leptocaris noodti Kunz, 1994	none	none	Copepods						
Crustaceans	M	Haplostomides hawaiiensis Ooishi, 1994	none	none	Copepods						
Crustaceans	M	Jusheyhoea moseri Kabata, 1991	none	none	Copepods						
Crustaceans	M	Anuretes menehune Lewis, 1964	none	none	Copepods						
Crustaceans	M	Dolerocypria minutissima Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Cobanocythere konensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Paracobanocythere hawaiiensis Gottwald, 19	none	none	Ostracods						
Crustaceans	M	Aglaiocypris mauiensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Paradoxostoma kauaiensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Paradoxostoma kunzi Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Parvocythere mauiensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Polycope hawaiiensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Psammocythere hawaiiensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Xestoleberis hawaiiensis Hartmann, 1991	none	none	Ostracods						
Crustaceans	M	Microasteropteron youngi Kornicker, 1976	none	none	Ostracods						
Crustaceans	M	Ancohenia hawaiiensis Kornicker, 1976	none	none	Ostracods						
Crustaceans	M	Sarsiella janiceae Kornicker, 1976	none	none	Ostracods						
Crustaceans	F	Heterocypris makua (Tressler, 1937)	none	none	Ostracods						
Crustaceans	M	Anoropallene laysani Child, 1972	none	none	Pycnogonid						
Crustaceans	M	Paravisquilla sinuosa (Edmondson, 1921)	none	none	Other Crustaceans						
Crustaceans	M	Alima maxima Ahyong 2002	none	none	Other Crustaceans						
Crustaceans	M	Pseudosquillisma guttata (Manning, 1972)	none	none	Other Crustaceans						
Crustaceans	M	Anisomysis extranea -	none	none	Other Crustaceans						
Crustaceans	M	Anisomysis hawaiiensis -	none	none	Other Crustaceans						
Crustaceans	M	Ampelisca hawaiiensis Goeke, 1985	none	none	Other Crustaceans						
Crustaceans	M	Amphilocus kailua Barnard, 1970	none	none	Other Crustaceans						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Crustaceans	M	Gitana liliuokalaniae Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Gitanopsis pele Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Mokuoloe ninole Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Ampithoe akuolaka Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Cymadusa hawaiensis (Schellenberg, 1938)	none	none	Other Crustaceans						
Crustaceans	M	Cymadusa oceanica Barnard, 1955	none	none	Other Crustaceans						
Crustaceans	M	Aloiloi nenue Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Aoroides nahili Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Bemlos intermedius Schellenberg, 1938	none	none	Other Crustaceans						
Crustaceans	M	Bemlos pualani Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Bemlos waipio Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Grandidierella makena (Barnard, 1970)	none	none	Other Crustaceans						
Crustaceans	M	Konatopus paao Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Colomastix kapiolani Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Atylus (Kamehatylus) nani Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Paradexamine (Wailele) maunaloa Barnard,	none	none	Other Crustaceans						
Crustaceans	M	Elasmopus calliactis Edmondson, 1951	none	none	Other Crustaceans						
Crustaceans	M	Elasmopus diplonyx Schellenberg, 1938	none	none	Other Crustaceans						
Crustaceans	M	Eriopisa hamakua Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Eriopisa laakona Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Eriopisella schellensis upolu Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Melita pahuwai Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Gammaropsis alamoana Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Gammaropsis haleiwa Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Gammaropsis kaumaka Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Gammaropsis pali Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Ischyrocerus oahu Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Leucothoe lihue Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Liljeborgia heeia Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Lysianassa ewa Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Ochlesis alii Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Kanaloa manoa Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Palinnotus alaniphlias Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Mandibulophoxus hawaiiloa Muir & DeFeli	none	none	Other Crustaceans						
Crustaceans	M	Paraphoxus centralis Schellenberg, 1938	none	none	Other Crustaceans						
Crustaceans	M	Parapleustes honomu Barnard, 1970	none	none	Other Crustaceans						

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Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Crustaceans	M	Laetmatophilus hala Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Podocerus hanapepe Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Podocerus talegus lawai (Barnard, 1970)	none	none	Other Crustaceans						
Crustaceans	M	Seba ekepuu Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Stenothoe haleloke Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Hyale ayaeli Barnard, 1955	none	none	Other Crustaceans						
Crustaceans	M	Hyale iole Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Hyale waimea Barnard, 1970	none	none	Other Crustaceans						
Crustaceans	M	Amakusanthura inornata (Miller and Menzie	none	none	Other Crustaceans						
Crustaceans	M	Mesanthura hieroglyphica Miller and Menzi	none	none	Other Crustaceans						
Crustaceans	M	Paranthura bellicauda Miller and Menzies, 1	none	none	Other Crustaceans						
Crustaceans	M	Paranthura ostergaardi Miller and Menzies, 1	none	none	Other Crustaceans						
Crustaceans	M	Aega quadratasinus Richardson, 1906	none	none	Other Crustaceans						
Crustaceans	M	Creniola breviceps (Schiodte & Meinert)	none	none	Other Crustaceans						
Crustaceans	M	Ichthyoxenus puhi (Bowman, 1960)	none	none	Other Crustaceans						
Crustaceans	M	Cymodocella hawaiiensis Bruce, 1994	none	none	Other Crustaceans						
Crustaceans	M	Hawaianira peleae Miller, 1967	none	none	Other Crustaceans						
Crustaceans	M	Jaeropsis hawaiiensis Miller, 1941	none	none	Other Crustaceans						
Crustaceans	M	Munna acarina Miller, 1941	none	none	Other Crustaceans						
Crustaceans	M	Stenetrium medipacificum Miller, 1941	none	none	Other Crustaceans						
Crustaceans	M	Colidotea edmondsoni Miller, 1940	none	none	Other Crustaceans						
Crustaceans	M	Gigantione hawaiiensis Danforth, 1967	none	none	Other Crustaceans						
Crustaceans	M	Ionella murchisoni Danforth, 1970	none	none	Other Crustaceans						
Crustaceans	M	Scyracepon hawaiiensis Richardson, 1910	none	none	Other Crustaceans						
Crustaceans	M	Faba glabra Nierstrasz and Brender a Brandi	none	none	Other Crustaceans						
Crustaceans	M	Gorgoniscus incisodactylus Grygier, 1981	none	none	Other Crustaceans						
Crustaceans	M	Zonophryxus retrodens Richardson, 1906	none	none	Other Crustaceans						
Crustaceans	M	Ligia hawaiiensis Dana, 1853	none	none	Other Crustaceans						
Crustaceans	M	Ligia kauaiensis Edmondson, 1931	none	none	Other Crustaceans						
Crustaceans	M	Littorophiloscia hawaiiensis Taiti & Ferrara,	none	none	Other Crustaceans						
Crustaceans	M	Apseudes tropicalis Miller, 1940	none	none	Other Crustaceans						
Crustaceans	M	Apseudomorpha oahuensis Miller, 1940	none	none	Other Crustaceans						
Crustaceans	M	Hodometrica prolixa Miller, 1940	none	none	Other Crustaceans						
Crustaceans	M	Parapseudes neglectus Miller, 1940	none	none	Other Crustaceans						
Crustaceans	M	Synapseudes minutus Miller, 1940	none	none	Other Crustaceans						
Bryozoa	M	Rhynchozoon tuberosum (Canu and Bassler,	none	none	Misc. Filter Feeders						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Bryozoa	M	Immergentia angulata Soule and Soule, 1969	none	none	Misc. Filter Feeders						
Bryozoa	M	Celleporaria honoluensis (Busk, 1884) used	none	none	Misc. Filter Feeders						
Bryozoa	M	Terebripora varians Soule and Soule, 1969	none	none	Misc. Filter Feeders						
Bryozoa	M	Cosciniopsis fusca Canu and Bassler, 1927	none	none	Misc. Filter Feeders						
Bryozoa	M	Mucropetraliella albirostris (Canu and Bassl	none	none	Misc. Filter Feeders						
Bryozoa	M	Mucropetraliella magnifica (Busk, 1884)	none	none	Misc. Filter Feeders						
Bryozoa	M	Rhynchozoon nudum (Canu and Bassler, 19	none	none	Misc. Filter Feeders						
Bryozoa	M	Hemismittoidea corallinea Soule and Soule,	none	none	Misc. Filter Feeders						
Bryozoa	M	Hemismittoidea osburni Soule and Soule, 19	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina alanbanneri Soule and Soule, 1	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina circularis Soule and Soule, 197	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina emersoni Soule and Soule, 197	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina ilioensis Soule and Soule, 1973	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina kauaiensis Soule and Soule, 19	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina leviavicularia Soule and Soule,	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina marsupialis (Busk, 1884)	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina parviuncinata Soule and Soule,	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina raigiformis Soule and Soule, 19	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina sp. -	none	none	Misc. Filter Feeders						
Bryozoa	M	Parasmittina uncinata Soule and Soule, 1973	none	none	Misc. Filter Feeders						
Bryozoa	M	Pleurocodonellina lahainae Soule and Soule,	none	none	Misc. Filter Feeders						
Bryozoa	M	Smittina kukuiula Soule and Soule, 1973	none	none	Misc. Filter Feeders						
Bryozoa	M	Thalamoporella delicata Soule and Soule, 19	none	none	Misc. Filter Feeders						
Bryozoa	M	Thalamoporella molokaiensis Soule, Soule &	none	none	Misc. Filter Feeders						
Bryozoa	M	Thalamoporella verrilli Soule and Soule, 197	none	none	Misc. Filter Feeders						
Bryozoa	M	Antropora levigata Canu and Bassler, 1927 u	none	none	Misc. Filter Feeders						
Bryozoa	M	Penetrantia operculata Soule and Soule, 196	none	none	Misc. Filter Feeders						
Bryozoa	M	Crisiona baculifera (Canu and Bassler, 1927	none	none	Misc. Filter Feeders						
Brachiopoda	M	Lingula reevii Davidson, 1880	none	none	Misc. Filter Feeders						
Crustaceans	M	Metapenaeopsis sp. -	none	Bicolor Sand Shrimp	Other Crustaceans						
Crustaceans	M	Sicyonia longicauda Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Stenopus earlei Goy and Randall, 1984	none	Earle's Coral Shrimp	Other Crustaceans						
Crustaceans	M	Spongicola henshawi Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Spongicoloides hawaiiensis Baba, 1983	none	none	Other Crustaceans						
Crustaceans	M	Oplophorus foliaceus Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Pasiphaea truncata Rathbun, 1906	none	none	Other Crustaceans						

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Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	O'ahu	Moloka'i	Lāna'i	Maui	Hawai'i
Crustaceans	M	Cinetorhynchus hawaiiensis Okuno & Hoov	none	Hawaiian Hinge-Beak Shrimp	Other Crustaceans						
Crustaceans	M	Cinetorhynchus hendersoni (Kemp, 1925)	none	Henderson's Hinge Beaked Shrimp	Other Crustaceans						
Crustaceans	M	Rhynchocinetes rathbunae Okuno, 1996	none	Rathbun's hinge beaked shrimp	Other Crustaceans						
Crustaceans	M	Gnathophyllum precipuum Titgen, 1989	none	Hawaiian Cave Shrimp	Other Crustaceans						
Crustaceans	M	Levicaris mammillata (Edmondson, 1931)	none	Red Pencil Urchin Shrimp	Other Crustaceans						
Crustaceans	M	Hymenocera picta Dana, 1852	none	Harlequin shrimp	Other Crustaceans						
Crustaceans	M	Leptalpheus pacificus Banner & Banner, 197	none	none	Other Crustaceans						
Crustaceans	M	Metalpheus hawaiiensis (Edmondson, 1925)	none	none	Other Crustaceans						
Crustaceans	M	Salmoneus mauiensis (Edmondson, 1930)	none	none	Other Crustaceans						
Crustaceans	M	Processa hawaiensis (Dana,)	none	none	Other Crustaceans						
Crustaceans	M	Heterocarpus signatus Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Pontophilus modumanuensis Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Axiopsis (Axiopsis) irregularis (Edmondson	none	none	Other Crustaceans						
Crustaceans	M	Prosthonocaris rudis (Rathbun, 1906) used t	none	none	Other Crustaceans						
Crustaceans	M	Axius (Eiconaxius) asper -Rathbun 1906	none	none	Other Crustaceans						
Crustaceans	M	Axius (Paraxius) tridens - Rathbun 1906	none	none	Other Crustaceans						
Crustaceans	M	Callianassa (Callichirus) articulata Rathbun,	none	none	Other Crustaceans						
Crustaceans	M	Homeryon asper Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Pentacheles snyderi Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Panulirus marginatus (Quoy & Gaimard, 182	ula poni	black leg spiny lobster	Other Crustaceans						
Crustaceans	M	Aniculus hopperae McLaughlin & Hoover, 1	Unauna	Hopper's Hermit Crab	Other Crustaceans						
Crustaceans	M	Ciliopagurus hawaiiensis (McLaughlin & Ba	none	none	Other Crustaceans						
Crustaceans	M	Catapaguroides setosus (Edmondson, 1951)	none	none	Other Crustaceans						
Crustaceans	M	Catapaguroides hooveri McLaughlin and Pitt	none	none	Other Crustaceans						
Crustaceans	M	Catapagurus granulatus Edmondson, 1951	none	none	Other Crustaceans						
Crustaceans	M	Micropagurus devaneyi McLaughlin, 1986	none	none	Other Crustaceans						
Crustaceans	M	Nanopagurus reesei McLaughlin, 1986	none	none	Other Crustaceans						
Crustaceans	M	Pygmaeopagurus hadrochirus McLaughlin, 1	none	none	Other Crustaceans						
Crustaceans	M	Sympagurus pacificus Edmondson, 1925	none	none	Other Crustaceans						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Crustaceans	M	Pseudomunida fragilis Haig, 1979	none	none	Other Crustaceans						
Crustaceans	M	Munida hawaiiensis Baba, 1981	none	none	Other Crustaceans						
Crustaceans	M	Pachycheles attaragos Harvey & de Santo, 1	none	none	Other Crustaceans						
Crustaceans	M	Albunea danai Boyko, 1999	none	none	Other Crustaceans						
Crustaceans	M	Dromia dormia (Linnaeus, 1763)	makua-o-ka-lipoa	Sleepy Sponge Crab	Other Crustaceans						
Crustaceans	M	Cyrtomaia lamellata Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Oxypleurodon carbunculus Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Calappa pokipoki Ng 2000	pokipkoi	none	Other Crustaceans						
Crustaceans	M	Ebalia jordani Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Heteronucia spinifera Edmondson, 1951	none	none	Other Crustaceans						
Crustaceans	M	Oreotlos angulatus (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Randallia gilberti Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Cyclograpsus henshawi Rathbun, 1902	none	none	Other Crustaceans						
Crustaceans	M	Labuanium rotundatum Hess , 1865	none	none	Other Crustaceans						
Crustaceans	M	Garthambrus complanata (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Garthambrus lacunosa (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Parthenope (Platylambrus) nummifera Rathb	none	none	Other Crustaceans						
Crustaceans	M	Progeryon mus Ng & Guinot, 1999	none	none	Other Crustaceans						
Crustaceans	M	Carpilius maculatus (Linnaeus, 1758)	ʻalakuma	7-11 crab	Other Crustaceans						
Crustaceans	M	Carcinoplax cooki Rathbun , 1906	none	none	Other Crustaceans						
Crustaceans	M	Pilumnus acutifrons Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Pilumnus nuttingi Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Pilumnus taeniola Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Liomera medipacificus Edmondson, 1951	none	none	Other Crustaceans						
Crustaceans	M	Liomera supernodosa Rathbun, 1906	none	Knotted Liomera	Other Crustaceans						
Crustaceans	M	Liomera virgata (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Lybia edmondsoni Takeda and Miyake, 197(	kū mimi pua	Hawaiian Pom-Pom Crab	Other Crustaceans						
Crustaceans	M	Macromedaeus lacunosus Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Nanocassiope sexlobata Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Neoliomera praetexta (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Neoxanthops angustus (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Paractaea garretti (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Platypodia hawaiiensis (Rathbun, 1906)	none	none	Other Crustaceans						
Crustaceans	M	Xanthias flavescens Rathbun, 1906	none	none	Other Crustaceans						
Crustaceans	M	Xanthias glabrous Edmondson, 1951	none	none	Other Crustaceans						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Echinodermata	M	Amphiophiura insolita (Koehler, 1904)	none	none	Echinoderms						
Echinodermata	M	Lovenia subcarinata Gray, 1845	none	none	Echinoderms						
Echinodermata	M	Glyptometra lateralis (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Cosmiometra crassicirra (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Cosmiometra delicata (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Oceanometra gigantea (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Parametra fisheri (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Stiremetra decora Clark, 1950	none	none	Echinoderms						
Echinodermata	M	Thalassometra hawaiiensis (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Argyrometra crispa (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Psathyrometra congesta Clark, 1908	none	none	Echinoderms						
Echinodermata	M	Sarametra triserialis (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Trichometra vexator Clark, 1908	none	none	Echinoderms						
Echinodermata	M	Atelecrinus conifer Clark, 1908	none	none	Echinoderms						
Echinodermata	M	Thaumatocrinus rugosus (Clark, 1908)	none	none	Echinoderms						
Echinodermata	M	Astropecten hawaiiensis Doderlein, 1917	none	none	Echinoderms						
Echinodermata	M	Astropecten productus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Astropecten pusillulus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Astropectinides callistus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Astropectinides ctenophora Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Ctenophoraster hawaiiensis Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Dipsacaster nesiotes Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Patagiaster nuttingi Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Peresphonaster cingulatus cingulatus (Fisher	none	none	Echinoderms						
Echinodermata	M	Psilaster attenuatus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Tritonaster craspedotus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Luidia hystirx Fisher, 1906	la kai, pe a	none	Echinoderms						
Echinodermata	M	Luidia magnifica Fisher, 1906	none	Magnificent Star	Echinoderms						
Echinodermata	M	Cheiraster (Cheiraster) inops Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Cheiraster (Cheiraster) snyderi Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Cheiraster (Christopheraster) horridus Fisher	none	none	Echinoderms						
Echinodermata	M	Anseropoda insignis Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Asterodiscides tuberculosus (Fisher, 1906)	none	Toenail Star	Echinoderms						
Echinodermata	M	Antheniaster epixanthus (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Astroceramus callimorphus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Calliaster pedicellaris Fisher, 1906	none	none	Echinoderms						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Echinodermata	M	Calliderma spectabilis Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Ceramaster bowersi (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Evoplosoma forcipifera Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Gilbertaster anacanthus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Mediaster ornatus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Peltaster micropeltus (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Pseudarchaster jordani Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Sphaeriodiscus ammophilus (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Pentaceraster hawaiiensis (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Tamaria scleroderma (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Tamaria tenella (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Asthenactis papyraceus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Benthaster eritimus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Hymenaster pentagonalis Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Pteraster reticulatus Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Sclerasterias euplecta (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Tarsastrocles verrilli (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Brisinga alberti Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Brisinga evermanni Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Brisinga panopla Fisher, 1906	none	none	Echinoderms						
Echinodermata	M	Hymenodiscus fragilis (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Novodinia pacifica (Fisher, 1906)	none	none	Echinoderms						
Echinodermata	M	Asteroschema ajax Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Asteroschema edmondsoni Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiopeza clarki Ely, 1942	none	none	Echinoderms						
Echinodermata	M	Ophiomusium elii Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiomusium zela Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiura fisheri Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiura ursula Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophioleila elegans Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiomoeris inflata Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophionereis degeneri (Clark, 1949)	none	none	Echinoderms						
Echinodermata	M	Ophioplax melite Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Amphioplus caelatus Ely, 1942	none	none	Echinoderms						
Echinodermata	M	Amphioplus cythera Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Amphiura dino Clark, 1949	none	none	Echinoderms						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Echinodermata	M	Amphiura immira Ely, 1942	none	none	Echinoderms						
Echinodermata	M	Histampica cythera (Clark, 1949)	none	none	Echinoderms						
Echinodermata	M	Ophiactis astarte (Clark, 1949)	none	none	Echinoderms						
Echinodermata	M	Ophiactis lethe Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiactis lycidas (Clark, 1949)	none	none	Echinoderms						
Echinodermata	M	Ophiacantha dumosa Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiologimus quadrispinus Clark, 1925	none	none	Echinoderms						
Echinodermata	M	Ophiomitra semele Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophioplinthaca athena Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophioplinthaca clothilde Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Ophiothamnus otho Clark, 1949	none	none	Echinoderms						
Echinodermata	M	Actinocidaris thomasi (Agassiz and Clark, 19	none	Thomas's Sea Urchin	Echinoderms						
Echinodermata	M	Histocidaris variabilis (Agassiz and Clark, 19	ha'ue'ue, peni	none	Echinoderms						
Echinodermata	M	Prionocidaris hawaiiensis (Agassiz and Clarl	none	none	Echinoderms						
Echinodermata	M	Stereocidaris leucacantha Agassiz and Clark,	none	none	Echinoderms						
Echinodermata	M	Stylocidaris calacantha (Agassiz and Clark, 1	none	none	Echinoderms						
Echinodermata	M	Sperosoma obscurum Agassiz and Clark, 19(	none	none	Echinoderms						
Echinodermata	M	Aspidodiadema arcitum Mortensen, 1939	none	none	Echinoderms						
Echinodermata	M	Centrostephanus asteriscus Agassiz and Clar	none	none	Echinoderms						
Echinodermata	M	Chaetodiadema pallidum Agassiz and Clark,	none	none	Echinoderms						
Echinodermata	M	Lissodiadema purpureum (Agassiz and Clark	none	Fine-Spined Urchin	Echinoderms						
Echinodermata	M	Caenopedina hawaiiensis Clark, 1912	none	none	Echinoderms						
Echinodermata	M	Salenocidaris crassispina Agassiz and Clark,	none	none	Echinoderms						
Echinodermata	M	Podocidaris ornata Clark, 1912	none	none	Echinoderms						
Echinodermata	M	Prionechinus depressus Agassiz and Clark, 1	none	none	Echinoderms						
Echinodermata	M	Prionechinus sculptus Agassiz and Clark, 19	none	none	Echinoderms						
Echinodermata	M	Temnotrema hawaiiense (Agassiz and Clark,	none	none	Echinoderms						
Echinodermata	M	Micropetalon purpureum Agassiz and Clark,	none	none	Echinoderms						
Echinodermata	M	Clypeaster (Rhaphidoclypus) lytopetalus Ag	none	none	Echinoderms						
Echinodermata	M	Clypeaster (Stolonoclypus) leptostracon Aga	none	none	Echinoderms						
Echinodermata	M	Echinocyamus megapetalus Clark, 1914	none	none	Echinoderms						
Echinodermata	M	Peronella strigata (Agassiz and Clark, 1907)	none	none	Echinoderms						
Echinodermata	M	Aceste ovata Agassiz and Clark, 1907	none	none	Echinoderms						
Echinodermata	M	Phrissocystis multispina Agassiz and Clark,	none	none	Echinoderms						
Echinodermata	M	Pycnolampas oviformis Agassiz and Clark, 1	none	none	Echinoderms						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					*Island Distribution: Feshwater only*					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Echinodermata	M	Hypselaster maximus (Agassiz and Clark, 19	none	none	Echinoderms						
Echinodermata	M	Eupatagus obscurus (Agassiz and Clark, 190	none	none	Echinoderms						
Echinodermata	M	Rhinobrissus placopetalus Agassiz and Clark	none	none	Echinoderms						
Echinodermata	M	Lovenia grisea Agassiz and Clark, 1907	none	none	Echinoderms						
Echinodermata	M	Lovenia hawaiiensis Mortensen, 1950	none	Hawaiian Lovenia	Echinoderms						
Echinodermata	M	Pseudolovenia hirsuta Agassiz and Clark, 19	none	none	Echinoderms						
Echinodermata	M	Psolus macrolepis Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Thyonidium alexandri Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Thyonidium hawaiiense Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Holothuria (Stauropora) anulifera Fisher, 19	none	none	Echinoderms						
Echinodermata	M	Holothuria kapiolaniae Bell, 1887	none	none	Echinoderms						
Echinodermata	M	Stichopus n.sp. -	none	none	Echinoderms						
Echinodermata	M	Stichopus sp.1 -	none	Hawaiian Spiny Sea Cucumber	Echinoderms						
Echinodermata	M	Stichopus sp.2 -	none	Hawaiian Yellow-tip Sea Cucumber	Echinoderms						
Echinodermata	M	Mesothuria carnosa Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Laetmogone biserialis Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Laetmogone sp. Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Orphnurgus insignis Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Scotodeima vitreum Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Anapta inermis Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Chiridota hawaiiensis Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Chiridota uniserialis Fisher, 1907	none	none	Echinoderms						
Echinodermata	M	Protankyra albatrossi Fisher, 1907	none	none	Echinoderms						
Ascidians	M	Didemnum elikapekae Eldredge, 1967	none	none	Misc. Filter Feeders						
Ascidians	M	Leptoclinides hawaiiensis Tokioka, 1967	none	none	Misc. Filter Feeders						
Ascidians	M	Tridemnum profundum (Sluiter, 1909)	none	none	Misc. Filter Feeders						
Ascidians	M	Eudistoma austerum Hartmeyer, 1909	none	none	Misc. Filter Feeders						
Ascidians	M	Eudistoma fusca Sluiter, 1900	none	none	Misc. Filter Feeders						
Ascidians	M	Eudistoma parva (Sluiter, 1900)	none	none	Misc. Filter Feeders						
Ascidians	M	Aplidium sp.1 -	none	Gold Ring Aplidium	Misc. Filter Feeders						
Ascidians	M	Ecteinascidia diligens Sluiter, 1900	none	none	Misc. Filter Feeders						
Ascidians	M	Eusynstyela transversalis Tokioka, 1963	none	none	Misc. Filter Feeders						
Ascidians	M	Microcosmus miniaceus Sluiter, 1900	none	none	Misc. Filter Feeders						
Mollusca	M	*Acanthochiton viridis*	kuakulu	Green Chiton	Chitons						

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Mollusca	M	*Ischnochiton petaloides*	pupu mo'o	Flat Chiton	Chitons						
Mollusca	M	*Acanthochiton armata*	none	none	Chitons						
Mollusca	M	*Chaetoderma hawaiiensis*	none	none	Chitons						
Mollusca	M	*Drepanomenia vampyrella*	none	none	Chitons						
Mollusca	M	*Proneomenia insularis*	none	none	Chitons						
Mollusca	M	*Proneomenia hawaiiensis*	none	none	Chitons						
Mollusca	M	*Strophomenia scandens*	none	none	Chitons						
Mollusca	M	*Lophomenia spiralis*	none	none	Chitons						
Algae	F	*Batrachospermum spermatiophorum*	none	none	none						
Algae	F	*Cladophora longiarticulata var. valida*	none	none	none						
Algae	F	*Conferva sandvicensis*	none	none	none						
Algae	F	*Cosmarium depauperatum*	none	none	none						
Algae	F	*Eunotia abbottiae*	none	none	none						
Algae	F	*Eunotia smithiae*	none	none	none						
Algae	F	*Frustulia creuzburgensis*	none	none	none						
Algae	F	*Haematococcus thermalis*	none	none	none						
Algae	F	*Lophopodium sandvicense*	none	none	none						
Algae	F	*Lyngbya cladophorae*	none	none	none						
Algae	F	*Micrasterias adscendens*	none	none	none						
Algae	F	*Navicula genustriata*	none	none	none						
Algae	F	*Navicula oahuensis*	none	none	none						
Algae	F	*Navicula testata*	none	none	none						
Algae	F	*Pithophora affinis*	none	none	none						
Algae	F	*Pithophora macrospora*	none	none	none						
Algae	F	*Staurastrum monticulosum var. duplex*	none	none	none						
Algae	F	*Staurastrum subtile*	none	none	none						
Algae	F	*Stauroneus maunakeäensis*	none	none	none						
Algae	F	*Stigonema aerugineum*	none	none	none						
Algae	F	*Tolypothrix musicola var. havaiensis*	none	none	none						
Algae	F	*Trentepohlia cucculata var. sandvicensis*	none	none	none						
Algae	F	*Trentepohlia diffracta var. sandvicensis*	none	none	none						
Algae	F	*Xanthidium octocorne var. majus f. havaiens*	none	none	none						
Algae	M	*Acrochaetium dotyi*	none	none	none						
Algae	M	*Alsidium cymatophilum*	none	none	none						
Algae	M	*Antithamnion erucacladellum*	none	none	none						
Algae	M	*Boodleopsis hawaiiensis*	none	none	none						

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	Habitat: F = Freshwater, A = Anchialine, M = Marine					***Island Distribution: Feshwater only***					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Algae	M	*Callidictyon abyssorum*	none	none	none						
Algae	M	*Callithamniella pacifica*	none	none	none						
Algae	M	*Centroceras corallophilloides*	none	none	none						
Algae	M	*Ceramium cingulum*	none	none	none						
Algae	M	*Ceramium dumosertum*	none	none	none						
Algae	M	*Ceramium hanaense*	none	none	none						
Algae	M	*Ceramium tranquillum*	none	none	none						
Algae	M	*Ceramium womersleyi*	none	none	none						
Algae	M	*Chrysymenia glebosa*	none	none	none						
Algae	M	*Codium cicatrix*	none	none	none						
Algae	M	*Codium extricatum*	none	none	none						
Algae	M	*Corallophila ptilocladioides*	none	none	none						
Algae	M	*Crouania sp*	none	none	none						
Algae	M	*Dasya iridescens*	none	none	none						
Algae	M	*Dasya kriseniae*	none	none	none						
Algae	M	*Dasya muurayana*	none	none	none						
Algae	M	*Ditria reptans*	none	none	none						
Algae	M	*Dotyella hawaiiensis*	none	none	none						
Algae	M	*Dotyella irregularis*	none	none	none						
Algae	M	*Dotyophycus pacificum*	none	none	none						
Algae	M	*Dudresnaya littleri*	none	none	none						
Algae	M	*Euptilocladia magruderi*	none	none	none						
Algae	M	*Fernandosiphonia ecorticata*	none	none	none						
Algae	M	*Gelidiella womersleyana*	none	none	none						
Algae	M	*Gelidium pluma*	none	none	none						
Algae	M	*Gelidium reediae*	none	none	none						
Algae	M	*Gracilaria abbottiana*	none	none	none						
Algae	M	*Gracilaria coronopifolia*	none	none	none						
Algae	M	*Gracilaria dawsonii*	none	none	none						
Algae	M	*Gracilaria dotyi*	none	none	none						
Algae	M	*Gracilaria epihippisora*	none	none	none						
Algae	M	*Grateloupia hawaiiana*	none	none	none						
Algae	M	*Halymenia chiangiana*	none	none	none						
Algae	M	*Halymenia cromwellii*	none	none	none						
Algae	M	*Halymenia stipitata*	none	none	none						
Algae	M	*Hawaiia trichia*	none	none	none						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

	Habitat: F = Freshwater, A = Anchialine, M = Marine					***Island Distribution: Feshwater only***					
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Hawai'i***
Algae	M	*Helminthocladia rhizoidea*	none	none	none						
Algae	M	*Helminthocladia simplex*	none	none	none						
Algae	M	*Herposiphonia dubia*	none	none	none						
Algae	M	*Hypoglossum wynnei*	none	none	none						
Algae	M	*Janczewskia hawaiiana*	none	none	none						
Algae	M	*Laurencia crustiformans*	none	none	none						
Algae	M	*Laurencia mcdermidae*	none	none	none						
Algae	M	*Liagora perennis*	none	none	none						
Algae	M	*Lophocladia kipukaia*	none	none	none						
Algae	M	*Micropeuce setosus*	none	none	none						
Algae	M	*Naccaria hawaiiana*	none	none	none						
Algae	M	*Padina melemele*	none	none	none						
Algae	M	*Padina thivyae*	none	none	none						
Algae	M	*Peleophycus multiprocarpium*	none	none	none						
Algae	M	*Phaeocolax kajimurai*	none	none	none						
Algae	M	*Platoma ardreanum*	none	none	none						
Algae	M	*Pleonosporium intricatum*	none	none	none						
Algae	M	*Plocamium*	none	none	none						
Algae	M	*Polyopes hakalauensis*	none	none	none						
Algae	M	*Polysiphonia profunda*	none	none	none						
Algae	M	*Polysiphonia rubrorhiza*	none	none	none						
Algae	M	*Polysiphonia tuberosa*	none	none	none						
Algae	M	*Prionitis corymbifera*	none	none	none						
Algae	M	*Pseudochlorodesmis hawaiiensis*	none	none	none						
Algae	M	*Pterocladiella bulbosa*	none	none	none						
Algae	M	*Reticulocaulis mucosissimus*	none	none	none						
Algae	M	*Sargassum echinocarpum*	none	none	none						
Algae	M	*Sargassum obtusifolium*	none	none	none						
Algae	M	*Sargassum polyphyllum*	none	none	none						
Algae	M	*Scinaia furcata*	none	none	none						
Algae	M	*Scinaia hormoides*	none	none	none						
Algae	M	*Spirocladia hodgsoniae*	none	none	none						
Algae	M	*Sporochnus dotyi*	none	none	none						
Algae	M	*Trichogloeopsis hawaiiana*	none	none	none						
Algae	M	*Ululania stellata*	none	none	none						
Algae	M	*Valonia trabeculata*	none	none	none						

APPENDIX B: AQUATIC WILDLIFE SPECIES OF GREATEST CONSERVATION NEED

Habitat: F = Freshwater, A = Anchialine, M = Marine ***Island Distribution: Feshwater only***

Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	*Kaua'i*	*O'ahu*	*Moloka'i*	*Lāna'i*	*Maui*	*Hawai'i*
Algae	M	*Womersleyella pacifica*	none	none	none						
Algae	M	*Wrangelia elegantissima*	none	none	none						
Plant	M	*Halophila hawaiiana*	none	none	none						
Plant	M	*Ruppia maritima*	none	none	none						