HAWAII'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Effective October 1, 2005

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As submitted to the National Advisory Acceptance Team
October 1, 2005

Department of Land and Natural Resources
1151 Punchbowl Street, Room 325
Honolulu, HI 96813

Authors

Christen Mitchell[1], Christine Ogura[2], Dwayne Meadows[3], Austin Kane[4], Laurie Strommer[5], Scott Fretz[6], David Leonard[7], Andrew McClung[8]

Affiliations of Authors

[1] Pacific Cooperative Studies Unit, Research Cooperation of the University of Hawai‘i
[2] Pacific Cooperative Studies Unit, Research Cooperation of the University of Hawai‘i
[3] Pacific Cooperative Studies Unit, Research Cooperation of the University of Hawai‘i
[4] Pacific Cooperative Studies Unit, Research Cooperation of the University of Hawai‘i
[5] Pacific Cooperative Studies Unit, Research Cooperation of the University of Hawai‘i
[6] Division of Forestry and Wildlife, Department of Land and Natural Resources
[7] Division of Forestry and Wildlife, Department of Land and Natural Resources
[8] Pacific Cooperative Studies Unit, Research Cooperation of the University of Hawai‘i

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Division of Forestry and Wildlife (DOFAW) or the Division of Aquatic Resources (DAR)
Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813
Phone: 808-587-0166 (DOFAW)
808-587-0100 (DAR)

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FOREWORD

Aloha! I am pleased to introduce Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS), a historic endeavor to address the conservation needs of over 10,000 species native to Hawai'i. Never before has the State attempted to outline a statewide strategy for native wildlife conservation that includes species from the mountains to the ocean, from the Northwestern Hawaiian Islands to the main Hawaiian Islands.

Much of Hawaii's unique wildlife is found nowhere else on earth, and these species and their habitats face tremendous challenges due to habitat loss and the introduction of non-native, invasive species. More than half of the native habitats have been lost and the introduction of non-native plants, animals, and diseases, like miconia, coqui frog, or West Nile virus, constitute an ongoing threat to species in restricted ranges. Hawaii's CWCS is an opportunity to turn the tide on the decline of our native species and habitats. By building on earlier conservation and research efforts, the CWCS uses the best possible science available to establish statewide objectives and strategies to address the challenges facing our native wildlife and habitats.

The CWCS is the result of the hard work of many people, and I offer a sincere *mahalo* to all who participated in its development. As we turn to the implementation of this ambitious strategy, I invite everyone to join in, working in partnership with and alongside management agencies, community groups, businesses, landowners, and citizens. Together, we can ensure these unique and rare Hawaiian species continue to exist for future generations.

Linda Lingle
Governor of Hawai'i

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List of Acronyms

BRA	Bottomfish Restricted Area
CI	Confidence Interval
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
GSN	Genetic Safety Net
HI-GAP	Hawai‘i Gap Analysis Project
IUCN	International Union for the Conservation of Nature and Natural Resources
KIRC	Kaho‘olawe Island Reserve Commission
KS	Kamehameha Schools
MGD	Million gallons per day
MHI	Main Hawaiian Islands
MLCD	Marine Life Conservation District
MMA	Marine Managed Area
NAR	Natural Area Reserve
NGO	Non-governmental organization
NHP	National Historic Park
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWHI	Northwestern Hawaiian Islands
NWR	National Wildlife Refuge
SE	Standard Error
SD	Standard Deviation
SGCN	Species of Greatest Conservation Need
SOS	Save Our Shearwaters Program
SWG	State Wildlife Grant
TNC	The Nature Conservancy of Hawai‘i
UH	University of Hawai‘i
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey (Biological Resources Division)
WP	Watershed Partnership

EXECUTIVE SUMMARY

BACKGROUND

Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS) is a historic initiative that comprehensively reviews the status of the full range of the State's native terrestrial and aquatic species, over 10,000 of which are found nowhere else on earth. Hawaii's CWCS presents strategies for long-term conservation of these species and their habitats. The development of the CWCS built upon Hawaii's strong history of conservation and involved working with resource managers, biologists, and concerned individuals statewide. As a result, the CWCS 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 CWCS 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 are preparing a CWCS 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 has taken the lead in preparing the CWCS and has gone beyond simply meeting mandated requirements by making the CWCS a 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 CWCS builds on and synthesizes information gathered from existing conservation partnerships and cooperative efforts, such that the development of this Strategy is based on collaboration with other local, State, and Federal agencies, non-governmental organizations, private landowners, and interested citizens. A combination of traditional outreach, such as public meetings and technical workshops, with 'modern' outreach, such as the development of a website and use of email, was used to invite and expand participation in the development of the CWCS. Chapter 2 of this document outlines the methods and approaches used to develop Hawaii's CWCS.

Recognizing the effectiveness of taking conservation actions at a habitat-level in addition to a species-specific level, the CWCS emphasizes threats to species and their habitats and conservation needs at three levels: statewide, island-wide, and taxa-specific. Chapters 3 and 4 present an overview of Hawaii's unique species and their habitats, identify the major threats to the long-term conservation of these species and habitats, and present seven conservation objectives to address these threats. Under each objective, strategies of highest priority are labeled; however, because conservation needs in Hawai'i far exceed the resources available, implementation of any of the identified strategies will benefit native wildlife and habitats. Chapters 5 and 6 present more specific information for the marine environment (Chapter 5) and the individual islands and the Northwestern Hawaiian Islands (Chapter 6). Fact sheets on individual taxa or on groupings of taxa were developed to present information relating to elements one through five, and are compiled in Chapter 7. Finally, recognizing that monitoring is critical to the overall success of the CWCS, Chapter 8 discusses existing and needed monitoring programs for species and habitats as well as implementation and monitoring of Hawaii's CWCS, including the 10-year revision.

HAWAII'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

Hawaii's Species of Greatest Conservation Need (SGCN) include all native terrestrial animals, all endemic aquatic animals, additional indigenous aquatic animals identified as in need of conservation attention, a range of native plants identified as in need of conservation attention, and all identified endemic algae. The SGCN includes: terrestrial mammal (1), birds (77), terrestrial invertebrates (~5,000), freshwater fishes (5), freshwater invertebrates (12), anchialine pond-associated fauna (20), marine mammals (26), marine reptiles (6), marine fishes (154), marine invertebrates (197), flora (over 600).

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, wildfire, invasive species, recreational overuse, natural disaster, and climate change;
- Introduced invasive species (e.g., habitat-modifiers, including weeds, ungulates, algae and corals, predators, competitors, disease carriers, and disease);
- Limited information and insufficient information management;

- Uneven compliance with existing conservation laws, rules and regulations;
- Overharvesting and excessive extractive use;
- Management constraints; and
- Inadequate funding to implement needed conservation actions.

To address these threats, the CWCS 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 CWCS 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 unique 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.

CHAPTER 1: PURPOSE AND VALUE

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

PURPOSE OF HAWAII'S COMPREHENSIVE WILDLIFE CONSERVATION STRATEGY

The purpose of developing Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS) is to provide the opportunity for resource managers to develop a comprehensive planning process to help manage all of Hawaii's unique native wildlife. Hawaii's CWCS is truly comprehensive in scope, going beyond the initial legislative mandate to fully recognize the interconnectedness of Hawaii's diverse flora and fauna to create an integrated, strategic blueprint for the protection and recovery of Hawaii's biodiversity. Although the magnitude and scope of the work needed to protect and recover Hawaii's unique species are challenging, the 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) to remain eligible for SWG funding. Each CWCS 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;

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 DLNR is leading the effort to collect the best available information from the many 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 native wildlife through Hawaii's CWCS.

VALUE OF HAWAII'S CWCS

The value of Hawaii's CWCS toward achieving its mission lies in its ability to integrate the needs of the full range of native species and habitats into a coordinated effort that enhances the effectiveness of broad cooperation among agencies and landowners toward the conservation of native species and habitats. Much of the groundwork for this collaboration exists in Hawai‘i in the form of numerous partnerships and existing management and species recovery plans. Although this conservation effort is characterized by working together and sharing information and responsibilities, no one document has synthesized all this information into a strategy for the entire State.

The value of having one document covering the needs of a diverse range of species groups makes Hawaii's CWCS a historic endeavor. Additionally, by working with and soliciting information from a broad range of governmental agencies, non-governmental organizations, and citizens, Hawaii's CWCS has helped to create consensus, excitement, support, and momentum to protect our native species. Whether or not our generation leaves a legacy of biodiversity to our grandchildren begins with the decisions and actions made today.

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 CWCS lays the foundation for conservation of native wildlife and their habitats. By taking a proactive approach, Hawaii's CWCS takes a fiscally responsible stand. The CWCS 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 CWCS is a change from single species management. The true challenge, however, will come with the implementation of this CWCS.

HAWAII'S UNIQUE WILDLIFE RESOURCES AND THEIR VALUES

A CWCS is especially important to Hawai'i, the United States, and even the world, because of the unique biology, cultural importance, and economic value of native 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 extremely limited gene flow from their distant, original populations, colonists rapidly adapted to their novel environments. For many such colonists, unique adaptations occurred simultaneously among populations that were isolated from one another on an island and between islands. Hawai'i provides a text-book example of adaptive radiation, the process by which many new species evolved from a single common ancestor in a relatively short time span.

Although Charles Darwin never visited the Hawaiian Islands, he was aware of their unique biology. If he had visited the islands, he would have discovered that Hawai'i surpasses the Galapagos Islands in the number and variety of species that evolved from a small set of original colonizing ancestors. Scientists now recognize that the world's premier showcase of adaptive radiation is the Hawaiian archipelago. 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 been described as its own biogeographic province that possesses the world's highest degree of endemism – 90 percent for terrestrial species and 15 to 20 percent for marine species.

The arrival of Polynesians approximately 1,600 years ago, and increasingly with the arrival of Westerners in 1778, contributed to the destruction of native habitats and introduced many novel threats to which the island's species had never been exposed. For more than 70 million years, the evolution of new 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. These losses include at least half of the native bird life, hundreds of unique plant species, and undoubtedly thousands of lesser known taxa such as terrestrial insects and spiders that were lost before they were ever described. Today, with less than 0.2 percent of the land area of the United States, the Hawaiian Islands hold more than 30 percent of the nation's imperiled species. These include 317 taxa of plants and animals listed by the U.S. Fish and Wildlife Service (USFWS) as endangered or threatened, 12 taxa proposed as endangered, and 105 taxa as candidates for listing.

Despite this, 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; Limahuli and Lumaha‘i valleys on Kaua‘i; Mo‘omomi, Moloka‘i; and Keauhou, Hawai‘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 native 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: invasive weeds increase the likelihood of wildfires that threaten homes and native habitats; introduced ungulates (hooved animals) denude native forest, causing soil erosion and sedimentation of streams and nearshore reefs and impacting fishing opportunities; plants such as *Miconia calvescens* provide much less erosion control than native trees, threatening billions of gallons of water provided by our watersheds; the coqui frog (*Eleutherodactylus coqui*) poses quality of life issues for residents while eating native invertebrates; and West Nile Virus and the brown tree snake raise public health and safety concerns.

ORGANIZATION AND FORMAT OF HAWAII'S CWCS

Hawaii's CWCS is organized in a way that addresses the required eight elements at multiple scales, from the statewide perspective to island-specific and taxa-specific levels. Chapter 2, **Approach and Methods**, describes the processes used to develop the Strategy and addresses elements 7 and 8. Chapters 3 and 4, **State of Hawai‘i Overview** and **Statewide Conservation Needs**, provide a statewide overview outlining the current condition of the State's natural resources, management activities, key threats to native species and habitats, and statewide conservation goals, objectives, and strategies. Chapter 5, **Marine Conservation Needs**, and Chapter 6, **Island Conservation Needs**, go beyond the statewide perspective to location-specific threats and strategies, including those for the Northwestern Hawaiian Islands. Chapter 7, **Species of Greatest Conservation Need**, provides details on all the listed wildlife taxa in fact sheets that

contain information for one taxa, closely related groups of species, or species facing similar threats. These Chapters (3-7) address 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 CWCS itself, addressing elements 6 and 7. Finally, supporting sections consisting of **Appendices, Glossary,** and **References** are included to provide additional detail.

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CHAPTER 2: APPROACH AND METHODS

APPROACH

Given Hawaii's biological uniqueness on a global scale, the Comprehensive Wildlife Conservation Strategy (CWCS) recognizes the importance of protecting all native terrestrial animals, all endemic aquatic wildlife, other aquatic species threatened with decline, and a broad range of native flora. On the ecological level, the CWCS takes a habitat management approach, adopting a landscape view that takes into account the complex inter-relationships between species and their habitats and the need for change and adaptability. The CWCS builds on and synthesizes information gathered from existing conservation partnerships and cooperative efforts. Additionally, the CWCS 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 implementing Hawaii's CWCS.

The Hawai'i Department of Land and Natural Resources (DLNR) coordinated the development of Hawaii's CWCS, with joint cooperation by the Division of Forestry and Wildlife (DOFAW) and the Division of Aquatic Resources (DAR), the divisions primarily charged with protecting the State's terrestrial and aquatic resources. The CWCS core team consists of staff hired through the Pacific Cooperative Studies Unit (PCSU) of the University of Hawai'i (UH). A broader CWCS team includes DOFAW and DAR staff that directly supported and assisted the development of the CWCS. In addition, other CWCS contributors include advisory groups and committees of representatives from government agencies and partner organizations, other internal and external stakeholders, and technical workshops and public meetings participants. For terrestrial wildlife, informal advisory groups were developed around species or geographic interests, building upon existing working groups (e.g., the Hawaiian Hoary Bat Research Cooperative). For aquatic wildlife, a Statewide Aquatic Wildlife Conservation Strategy Advisory Committee, with representatives from Federal and State agencies, resource user groups, and non-profit organizations was established. The Advisory Committee also assisted DAR in developing their CWCS products and a stand-alone Statewide Aquatic Wildlife Conservation Strategy to be published by PCSU.

METHODS

Multiple methods were used to develop and draft Hawaii's CWCS. The goal of each method was to engage different audiences and groups, garner information to meet the required eight elements, and build support for the strategy and its implementation. The following sections describe the planning process and methods utilized, addressing required elements 7 and 8.

OUTREACH

Public Participation

A variety of methods and opportunities were used to reach out to the public to introduce them to Hawaii's CWCS. The primary method used to engage the public as well as resource managers and technical experts was the CWCS website, www.state.hi.us/dlnr/dofaw/cwcs/index.html. The public was encouraged to comment at all stages of CWCS development, beginning with the draft

list of species covered by the CWCS to taxa-specific fact sheets and the 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 CWCS 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 600 individuals, agencies, and organizations.

DLNR also issued press releases between the fall of 2004 and 2005 that resulted in media coverage by the two statewide papers, individual island papers, and local radio stations. Hawaii's CWCS gained national attention when the Associated Press picked up a local article that resulted in coverage in the Washington Post and other major newspapers. During the month of April 2005, several outreach initiatives 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 CWCS. During the months of June and July, 2005, 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 CWCS benefited from this foundation of established partnerships and built upon existing species recovery plans, location-specific management plans, and other available related plans and documents.

The CWCS core team invited resource managers and technical experts to participate in the development of the CWCS through an initial outreach effort, sent both by mail and email, to a wide range of local, State, and Federal agencies, non-governmental organizations, researchers, and private landowners. The CWCS core team also identified existing partners and individually contacted them to introduce the strategy and invite their participation. Members of the CWCS core team attended several professional conferences where additional biologists and researchers were invited to participate in the development of the CWCS. Based on these outreach efforts, informal and formal advisory groups were developed on both a species and habitat level, providing information used to develop the Draft CWCS and reviewing of initial draft products. 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, provide comments, and suggest additions for incorporation into the Final Draft of Hawaii's CWCS.

Current major collaborators include a wide range of agencies and organizations that have been integral in building support for the CWCS, sharing data and information, providing comments and recommendations, and assisting in the overall planning effort. Major contributors include the Hawai‘i Gap Analysis Program (HI-GAP), Bishop Museum, Nature Conservancy of Hawai‘i (TNC), the National Tropical Botanical Gardens (NTBG), Hawai‘i Invasive Species Council (HISC), UH, U.S. Fish and Wildlife Service (USFWS), U.S. National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), U.S. National Park Service (NPS), U.S. Army, and U.S. Marine Corps.

STRATEGY DEVELOPMENT

From the methods described previously, individuals and organizations were identified with information or expertise on species groups or islands and organized into informal reviewer groups. These groups along with the website, technical workshops, and public meetings were used to develop the following components of Hawaii's CWCS.

Identifying Species of Greatest Conservation Need and their Habitats

The Hawaiian Islands are biologically diverse, with fauna characterized by high levels of endemism. In addition, many migratory species spend key parts of their life cycles (e.g., breeding or wintering) in Hawai‘i. 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 terrestrial indigenous animals as identified by the Hawai‘i list of indigenous species (Hawai‘i Administrative Rules Title 13 Chapter 124); 2) all aquatic endemic animals; 3) any animal taxa on the Federal threatened, endangered, candidate, or species of concern list; 4) any animal protected by the U.S. Marine Mammal Protection Act; 5) any native 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 6) additional animals suggested by the Statewide Aquatic Wildlife Conservation Strategy Advisory Committee or by the informal advisory groups as deserving of attention for other reasons. Migratory species with irregular or insignificant presence in the State were not included on the list; neither were introduced species, which by their nature do not represent the natural biodiversity of Hawai‘i.

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: terrestrial mammal, birds (forest birds, raptors, waterbirds, seabirds, migratory shorebirds and waterfowl, and Northwestern Hawaiian Islands passerines), terrestrial invertebrates, freshwater fishes, freshwater invertebrates, anchialine pond fauna, marine mammals, marine reptiles, marine fishes, and marine invertebrates.

A consistent theme during public review was the recommendation to include native flora on the list of SGCN for the following reasons: 1) native flora have a high degree of endemism; 2) native flora are in dire need of conservation attention with over 250 species federally listed as threatened or endangered; 3) native flora are highly important to native wildlife, as many native birds and native invertebrates rely upon native plants for food or for habitat.

After review of public comment, the CWCS core team developed a list of Flora Species of Greatest Conservation Need for inclusion in the CWCS using the following criteria: 1) plant species federally listed as threatened, endangered, or as a candidate for listing; 2) plant species identified as Genetic Safety Net (GSN) plants (i.e., plants with less than 50 individuals extant); 3) plant species identified as important elements of native habitats; 4) endemic aquatic plants; and 5) endemic terrestrial and aquatic algae. A plant species was considered an important element of native habitat if it was a dominant or co-dominant member of an identified natural community according to the *Manual of the Flowering Plants of Hawai‘i* or if there was evidence

that the plant was known to be a host for native wildlife, a food source for native wildlife, or habitat for native wildlife. The CWCS core team solicited the assistance of the Hawaiian botanical community to develop the list of Flora Species of Greatest Conservation Need, which was posted on the website for further public consideration and comment.

Together, the Fauna Species of Greatest Conservation Need and the Flora Species of Greatest Conservation Need compose Hawaii's SGCN. This broad approach of identifying Hawaii's SGCN recognizes the uniqueness and global rarity of Hawaii's natural environment. However, although this CWCS begins with SGCN, the CWCS focuses on habitats essential to these species, threats to these important habitats, and management strategies needed to preserve these habitats.

Identifying Threats, Conservation Objectives, Research Needs, Monitoring, and Priorities

Hawaii's CWCS core 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 CWCS core 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 a taxa-level, island-level, and statewide-level. At the statewide-level, major threats to and needs 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. Under each objective, strategies of highest priority were labeled, but no further prioritization occurred as all strategies are important priorities and implementation of these strategies depends on several factors beyond relative ecological importance, such as funding, landowner interest, community support, or technological capacity. 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 were highlighted for each island, for the Northwestern Hawaiian Islands, for the marine environment, and for specific taxa.

Maps/Geographic Information System information

The CWCS core team worked closely with HI-GAP to develop spatial information and incorporate Geographic Information System (GIS) analysis into the Strategy. These products were reviewed not only by the HI-GAP team (which consisted of representatives from the Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program), TNC, Bishop Museum, UH, USGS, DOFAW, NPS, and USFWS), but also during the island technical workshops with local specialists. This collaboration was essential to Hawaii's CWCS process of identifying species distributions, management needs, information gaps, and potential new areas for conservation enhancement. In addition to HI-GAP, valuable spatial information was provided by the State of Hawaii's Division of Business and Economic Development, USFWS, USGS, NPS, NOAA, Hawai‘i Forest Bird Interagency Database Project, Hawai‘i

Biodiversity and Mapping Program (rare species database), and Bishop Museum (Invertebrates database).

The maps in Chapter 7 were based on data from two sources: incidental records and standardized surveys. Incidental records note were a species was located or collected, and provide limited information regarding a species' actual distribution. When the date was available, information post-1900 was utilized due to data limitations pre-1900. Maps based on standardized surveys represent occurrence data at survey or count stations. Density figures are available in Scott et al. (1986), and these figures are currently being updated. Distributions based on these surveys only provide distributional information in the areas surveyed (see Scott et al. 1986 for details). Distributions for the waterbirds are based on weighted occurrences of non-standardized count data (2000-2005). The distribution map for the nēnē was based on information from the USFWS recovery plan for that species. Long-term waterbird trend analyses are in preparation. Maps for certain widespread species were not provided because of a lack of systematic surveys. Maps for seabirds and migratory birds are not provided because many of these species have very limited ranges in Hawai‘i or because of a lack of systematic survey data.

Plan Review

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 by email and direct mail to the CWCS contact list and additional parties, by 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. In addition, new materials (e.g., fact sheets on terrestrial invertebrates) were made available for public review. This Revised Draft CWCS was posted on the website for review and both emailed and mailed to the CWCS Contact List, followed by another public comment period. Comments were again reviewed and incorporated as appropriate and 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.

CHAPTER 3: STATE OF HAWAIʻI OVERVIEW

Due to its extreme isolation and climactic conditions, Hawaiʻi is characterized by high levels of endemism in both its native animals and plants, with over 10,000 species found nowhere else on earth. Unique and varied habitats are also found across the islands. As a result, Hawaiʻi presents both an opportunity and challenge for conservation. While the threats to Hawaii's native species persist, recent years have seen greater awareness of the need to take action to conserve biodiversity, more assertive political will to take steps to address the problems, and wider community involvement in projects. These changes have resulted in positive steps towards the recovery for Hawaii's endangered species and towards the protection for those species that remain common so that they do not become endangered. Success stories include bringing the nēnē (*Branta sandvicensis* [Hawaiian goose]) from the edge of extinction, increasing populations of honu (*Chelonia mydas agassizi* [green sea turtle]), protection of important habitats such as that of Hanawī on Maui, and community-led restoration efforts of Waimānalo streams encouraging the return of the endangered aeʻo (*Himantopus mexicanus knudseni* [Hawaiian stilt]). However, despite these success stories, Hawaiʻi continues to face major conservation challenges in protecting its over 10,000 native wildlife species. Chapter 3 provides both a social and biological overview, assessing the current status of natural resources in the State. This chapter, in combination with Chapter 4, addresses elements 1-4 at the statewide level.

SOCIAL OVERVIEW

HUMAN LANDSCAPE

The population of the State of Hawaiʻi was estimated at 1,262,840 people in 2004, with the majority (70%) found on Oʻahu, 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 Oʻahu and Maui.

Hawaiʻi has four local governments: the City and County of Honolulu (island of Oʻahu and the Northwestern Hawaiian Islands), the County of Kauaʻi (islands of Kauaʻi and Niʻihau), the County of Maui (islands of Maui, Molokaʻi, Lānaʻi and Kahoʻolawe), and the County of Hawaiʻi (island of Hawaiʻi). Hawaiʻi 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 (Molokaʻi) and is managed by the National Park Service (NPS) under a cooperative agreement with the State Department of Health.

Tourism 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.

LAND AND WATER USE

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 Hawaiʻi, manages over 467,000 hectares (1,155,900 acres) for watershed protection, preservation of natural resources, agricultural use, recreation, transportation, and public safety. The State Department of Hawaiian Home Lands manages an additional 82,000 hectares (202,658 acres) in trust for the present and

future use by Native Hawaiians. The Federal government (NPS, U.S. Fish and Wildlife Service (USFWS), and Department of Defense) 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. There are no lands managed by the U.S. Forest Service or the Bureau of Land Management in Hawai‘i.

The remaining land is in private ownership. Much of this land is controlled by a few owners; seven private landowners own approximately 20 percent of the land in the State (Kamehameha Schools, Parker Ranch, Castle & Cooke, Inc., Alexander and Baldwin, Inc., James Campbell Estate, C. Brewer and Company, Ltd., and Dole Food Company, Inc.). Some of these lands are managed in cooperation with adjacent landowners for conservation purposes as part of a watershed partnership. Modeled after the first watershed partnership that began in East Maui in 1991, there are now 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. These voluntary partnerships are the primary vehicle for conservation on private lands in Hawai‘i (as opposed to conservation easements, acquisition, or other methods).

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. Example areas include Mānele Bay (Lāna‘i), west Maui, central O‘ahu, and the Hāmākua Coast (island of Hawai‘i). The dissolutions of the Campbell Estate and the Damon Estate private trusts are expected to result in additional land use changes. Increased military activity associated with the location of a U.S. Army Stryker Brigade and the possible stationing of an aircraft carrier group is anticipated to result in additional land use changes in the Urban District for housing and infrastructure and in the Conservation District for construction related to training.

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. About 48 percent of the State (798,702 hectares or 1,973,636 acres) is in the State Conservation District, a designation where development and commercial activity is generally limited with varying levels of restrictions based on the applicable subzone. While the State Department of Land Natural Resources (DLNR) manages land in the Conservation District, the counties have primary responsibility for land in the other three districts. Those Districts are subject to county land-use and development controls, including county community plans, zoning, and building code regulations which affect farm, residential, commercial, and industrial development and use. In addition, in Special Management Areas located along the shoreline, each county has an additional layer of regulation that provides special control of development, even for land already subject to Conservation District restrictions.

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 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 Oceanic and Atmospheric Administration (NOAA).

A significant portion of the State (31%) has been designated for long-term resource protection and receives varying degrees of management: 260,267 hectares (643,134 acres) are in State Forest Reserves (DLNR), 147,710 hectares (365,000 acres) are within National Parks (NPS), 44,177 hectares (109,164 acres) are in State Natural Area Reserves (DLNR), 38,400 hectares (94,900 acres) are in State Wildlife Sanctuaries (DLNR), and 265,897 hectares (657,048 acres) of emergent and submerged land are in National Wildlife Refuges (USFWS). 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 Northwestern Hawaiian Islands (NWHI) Coral Reef Ecosystem Reserve protects submerged lands and waters in the NWHI.

CULTURAL SIGNIFICANCE OF NATIVE WILDLIFE

Native species in Hawai‘i play a significant role in Native Hawaiian culture. Historically, feathers from forest birds were used to make elaborate capes, leis, and helmets for the *ali‘i* (royalty). 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. 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 plants for hula, traditional medicines, carving, weaving, and ceremonies.

The belief system of the Native Hawaiians links people with all living and non-living things. Because all components of ecosystems were descended from *Wākea* (sky father) and *Papa-hanau-moku* (earth mother) and their offspring, *kini akua* (multitude of gods), both living and non-living elements possess spiritual qualities and *mana* (spiritual power). As such, Native Hawaiians, as *kanaka maoli* (native people), are guardians of these ecosystems and their well-being is directly related to the well-being of these ecosystems. For example, areas such as *wao akua* (upland forests) are sacred places, the realm of the gods. 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).

Native wildlife also play an important role in Native Hawaiian culture as many species such as the pueo (*Asio flammeus sandwichensis* [Hawaiian short-eared owl]), ʻio (*Buteo solitarius* [Hawaiian hawk]), ʻelepaio (*Chasiempis sandwichensis*), ʻalalā (*Corvus hawaiiensis* [Hawaiian crow]), sea turtles, and sharks are believed to be ʻ*aumakua* (ancestors or guardians) of certain Hawaiian families. Hawaiian names have been given to many of the native wildlife and they have been incorporated into *oli* (chants) and *moʻolelo* (legends). Today, Native Hawaiian teachings play an increasing role in natural resource management, especially in areas of cultural significance like Kahoʻolawe or Wao Kele o Puna (island of Hawaiʻi). The CWCS 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.

PUBLIC SUPPORT FOR CONSERVATION

Public Perspectives on Wildlife

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, 79 percent agree that in order to do this it is acceptable to eliminate introduced game animals from some areas, 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 expenditures for terrestrial wildlife watching activities in Hawaiʻi estimated at $132 million dollars. However, this is only a fraction of expenditures related to ocean wildlife viewing. A large proportion of the $10 billion dollar tourism sector is indirectly related to the viewing of marine wildlife, with one study estimating that snorkeling and diving alone generate $364 million dollars each year in added value for the State.

Funding for Conservation

Hawaiʻi ranks near the bottom (48th) in the nation for state spending on fisheries and wildlife, though the State forest reserve system ranks 11th in size and 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 (0.86%) 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.

A conservative estimate of the amount of State funds actually dedicated solely to conservation of native wildlife and their habitats is approximately $23 million dollars for Fiscal Year 2006. Though no comprehensive cost estimates exist for the protection and recovery of wildlife in Hawaiʻi, the inadequacy of current funding levels is obvious based on costs included in recovery

plans for endangered species. For example, the recently published Draft Revised Recovery Plan for Hawaiian Forest Birds (2003) estimates the cost of recovering 21 species of forest birds at nearly $2.5 billion dollars over the next 30 years – an annual cost ($83 million) that exceeds the budget for the entire DLNR. Costs associated with the recovery for endangered whales, sea turtles, seabirds, waterbirds, and plants would add tens of millions more per year.

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. In recent years, through related competitive grant programs within the Section 6 program, additional funding for conservation on private lands and for land acquisition has become available. Though Hawai'i has been successful in securing a portion of these grants because of extensive and progressive partnerships with landowners, lack of sufficient overall funding to implement recovery programs, especially on State lands, leaves both critically endangered species and lesser known native species (e.g., terrestrial invertebrates) with little support.

Clearly, unprecedented efforts are needed to increase the funding base for the protection of Hawaii's wildlife and their habitats, and comprehensive and integrated strategies are needed to ensure that limited funding for wildlife conservation is used wisely and for maximal benefit.

BIOGEOGRAPHICAL OVERVIEW

The Hawaiian archipelago is comprised of eight main islands and approximately 124 smaller islands, reefs, and shoals spanning over 2,400 kilometers (1,500 miles) 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 Northwestern Hawaiian Islands and the submersion under the sea surface of the seamounts which used to be islands.

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 possesses many natural wonders: the most active volcano in the world, the wettest place on earth, the tallest seacliffs, and extensive coral reefs.

HABITATS

The Hawaiian Archipelago possesses the full range of habitats, from wet forests to extremely dry coastal grasslands. Due to evolution and extreme isolation, these native habitats were

characterized by high levels of plant endemism. With the arrival of humans and consequent introduction of invasive plants and animals and development, many of these habitats have declined. For example, 90 percent of Hawaii's dryland habitat, 61 percent of the mesic habitat, and 42 percent of the wetland habitat are estimated to be lost, with less than 40 percent of the land surface covered in native vegetation today. Similarly, much of the habitat for freshwater species has declined, with 58 percent of the perennial streams in the State having been altered in some way. The following section provides specific information on terrestrial, freshwater, and marine habitats, including associated wildlife and major threats.

Terrestrial Habitats

Distribution of terrestrial habitat in Hawai'i is heavily influenced by elevation, climate, and substrate. Five elevation zones are recognized: alpine (typically found over 3,000 meters (10,000 feet)); subalpine (typically found between 2,000 and 3,000 meters (6,500 to 10,000 feet)); montane (typically found between 1,000 and 2,000 meters (3,000 to 6,500 feet)); lowland (typically found between 0 and 1,000 meters (0 to 3,000 feet)); and coastal (typically found along the coast at low elevations). Further, three general moisture categories are recognized: dry (typically receive less than 125 centimeters (50 inches) of rainfall each year); mesic (typically receive between 125 to 250 centimeters (50 to 100 inches) of rainfall each year); and wet (generally receive over 250 centimeters (100 inches) of rain per year).

Using the elevation zones and moisture categories, the State can be classified roughly into nine terrestrial habitat types: alpine communities, subalpine communities; montane wet communities; montane mesic communities; montane dry communities; lowland wet communities; lowland mesic communities; lowland dry communities; and coastal communities. These nine habitat types can be refined further based on the dominant plants and structural characteristics of the vegetation. Although Hawaiian communities or habitats have been classified in a number of different ways, the *Manual of the Flowering Plants of Hawai'i* (Wagner, 1999) recognizes 33 native forest communities, 36 native shrubland communities, eight native grassland communities, and four native herbland communities. Subterranean systems form a tenth habitat type defined by geology rather than elevation zones and moisture. A short description of each of these habitats, associated wildlife, and primary threats is presented below.

Alpine communities

Alpine communities are found only on the islands of Hawai'i (Mauna Kea and Mauna Loa) and Maui (Haleakalā). Conditions are dry, vegetation is sparse, and the soil is predominantly cinder or barren gravel. Native species include terrestrial invertebrates, including the wekiu bug (*Nysius wekiuicola*), a candidate for Federal listing as endangered, spiders, and a few plants, most notably the 'āhinahina or silversword (*Argyroxiphium sandwicense*). There has been relatively little invasion by alien plants, but introduced alien insects, including the Argentine ant (*Linepithema humile*), are a growing problem.

Subalpine communities

Subalpine communities are found only on the islands of Hawai'i and Maui. Mainly located above the inversion layer, these communities are predominantly dry habitats, but subalpine mesic and wet habitats are found on East Maui and a subalpine mesic habitat is

found on Mauna Loa, Hawai‘i. Dominant plants include māmane (*Sophora chrysophylla*), naio (*Myoporum sandwicense*), and ‘ōhi‘a (*Metrosideros polymorpha*) trees, ‘ōhelo (*Vaccinium* spp.) and pūkiawe (*Styphelia tameiameiae*) shrubs, and *Deschampsia nubigena* grass. Notable native species present include the palila (*Loxioides bailleui*), other endemic forest birds, ‘ua‘u (*Pterodroma sandwichensis* [Hawaiian petrel]), ‘akē‘akē (*Oceanodroma castro* [band-rumped storm petrel]), nēnē (Hawaiian goose), and terrestrial invertebrates. Introduced ungulates, including mouflon sheep (*Ovis musimon*), pigs (*Sus scrofa*), goats (*Capra hircus*), sheep (*Ovis aries*), and cattle (*Bos taurus*), are the primary threat to these communities, browsing the native vegetation and spreading invasive plant species.

Montane wet communities

Montane wet communities occur on the islands of Kaua‘i, O‘ahu, Maui, Moloka‘i, and Hawai‘i. A diverse variety of montane wet communities exist, including bogs, densely vegetated shrublands and forests, cliff faces, and steep valley walls. These communities typically exhibit a richer understory development than montane dry or mesic systems. Important native plants include the ferns hāpu‘u (*Cibotium* spp.) and ‘ama‘u (*Sadleria* spp.), sedges (*Carex* spp.), *Oreobolus furcatus* (found in many bogs), and the ‘ōhi‘a tree. Notable native wildlife species include critically endangered forest birds such as the puaiohi (*Myadestes palmeri*) and po‘ouli (*Melamprosops phaeosoma*), Hawaii’s only land mammal, the ‘ōpe‘ape‘a (*Lasiurus cinereus semotus* [Hawaiian hoary bat]), pueo (*Asio flammeus sandwichensis* [Hawaiian short-eared owl]), ‘io (*Buteo solitarius* [Hawaiian hawk]), and terrestrial invertebrates including *Megalagrion* spp. damselflies. Montane bog communities are particularly vulnerable to rooting pigs, and feral pigs contribute to the spread of habitat-modifying invasive plants such as strawberry guava (*Psidium cattleianum*) and kāhili ginger (*Hedychium gardnerianum*) in montane wet forest. Logging and then conversion to pastureland has also resulted in the loss of montane wet forest.

Montane mesic communities

Montane mesic communities occur on the islands of Kaua‘i, Maui and Hawai‘i. ‘Ōhi‘a, koa, olopua (*Nestegis sandwicensis*), and a‘e (*Sapindus saponaria*) are dominant trees, and the understory is composed of diverse trees, shrubs, sedges, and ferns. Notable native species include forest birds, ‘ōpe‘ape‘a, pueo, ‘io, and terrestrial invertebrates. Conversion to pastureland, the spread of introduced grasses, browsing by feral goats, sheep, and pigs, fires, and clearing for commercial tree planting have contributed to the loss and degradation of this habitat.

Montane dry communities

Montane dry communities are found on the leeward slopes of East Maui and of Hualālai, Mauna Loa, and Mauna Kea on Hawai‘i. Substrates are typically cinder or ash or weathered lava flows. Dominant plants include ‘ōhi‘a, ‘a‘ali‘i (*Dodonaea viscosa*), lovegrass (*Eragrostis atropioides*) and pili grass (*Panicum tenuifolium*). Notable native wildlife include terrestrial invertebrates, pueo, the ‘ōpe‘ape‘a (Hawaiian hoary bat), and forest birds. The primary threats to these communities are invasive plants, particularly

fountain grass (*Pennisetum setaceum*), and grazing by feral ungulates, including goats, sheep, and mouflon.

Lowland wet communities

Lowland wet communities are generally found on the windward side of every island except Niʻihau and Kahoʻolawe. Dominant plants include ʻōhiʻa and koa trees, mamaki (*Pipturus albidus*) and uluhe (*Dicranopteris linearis*) shrubs, and hāpuʻu ferns are an important component of the native understory. Notable native wildlife includes terrestrial invertebrates, waterbirds, migratory shorebirds and waterfowl, pueo, ʻio, and the ʻōpeʻapeʻa. Threats include the establishment and spread of invasive plants, especially kāhili ginger and strawberry guava and degradation of the understory by feral pigs.

Lowland mesic communities

Lowland mesic communities are found on every island except Kahoʻolawe. Most lowland mesic communities have been converted to agricultural or ranching use or lost due to logging, and the remaining native communities are threatened by a number of invasive plant species, including guava (*Psidium guajava*), strawberry guava, molasses grass (*Melinis minutiflora*), firetree (*Morella faya*), Christmas berry (*Schinus terebinthifolius*), silk oak (*Grevillea robusta*), *Eucalyptus* spp., and beardgrasses (*Andropogon virginicus* and *Schizachyrium condensatum*). Wildfires, feral ungulates and introduced game animals, particularly goats, pigs, and axis deer, also contribute to the degradation of these communities. In the remaining lowland mesic communities, dominant plants include kāwelu (*Eragrostis variabilis*), pūkiawe, ʻaʻaliʻi, and ʻūlei (*Osteomeles anthyllidifolia*) shrubs, and koa, ʻōhiʻa, and lama (*Diospyros sandwicensis*) trees. Notable native wildlife species include waterbirds, migratory shorebirds and waterfowl, ʻōpeʻapeʻa, and terrestrial invertebrates.

Lowland dry communities

Lowland dry communities occur on the leeward sides of all eight of the Main Hawaiian Islands (MHI), as well as the windward side of Hawaiʻi in the Puna and Kaʻū districts. Dominant vegetation includes ʻōhiʻa, lama, olopua, and wiliwili (*Erythrina sandwicensis*) trees, ʻaʻaliʻi shrubs, and pili grass. Notable native wildlife includes terrestrial invertebrates, waterbirds, migratory shorebirds and waterfowl, and forest bird species which have apparently developed immunity to avian malaria and pox. Most lowland dry communities have been converted to urban and residential use or degraded by fire, grazing, and invasive plants, especially fountain grass, beardgrass, and natal redtop (*Rhynchelytrum repens*). These invasive plants now dominate some lowland dry areas and constitute a major fire threat.

Coastal communities

Coastal systems are communities subject to marine influences and include dry, mesic and wet communities. In addition, this habitat includes anchialine ponds, which are areas where fresh and saltwater mix through underground connections. These communities are found on coral atolls and island remnants in the NWHI, along coastlines of the major islands in the MHI, and on the many offshore islands in the MHI. Naupaka kahakai (*Scaevola sericea*) is an important native shrub throughout the coastal system. Notable

native wildlife includes seabirds, terrestrial invertebrates, migratory shorebirds, and marine animals that use the coastal area for basking and nesting, such as the Hawaiian monk seal (*Monachus schauinslandi*) and honu (green sea turtle). Primary threats include conversion to residential development, introduction of invasive plants (e.g., mangrove (*Bruguiera gymnorrhiza* and *Rhizophora mangle*), pickleweed (*Batis maritime*), and ironwood (*Casuarina equisetifolia*)), off-road vehicle activity, and arson.

Subterranean systems

Some of Hawaii's most unique native invertebrates are associated with lava tube and cave ecosystems. These habitats can be found from higher elevations down to the coast throughout the MHI. Cave ecosystems are divided into five distinct zones (entrance, twilight, transition, dark, and stagnant air zones) with each characterized by different vegetation and animals. Primary threats include loss of native vegetation above caves (roots provide food sources for species), degradation of habitat by human visitation and trampling as well as by non-native species (particularly non-native invertebrates), and habitat loss through development.

Aquatic Habitats

Aquatic habitats ecologically link together most of the terrestrial habitats. Over geologic time, the flow of water and wind have 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 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.

Hawaiian streams, or sections of streams, are either perennial or intermittent. Perennial streams flow year round; however, some flow continuously, discharging into the ocean, while others are interrupted, discharging into the ocean only seasonally. Perennial streams are important to most of Hawaii's 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 ʻoʻopu, 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 primarily consists of oligochaete worms, several crustaceans, and algae.

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 *ahupuaʻa*. 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 parts of these streams in Hawaiʻi because of these limiting factors. Some native fishes, however, are highly evolved at climbing waterfalls. Second order streams are stream sections downstream from the junction of two first order streams and so on down to third or fourth order stream sections. Hawaiʻi does not have many streams higher than fourth order because of the steep terrain and short distance to the sea. Lower order 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 as salty seawater intrudes with the tides. The area where seawater from the ocean mixes with freshwater is an estuary. Estuaries in Hawaiʻi 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 higher. 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. Since estuaries are often calmer areas of water, boat harbors and other sources of human disturbance are often concentrated in these areas.

Sandy Bottom

The amount of sediment moving into the open ocean largely determines the presence of various types of marine habitats in Hawaiʻi. Too much sediment limits the presence 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 soft sediment.

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 fringing 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 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 MHI 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. In this bathypelagic or deep zone, the waters are cold and dark, with many unusual fishes and 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. 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.

All of the marine ecosystems can be affected by pollution or other activities originating onshore so the conservation management of the terrestrial habitats has relevance to the health of the marine systems. Additional information on marine habitats is found in Chapter 5.

NATIVE TAXA

Because of the extreme isolation and distance, relatively few life forms successfully colonized the Hawaiian Archipelago over its 70 million year history. Those species that did, however, found habitats that varied enormously over very short distances. As a result, the archipelago displays some of the world's premier examples of evolution, with the creation of countless new lineages of plants and animals through natural selection and adaptive radiation. Rates of endemism (i.e., percent of species found nowhere else on earth) are typically 99 to 100 percent for terrestrial insects, spiders, and land snails, 90 percent for plants, more than 80 percent for breeding birds, and 15 to 20 percent for aquatic fauna.

Although thousands of Hawaiian species have yet to be described, the estimated number of indigenous species is thought to include more than 14,000 terrestrial, 100 freshwater, and 6,500 marine taxa. Among these are an estimated 10,000 species found nowhere else on the planet, and extreme examples of rapid evolution are found among Hawaii's birds (especially passerines), insects, spiders, land snails, plants, and fishes. The Hawaiian honeycreepers (family: Fringillidae) are often cited as a dramatic example of this process, with at least 40 species having evolved from a single common ancestor. This group of birds diversified to fill niches often occupied by separate families on continental environments and at first glance, bear little resemblance to one another.

Equally impressive radiations are seen in many other taxa. For example among the cosmopolitan family of drosophilid flies, there are nearly 500 described Hawaiian species, as well as hundreds of undescribed species, all of which evolved from perhaps two colonists. Many other explosive radiations are found among terrestrial arthropod groups: more than 400 species of *Hyposmocoma* moths, 180 species of *Sierola* wasps, and 177 species of *Proterhinus* beetles.

This rapid evolution produced many species with unusual characteristics or life-histories, including two dozen flightless birds (now extinct), mintless mints, flightless flies, stinkless stink bugs, blind big-eyed spiders, carnivorous caterpillars, diadromous fish that scale 300-meter (1,000-foot) waterfalls, and nectarivorous birds with bills superbly adapted to the corollas of particular flowering plant species.

Beginning with the arrival of Polynesians to Hawai‘i around 1,600 years ago, and accelerating with the arrival of Westerners following Captain Cook's European discovery of the islands in the 1780s, humans have taken a dramatic toll on the biota of the Hawaiian Islands. With humans came the wholesale destruction of native habitats for agriculture, aquaculture, and development, and the introduction of perhaps thousands of alien species. The effects of these novel pressures on the native biota of the islands resulted in rapid declines and extinctions among hundreds if not thousands of native species. Some species were exterminated by Polynesians for food, especially species such as flightless birds which would have been relatively easy to capture. Some species were lost because of degradation or destruction of their unique habitats. Others

persisted in more remote areas only to be weakened or overcome by non-native predators such as cats (*Felis silvestris*), rats (*Rattus* spp.), and mongooses (*Herpestes auropunctatus*). Native forest birds were virtually eliminated from lowland areas by the night-biting mosquito following its introduction in 1826. The mosquito spread avian malaria and avian poxvirus, diseases for which the native birds had no natural resistance.

As a result of the widespread and rapid changes brought by humans, an estimated half of the native bird species have been lost to extinction. Numbers among other taxa are far higher, including 90 percent of the native land snails, and thousands more terrestrial insects and spiders that were forever lost long prior to being described. The known extinctions alone in Hawai‘i represent 75 percent of the recorded extinctions of plants and animals in the United States. Today, Hawai‘i has the highest number of threatened and endangered species in the United States, accounting for more than 30 percent of the federally listed taxa. The decline in native species is also mirrored by the loss of native habitat, with less than 40 percent of the land surface covered with native-dominated vegetation today.

Of this great diversity, the following species or taxa are covered in the Comprehensive Wildlife Conservation Strategy (CWCS) as Species of Greatest Conservation Need (SGCN): one terrestrial mammal, 77 birds, over 5,000 known terrestrial invertebrates, over 500 plants, six species of endemic terrestrial algae, 12 freshwater invertebrates, five freshwater fishes, 24 species of endemic freshwater algae, 20 anchialine-pond associated fauna, 26 marine mammals, six marine reptiles, 154 marine fishes, 197 marine invertebrates, and 79 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).

Terrestrial Mammal

The ‘ōpe‘ape‘a (Hawaiian hoary bat) is the only land mammal native to the Hawaiian archipelago and is an endemic subspecies of a bat found throughout North and South America. Historically, it is known from all of the MHI but Ni‘ihau. It is federally listed as endangered due to apparent population declines and a lack of information on its distribution, abundance, and habitat needs. Bats are affected by habitat loss, roost disturbance, and pesticides. The Hawaiian Bat Research Cooperative, a partnership composed of government agencies, non-profit organizations, and private landowners, was formed to prioritize and fund needed bat research.

Birds

The avifauna in Hawai‘i are of national and global importance, as Hawai‘i is home to the highest number of endemic forest birds in the United States and provides habitat for globally significant nesting populations of seabirds. Only about twenty bird species colonized Hawai‘i. These represent just a few of the bird families known worldwide (19 out of 144). Most species are year-round residents, including forest birds, waterbirds, and two endemic seabirds, but many species of seabirds and migratory birds have breeding or wintering grounds in the State.

Forest birds

The ancestors of the forest passerines encountered different resource opportunities and limitations on different islands (e.g., foods and forest types). Because the distances between islands are formidable barriers to most small birds, inter-island isolation also

contributed to speciation and led to several island endemic species. As a result, within each of the five families of passerines found in Hawai‘i, there are related but distinct subspecies or species represented on different islands. Unfortunately, only one of five historic species of the family Corvidae is extant, and all members of the family Melephigidae are likely extinct.

There are only about 30 extant species of native Hawaiian forest birds--less than half the number known from historic and fossil records--and one third of those remaining are extremely rare or possibly extinct. More than half are endangered. A number of factors have contributed to this decline. Conversion of land from native forests to agricultural and other human use began with the arrival of Polynesians and accelerated with European contact. Remaining forests have been degraded by ungulates and invasive plant species. The introduction of the avian malaria virus and avian pox have proven catastrophic to Hawaii's native bird species, especially the passerines. Rats, feral cats, and mongooses prey on bird nests, nestlings, and even on incubating adults. In addition, alien bird and arthropod species may compete with native forest birds for food or nest resources.

As a result of these changes, especially the introduction of mosquitoes, most remaining forest birds survive in montane mesic and wet native forests dominated by ‘ōhi‘a and koa or in subalpine forests dominated by māmane and co-dominated by māmane and naio where cooler temperatures limit mosquitoes. These include forests on Hawai‘i and Maui, as well as remnant forest patches at high elevations on Moloka‘i, Lāna‘i, O‘ahu and Kaua‘i. Thus, some species may be persisting in marginal habitats, further complicating their recovery. Critical conservation actions include protection of remaining native forest habitats from further degradation by ungulates and non-native plant species, control and eradication of introduced predators (primarily rodents and cats); captive propagation (‘alalā, puaiohi, ‘ākohekohe (*Palmeria dolei*), Maui parrotbill (*Pseudonestor xanthophrys*), Hawai‘i creeper (*Oreomystis mana*), Hawai‘i ‘ākepa (*Loxops coccineus coccineus*), ‘akiapōlā‘au (*Hemignathus munroi*), palila, ‘i‘iwi (*Vestiaria coccinea*), ‘amakihi (*Hemignathus virens*), and Hawai‘i ‘elepaio), and the prevention of the introduction of additional predators (e.g., snakes), disease (e.g., West Nile virus), or any other habitat-modifying plants or animals.

The Hawaiian Forest Bird Recovery Team, a cooperative effort involving multiple government agencies and non-profit organizations, guides forest bird conservation work, including the development of the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003) and five-year implementation plans for identified critical species, captive propagation, annual forest bird surveys, as well as other identified research and management projects.

Raptors

The ‘io (Hawaiian hawk) and the pueo (Hawaiian short-eared owl) are the only extant native raptors in Hawai‘i. The ‘io (Hawaiian hawk) is listed as endangered by both the USFWS and State and is restricted to the island of Hawai‘i. The pueo occurs on all the MHI and is listed by the State as endangered on O‘ahu only. Both birds are found from sea level to high elevations across most habitats. Primary threats include predation by

introduced rodents and cats (particularly for the ground-nesting pueo) and habitat loss. Additional research on the distribution and abundance of these species as well as potential limiting factors (e.g., environmental contaminants and harassment by humans) is needed for both species.

Waterbirds

Six species of extant, endemic waterbirds occur in Hawai‘i: the Laysan duck (*Anas laysanensis*), nēnē (Hawaiian goose), koloa maoli (*Anas wyvilliana* [Hawaiian duck]), ‘alae ‘ula (*Gallinula chloropus sandvicensis* [Hawaiian moorhen]), ‘alae ke‘oke‘o (*Fulica alai* [Hawaiian coot]), and ae‘o (Hawaiian stilt). An additional indigenous species, ‘auku‘u (*Nycticorax nycticorax* [black-crowned night-heron]), is common throughout the MHI. All of the endemic species are listed as endangered by the USFWS and by the State. A Draft Revised Recovery Plan for the Laysan duck was published in 2004, a Revised Recovery Plan for the nēnē (Hawaiian goose) is currently in preparation, and a Draft Revised Recovery Plan covering the other four listed waterbird species was published in 1999. The ‘alae ke‘oke‘o (Hawaiian coot) and ae‘o (Hawaiian stilt) have been observed on every MHI except Kaho‘olawe, the distribution of the other three endemic waterbird species is more restricted within the MHI, and the Laysan duck is limited to Laysan island and Midway Atoll in the NWHI.

Three of the waterbird species (‘alae ‘ula (Hawaiian moorhen), ‘alae ke‘oke‘o (Hawaiian coot), and ae‘o (Hawaiian stilt)) inhabit wetland habitats including tidal flats and estuaries, playas and ephemeral basins, freshwater marshes, coastal ponds, taro patches, and human-constructed wetlands, such as irrigation ditches and sewage treatment ponds. The koloa maoli (Hawaiian duck) occurs in the above freshwater environments as well as montane streams and swamplands. Nēnē (Hawaiian goose) have been reintroduced to Kaua‘i, Maui, Hawai‘i, and Moloka‘i, where they can be found from sea level to 2,400 meters (7,900 feet) in elevation, predominantly in dry forest, shrubland, and grassland. The Laysan duck utilizes all available habitats with vegetation cover and fresh water, including upland vegetation, ephemeral wetlands, mudflats, and coastal areas. Historically found in the MHI as well as the NWHI, the Laysan duck was found only on Laysan island until last year when 20 birds were translocated to Midway Atoll.

The loss and degradation of wetland habitats negatively affects these species. Predation (primarily by feral cats, but also by mongooses and feral dogs (*Canis familiaris*)), hybridization between non-native mallards and the koloa maoli (Hawaiian duck), and disease also negatively affects these birds. Protecting and maintaining existing habitat, identifying and securing needed additional habitat, controlling or eradicating introduced predators, improving understanding of the use of non-breeding habitats (e.g., maintenance sites), captive propagation and reintroduction, and monitoring populations are priority conservation actions.

Seabirds

Forty different seabird species have been observed in the Hawaiian Islands, and at least 20 are known to breed in Hawai‘i. Two seabirds are endemic to Hawai‘i: ‘ua‘u (*Pterodroma sandwichensis* [Hawaiian petrel]) and of the ‘a‘o (*Puffinus auricularis*

newelli [Newell's shearwater]). Many of these seabirds are of global or national importance: over 95 percent of the world's mōlī (*Phoebastria immutabilis* [Laysan albatross]) and ka'upu (*Phoebastria nigripes* [black-footed albatross]) populations nest in the Hawaiian Archipelago. Other seabirds of conservation concern include the 'akē'akē (band-rumped storm petrel), listed as endangered by the State, the short-tailed albatross (*Phoebastria albatrus*), listed as endangered by USFWS, and the Christmas shearwater (*Puffinus nativitatis*), the Tristram's storm petrel (*Oceanodroma tristrami*), and the blue-gray noddy (*Procelsterna cerulean*), identified as "high concern" in the U.S. Seabird Conservation Plan for the Pacific Region.

Historically, high densities of seabirds nested on all Hawaiian islands, but now most are restricted to the NWHI or to predator-free offshore islands within the MHI. A few birds, such as the 'ua'u (Hawaiian petrel) and 'a'o (Newell's shearwater), nest in high elevations or in inaccessible locations (e.g., sheer cliffs) in the MHI. Primary threats to seabirds while in Hawai'i include predation by feral cats, rodents, and mongooses, loss or degradation of habitat due to habitat-modifying invasive plants or animals, and human disturbance including coastal lighting. Threats at sea include fisheries bycatch and pollution (including oil spills). Needed conservation actions are protection of existing habitat, eradication of introduced predators (cats, rodents, and mongooses) from additional offshore islands and known breeding colonies, and additional surveys to locate additional breeding colonies and monitor population status and trends, particularly at sea.

Migratory shorebirds and waterfowl

Several species of migratory shorebirds and waterfowl winter in Hawai'i. Of these, the kōlea (*Pluvialis fulva* [Pacific golden plover]), the 'akekeke (*Arenaria interpres* [ruddy turnstone]), the 'ūlili (*Heteroscelus incanus* [wandering tattler]), and the kioea (*Numenius tahitiensis* [bristle-thighed curlew]) are regular migrants that have been identified as important (by the U.S. Shorebird Conservation Plan) because the populations in Hawai'i are hemispherically significant or relatively large. The habitats used by these migratory shorebirds and waterfowl generally overlap with those used by resident species, thus, protected wetland and coastal habitats often support both endemic waterbirds and migratory shorebirds and waterfowl. Primary threats to migratory shorebirds and waterfowl include loss or degradation of habitat and predation by feral cats and dogs. Protecting and maintaining existing habitat, identifying and securing needed additional habitat, controlling or eradicating introduced predators, improving understanding of the role of Hawaii's wintering habitats on global populations, and assessing population size and distributions are priority conservation actions.

Northwestern Hawaiian Islands passerines

Three species of passerines are found in the NWHI: the Laysan finch (*Telespiza cantans*), Nihoa finch (*Telespiza ultima*), and Nihoa millerbird (*Acrocephalus familiaris*). Found only on their respective named islands within the Hawaiian Islands National Wildlife Refuge in the NWHI, these three species are among the rarest birds in the world. Major threats include the introduction of habitat-modifying alien plants, the introduction of habitat-modifying or predaceous non-native animals, and environmental factors, including natural disaster, drought, and long-term climate change (e.g., sea level rise).

Priority conservation actions include maintaining the integrity of the islands' habitat by preventing and responding to non-native plant and animal introductions.

Terrestrial Invertebrates

Similar to native forest birds, Hawaii's native terrestrial invertebrates are characterized by high levels of endemism – over 90 percent of terrestrial invertebrates are found nowhere else on earth. Unique invertebrates include a carnivorous caterpillar, happy-face and no-eyed big-eyed spiders, and yellow-faced bees. Several invertebrates have been listed as endangered by the USFWS: O'ahu tree snails of the genus *Achatinella*, the Kaua'i cave wolf spider (*Adelocosa anops*), the Kaua'i cave amphipod (*Spelaeorchestia koloana*), and the Blackburn's sphinx moth (*Manduca blackburni*), with Recovery Plans prepared for all four taxa and critical habitat designated for the sphinx moth and the Kaua'i arthropods. Twelve species of *Drosophila* flies are currently proposed for listing as endangered, and two species of Lāna'i tree snails (*Partulina* spp.), six species of *Megalagrion* damselflies, two species of *Drosophila* flies, one gall fly (*Phaeogramma* sp.), and the wekiu bug are candidates for listing by the USFWS. Many more native invertebrates are believed to be rare.

Native invertebrates play many critical roles in the ecosystem such as food for native birds and as pollinators for native plants. They can also be found in almost every habitat known throughout the Hawaiian Archipelago, including aeolian alpine summits, lava tube and lava cave systems, and strand and littoral habitats.

The main threats facing terrestrial invertebrates are loss and degradation of habitats, predation and competition by introduced species, and the loss of native host plants. The endemic koa tree is of particular importance as habitat for a wide range of native invertebrates, and extensive logging or the introduction of a pest or disease that attacks koa would have a significant impact on native invertebrate diversity. Further, funding to document new species or determine accurate populations or distributions of known species is insufficient; there are over 5,000 native terrestrial species currently known with new species discovered every year. Conservation actions needed for terrestrial invertebrates include improved information (e.g., species biology, population assessments, habitat needs and interactions), protection and restoration of native habitats, increased quarantine and inspection as well as assessment of pest-control and biocontrol measures to prevent further injurious alien introductions, establishment of long-term monitoring programs, and better education and outreach programs. In addition, research to gain a better understanding of the causes behind the decline in native ground-dwelling arthropods such as jumping bristletails, bees, and wasps is needed.

Plants and algae

Over 1,000 distinct flowering plant species evolved from approximately 295 successful flowering plant colonist species. In addition, Hawai'i supports over 150 recognized taxa of native ferns and fern allies. Total species richness is concentrated on older islands, primarily in mesic and wet habitats and at relatively low elevation (700 to 800 meters; 2,100 to 2,400 feet), as a function of evolutionary and ecological processes acting within the constraints of geologic history. Richness of endangered plant species is highest in mesic and dry habitats of the Wai'anae mountains of O'ahu, with somewhat high concentrations in the mesic habitats of western Kaua'i and the wet habitats of the Ko'olau mountains on O'ahu. Plant species that are

naturally rare (those projected to have had a restricted range prior to human impact) are concentrated in the mesic habitats of the Waiʻanae mountains (Oʻahu), the Alakaʻi swamp region (Kauaʻi), and other wet summit regions (e.g., Koʻolau mountains, Oʻahu). Plant species that have suffered the greatest percentage of habitat loss are concentrated in very low elevation mesic habitats on Kauaʻi mesic to dry habitats in the Waiʻanae mountains (Oʻahu), very low elevation mesic habitats in the Koʻolau mountains (Oʻahu), and low elevation dry to mesic habitats on Molokaʻi, Maui and Lānaʻi. Critical habitat has been designated on every island in the MHI and on Nihoa, Necker, and Laysan in the NWHI for over 100 listed plants.

Feral ungulates, such as cattle, pigs, goats, deer (*Odocoileus hemionus* and *Axis axis*), and mouflon sheep, pose a major threat to native plants by consuming and trampling native understory plants, creating conditions favoring non-native plant infestation and establishment, preventing the establishment of ground-rooting native plants, and disrupting soil nutrient cycling. Introduced invertebrates and disease weaken and kill native plants and compete with native pollinators, and invasive habitat-modifying plants outcompete native plants within the habitat. Conservation actions needed include protection of existing native habitats from feral animals, invasive plant control and eradication, monitoring of populations, and additional research on methods to address the role of invertebrates and disease. Extremely rare plants require additional *ex situ* (off site) conservation actions (e.g., seed banking, *in vitro* propagation, and cryopreservation).

Hawaiʻi also has an endemic marine plant, the seagrass *Halophila hawaiiana*, which is host to an endemic snail. Threats to 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 its role in the ecosystem, beyond the importance of marine algae as a food source for marine fishes, invertebrates, and green sea turtles. Over 100 species of endemic terrestrial, freshwater, and marine endemic algae have been identified.

Freshwater Species

Streams in Hawaiʻi have a relatively small number of native species. There are five native fishes or ʻoʻopu, that occur in freshwater streams and evolved from two families of marine fishes. These ʻoʻopu are mostly small herbivores or omnivores. There are twelve freshwater invertebrates of conservation need, including two omnivorous shrimps, at least eight species of herbivorous snails, one endemic worm species, and one endemic 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.

Anchialine-pond Fauna

Anchialine ponds are home to numerous animals. 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 where 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. 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. Some *Megalagrion* damselflies are also found in anchialine ponds, but require vegetation that is often removed from the ponds. Many other marine species can be occasionally found in anchialine ponds. 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 management of human access, protection of pond habitats, and development of effective methods to prevent and control invasive species.

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 of Hawai‘i. Over 5,000 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, 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) 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 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.

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CHAPTER 4: STATEWIDE CONSERVATION NEEDS

Based on the overview provided in Chapter 3, Chapter 4 discusses the major threats affecting species statewide, followed by seven objectives and priority strategies to address the major threats outlined. The adoption of these seven objectives and priority strategies by the people and institutions of Hawai‘i will continue to build on the success stories and conservation achievements to ensure that a legacy of healthy biodiversity is left for future generations. This chapter addresses elements 3 and 4 at the statewide level.

OVERVIEW OF THREATS

CURRENT THREATS

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

- Loss and degradation of habitat resulting from human development, alteration of hydrology, wildfire, invasive species, recreational overuse, natural disaster, climate change, and other factors;
- Introduced invasive species (e.g., habitat-modifiers, including weeds, ungulates, algae and corals, predators, competitors, disease carriers, and disease);
- Limited information and insufficient information management;
- Uneven compliance with existing conservation laws, rules and regulations;
- Overharvesting and excessive extractive use;
- Management constraints; and
- Inadequate funding.

Loss and Degradation of Habitat

Loss, fragmentation, and degradation of habitat have been primary contributors to extinction and rarity of native bird species and are suspected to play an important role in the decline of native invertebrate populations. Historically, logging, agriculture, grazing, military use, fire, and urban and residential development have claimed more than half of Hawaii's native habitats. At low elevations where development pressures are highest, less than ten percent of native vegetation remains. 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. For other sensitive areas such as subterranean systems or nearshore reefs, the increase in human visitation, particularly by tourists, cumulatively impacts habitat quality and is a growing cause for concern.

Populations of many species are limited by the amount of suitable habitat available. This results in multiple problems that increase the probability of future extinction. Because many of the Hawaiian plant and animals co-evolved with one another, extinction of one species could lead to cascading extinctions of other species. While the current land use zoning of the Conservation District limits further loss of forested habitat to development, this designation confers only the coarsest protection. Without active management, these lands remain threatened by invasive

plants and animal species or require restoration to support native wildlife. In addition, zoning does not protect all of the remaining quality habitat from being converted to another land use.

Development and shoreline alterations

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. The closure of sugar plantations resulted in the loss of irrigation ponds used by waterbirds, and many former fields are 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 Kaʻū. Shoreline alterations, including the building or expansion of harbors, seawalls, and other structures, damages marine habitats for corals and other species directly or indirectly by changing water flows or sediment deposition.

Alteration of hydrology

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. Such activities indirectly affect terrestrial wildlife where these changes alter plant communities or the availability of drinking water. Insufficient instream flows with lack of set 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.

Fire

Unlike many continental ecosystems, Hawaiian plants and animals are not adapted to periodic fires, most likely because of few natural ignition sources like lightning. Today, invasive plants have increased the fuel loads in some areas, and most fires are caused by human activities. Fires are more likely to occur on the dry leeward side of the islands, destroying existing habitat and providing invasive species with an opportunity to displace native vegetation.

Recreational Overuse and Tourism Effects

The cumulative impact of human interaction with native species and habitats is a growing concern. Most attention recently has centered on marine activities, and 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. On land, recreational overuse is also an emerging concern. An increase in the popularity of guidebooks and Internet sites that reveal the locations of sensitive habitats to more people has increased visitation in these areas. Many sensitive habitats such as anchialine ponds, lava tube and cave systems, 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 native plant communities and nesting seabirds.

Natural Disaster

Because many Hawaiian plant and animal species persist in low numbers or in restricted ranges, natural disasters, such as hurricanes, volcanic eruptions, or tsunamis can be particularly devastating. For example, several species of forest birds endemic to Kauaʻi suffered significant declines in population or have not been seen since Hurricanes Iwa (1982) and Iniki (1992) and volcanic eruptions from Mauna Loa on the island of Hawaiʻi in 1984 destroyed quality habitat for island endemic forest birds.

Climate Change

Global climate change is anticipated to have multiple and disastrous effects on Hawaiian wildlife. First, sea level rise will inundate the Northwestern Hawaiian Islands (NWHI), reducing habitat for nesting seabirds, monk seals, and sea turtles, and alter coastal habitats throughout Hawaiʻi. Second, temperature increases will allow avian disease pathogens and vectors to expand their ranges to higher elevations, areas which currently support the last remaining populations of many forest bird species. Third, Hawaiʻi could experience increased frequency of El Nino/Southern Oscillation (ENSO) events, meaning more drought periods that could impact both wildlife and habitat. ENSOs may have implications for marine wildlife as well. Fourth, increases in ocean temperatures could impact invertebrate and fish populations, which would in turn impact seabird 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 Hawaiʻi 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

Due to their evolutionary history and high levels of endemism, Hawaii's native plants and animals 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 other region of the United States has experienced a similar invasion of non-native competitors, predators, habitat-modifiers, vectors of infectious disease, and pathogens.

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. The establishment of non-native species is facilitated by Hawaii's benign climate, year-round growing season, the range of habitats, and the number of "open niches." 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 6,000 introduced terrestrial and aquatic species are now established, and that of all the species currently in Hawai‘i, approximately 26 to 30 percent are non-native. While many introductions do not pose a threat to native habitats, approximately ten percent of the established non-native species are highly invasive or pose significant threats to Hawaiian ecosystems.

In addition to the already established introduced species, numerous species currently not found on the islands are poised to invade island ecosystems. Over a nine-month period, a Pest Risk Assessment conducted at Kahului Airport by the State Department of Agriculture discovered over 100 alien species entering via air cargo. Because the establishment of additional invasive species poses such a risk to Hawaii's native wildlife, ecosystem, economy, and public health, preventive measures have been established for a few identified threats, such as the brown treesnake (*Boiga irregularis*) and West Nile virus. Many other potential introduced species, such as the red-imported fire ant, Africanized honey bee, biting flies, marine organisms, and "lethal yellows" (palm disease) pose such high risk of damage that similar preventive planning is needed, but prevention is expensive and requires continual vigilance. Finally, the rise of the genetically modified organisms (GMO) industry in Hawai‘i is an emerging issue as the impacts of GMOs to native flora and fauna, such as through inter-species transfer of genes, is under research.

Habitat Modifiers: Invasive Plants and Ungulate Grazers and Browsers

One of the major threats to Hawaii's native species and forests is the uncontrolled spread of many invasive non-native plants. These plants displace Hawaii's distinctive native flora, resulting in a loss of species diversity and eventually in more pronounced and permanent changes to ecosystem function such as alteration of primary productivity and nutrient cycling. Many invasive species completely replace native vegetation resulting in total loss of native habitats. Invasive plants such as fire-adapted fountain grass (*Pennisetum setaceum*) and orchard grass (*Dactylis glomerata*) provide fuels for fires and often increase in abundance after fires. A short list of invasive plant species that pose a significant threat to native plant communities and require aggressive management include miconia (*Miconia calvescens*), firetree (*Morella faya*), fountain grass (*Pennisetum setaceum*), banana poka (*Passiflora tarminiana*), blackberry (*Rubus argutus*), mangrove (*Bruguiera gymnorrhiza* and *Rhizophora mangle*), strawberry guava (*Psidium cattleianum*), and golden crown-beard (*Verbesina encelioides*); there are many other invasive plants that degrade and destroy native habitat. Because the seeds of many invasive plants persist for years, eradication is exceedingly difficult after the plant is established and control requires an ongoing effort to prevent further spread. However, control operations are expensive; for example, the current expenditures to control miconia on Maui alone are $1 million dollars a year.

Established ungulates (hooved animals) are another major threat to native habitat. Ungulates in Hawai‘i include pigs (*Sus scrofa*), goats (*Capra hircus*), sheep (*Ovis aries*), mouflon sheep (*Ovis musimon*), deer (*Odocoileus hemionus* and *Axis axis*), and to a lesser extent, feral cattle (*Bos taurus*). Ungulates directly and indirectly affect native ecosystems in a variety of ways. These effects include damaging vegetation by grazing and browsing, trampling seedlings and aquatic invertebrates, spreading non-native plant seeds, disturbing soil, and increasing erosion. These activities can affect the amount of light and moisture levels within forests, as well as nutrient cycling, and result in modified or destroyed plant and animal communities, decreased water retention of soils, erosion, and decreased water quality. In addition, pigs have been observed destroying the nests of ground-nesting birds (e.g., nēnē) and have been linked to the spread of mosquito-borne avian disease (i.e., pig wallows creating mosquito breeding habitat).

Because Hawaiian plants only recently have been exposed to the effects of grazing, they lack common defenses such as thorns or toxins. Thus, grazing and browsing animals often prefer native plants over non-native plants. Grazing and browsing can result in the extirpation of native plant populations, but even low intensity browsing can affect the species composition of habitats and encourage a shift in dominance from native towards non-native species. Non-ungulate herbivores, such as rabbits (*Oryctolagus cuniculus*), can have the same impact.

Soil disturbance by rooting animals (typically pigs) occurs throughout Hawai‘i and favors the germination and establishment of alien plant species, many of which are adapted to such disturbances and may require disturbance to complete their life cycle. Conversely, native species are not adapted to such disturbances and tend to be negatively affected. This in turn affects the composition of plant communities, which indirectly affects the animals that depend on the community; effects on native invertebrates may be particularly acute. Removal of ungulates is often the first step in ecosystem restoration and usually results in the recovery of native habitat, as well as the decline of particular alien plants.

The distribution of ungulates varies across the landscape. Subalpine communities have been and continue to be affected by feral goats, mouflon sheep, and feral pigs. Montane and lowland mesic forests on Kaua‘i and Maui are impacted by the spread of axis deer. Dryland forests have suffered greatly because of cattle and goats. Feral pigs typically affect wetter communities, and their effects are widespread throughout the islands. Control of animal populations is difficult and expensive, given high rates of reproduction and the ability of these animals to hide.

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 Kāne‘ohe Bay, O‘ahu and Waikīkī, O‘ahu have experienced algal blooms or have growing invasive algae

populations. Another marine invasive, snowflake coral (*Carijoa* sp.), outcompetes and overgrows native coral species, possibly including the precious black corals found in deeper waters off Maui.

Introduced Predators

Hawaiian terrestrial animals evolved in the total absence of mammalian predators and are extremely vulnerable to predation by these introduced species, especially rats (*Rattus* spp.) and feral cats (*Felis silvestris*), and to a lesser extent, mongooses (*Herpestes auropunctatus*). All of these species prey on eggs, nestlings, and adult birds, limiting populations. Rats have been implicated in the decline in native bird populations in the early 1900s. Rats are ubiquitous throughout Hawaiian habitat and while rats are commonly known to prey on seabirds, waterbirds, and forest birds, even climbing into trees to prey upon canopy-nesting species, they are also known predators of native tree snails and other native invertebrates. Rats also eat the seeds of a large number of native plant species, limiting their regeneration. Feral cats are extremely skilled predators and have been responsible for the extinction of birds on other islands. In Hawai‘i, cats are widely distributed and are found throughout bird habitat on all of the Main Hawaiian Islands (MHI) from sea level to high elevation. While a single cat can have a devastating effect on a breeding seabird colony, “cat colonies” pose an even greater threat to bird populations because of their concentrated sheer numbers. Although less arboreal than rats, mongooses are efficient predators. With few rare exceptions, populations of nēnē (Hawaiian goose), waterbirds, and seabirds do not persist long in areas where mongooses are present. Presently, high densities of feral cats, rodents, and mongooses are a major cause of mortality among native birds and may place similar pressures on native terrestrial invertebrates. In general, Hawaiian bird species have low reproduction rates, so increased predation can be particularly problematic.

Other predators that pose ongoing threats to native bird species include feral and unleashed dogs (*Canis familiaris*), cattle egrets (*Bubulcus ibis*), barn owls (*Tyto alba*), frogs, and pigs. Fortunately, snakes have yet to become established in the islands. Given that the brown treesnake (*Boiga irregularis*) effectively caused the extinction of Guam’s avifauna, it is expected that the successful establishment of predatory snakes in Hawai‘i would have equally devastating consequences.

Introduced fishes have been documented to prey on native freshwater fishes and invertebrates, while introduced frogs, such as the coqui, prey on aquatic and terrestrial invertebrates. Anchialine ponds are threatened by introduced fishes and shrimps that prey on the native shrimp and alter the habitat structure. Over the last 200 years, introductions of invertebrates, including ants, snails, and wasps, have been extensive throughout the archipelago. Many of these species prey on or parasitize native invertebrates. Biologists have long suspected that these introductions caused declines in native insects and snails and had indirect community-level effects. Scientists in the last century, for example, noted extensive declines in native moths after introductions of predatory arthropods. These declines were followed by declines in native birds that preyed on the native moths. More recently, studies have documented the effects of introduced ants and vespid wasps

on native arthropod fauna and on nesting birds; for example, introduced ants have been documented killing nestlings.

Disease carriers, Disease, and Pathogens

The introduction of mosquitoes (*Culex quinquefasciatus*) to the Hawaiian Islands in 1826 had a profound effect on native forest birds and continues to affect the distribution and abundance of many bird species. By serving as vectors for avian malaria (*Plasmodium relictum*) and avian poxvirus (*Poxvirus avium*), mosquitoes effectively spread these diseases throughout lowland areas. Many species of introduced birds now present in Hawai‘i may provide effective reservoirs for these diseases, allowing them to persist and spread widely. For Hawaiian birds that had evolved in the absence of these diseases for millions of years, the impacts were severe. Over the next 150 years, many bird species became extinct. Today, most of the remaining native forest birds persist at elevations above 1,600 meters (5,000 feet), where few mosquitoes can survive.

In recent years, a few species have begun to recolonize lower elevations where avian malaria and poxvirus are common, indicating that at least some species may have developed resistance to these diseases. However, global warming could enable transmission of poxvirus and malaria to higher elevations, threatening remaining populations of endangered birds. New vectors of such diseases are also of concern. On the island of Hawai‘i, the recent establishment of *Aedes japonicus*, the State’s first truly temperate mosquito, may extend the range of mosquito-borne disease into currently mosquito-free high elevation forests.

Other diseases impact native wildlife; for example, avian botulism is the most prevalent disease in Hawai‘i for native waterbirds and the introduction of West Nile virus could have even more devastating impacts. Threat by disease is not limited to terrestrial fauna, however. 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 agassizi* [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 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

Resource managers must typically make decisions based on incomplete data and information. Data on the effects of different threats to native species 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.

For example, Hawaii’s forest birds have been systematically surveyed for the past 25 years, yet current information on population size or distribution in certain areas remains poorly known for some species. Limited funds restrict surveys mainly to currently managed lands and may not accurately reflect a population’s full distribution or abundance. Accurate population estimates for many Hawaiian waterbirds, seabirds, fishes, and for most non-threatened or endangered

invertebrate populations 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 native species. Population censuses 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. For example, for many Hawaiian forest birds, virtually nothing is known about their reproductive behavior, demography, survival, or dispersal tendencies.

Gaps in information are often magnified by the challenges inherent in sharing information across institutions. Multiple agencies and organizations in Hawai‘i 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 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 for the value of protecting native 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. As a result, voluntary compliance with conservation laws and regulations decreases as the public sees few consequences for violations. Poaching of native wildlife and other non-compliance with conservation laws, rules, and regulations is a direct threat to native 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 that encourage voluntary compliance. In many locations, this level of community involvement is absent.

Overharvesting and Excessive Extractive Use

Bottomfishes, as defined by the Federal government to include the ulua (*Caranx* spp.) as well as ‘ōpakapaka (*Pristipomoides filamentosus*), onaga (*Etelis coruscans*), and hāpu‘u (*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 wildlife as well. Certain reef fishes are harvested for sale in the aquarium trade. Freshwater and marine fishes and invertebrates are collected for subsistence, recreation, and commercial purposes. Native plants and snails that may be important food sources or habitat for native birds and invertebrates are illegally collected for lei making, flower arrangements, jewelry, or herbal use. Logging of native koa (*Acacia koa*), ʻōhiʻa (*Metrosideros polymorpha*), and hāpuʻu tree ferns (*Cibotium* spp.) removes important components of a native forest. These activities are not sustainable on a large scale and impact native wildlife.

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. Regardless of their jurisdiction and management goals, land managers face similar constraints, such as multiple use mandates, insufficient funds for day-to-day management, infrastructural challenges, regulatory hurdles, high numbers of visitors, and increasing demands for public access.

The Department of Land and Natural Resources (DLNR), the State agency charged with managing the State's lands and waters, has multiple management responsibilities. For example, DLNR is charged with documenting and preventing illegal activities on public lands, conducting auctions to lease public lands, protecting and recovering indigenous wildlife and their habitats, preserving natural areas and protecting watershed resources, promoting public hunting, establishing and regulating public fishing areas, harvesting forest products, providing public lands for agricultural purposes, and generating revenue from the lease of State lands. While generally consistent, these multiple uses may not always facilitate strategic native wildlife conservation objectives. For example, a State lease for pasture use may degrade remnant native habitat or public hunting rules may not adequately control ungulate populations to meet the management needs for forest bird recovery and native plant protection. Efforts to identify inconsistencies in management guidelines and policies can be delayed by a lack of resources (technical, human, and financial) and the lack of effective working relationships with different resource user groups to jointly identify areas for dedicated conservation and areas for multiple use.

DLNR also 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) is delayed by the existing regulatory process. Current State and Federal regulations require more review and

approvals of techniques to control invasive non-native 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 horticulture. Other management actions such as invasive plant species removal or ungulate-proof fence construction can trigger State permitting and environmental review processes. Finally, at least 117 Hawaiian species qualify for listing as threatened or endangered by USFWS, 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 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 (such as private land ownership or former farm land). These factors contribute to "opportunistic" conservation on a piecemeal basis based on funding availability, rather than addressing needs in order of biological priority.

The largest landowner of important habitat for native plants and animals is the State of Hawai‘i. However, as discussed earlier in Chapter 3, the amount of State funds dedicated to conservation of native wildlife and their habitats is conservatively estimated at $23 million dollars annually, while annual funding requirements estimated for the recovery of forest birds alone is four times this amount. Although much of the State funding is matched by Federal funds (e.g., Endangered Species Act Section 6 grants and State Wildlife Grant funds) to increase the overall conservation budget, it still is inadequate to address the wildlife conservation needs in Hawai‘i, let alone effectively prevent the introduction of new invasive species. Moreover, 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.

STATEWIDE CONSERVATION OBJECTIVES

The goal of this CWCS is to guide conservation efforts across the State to ensure protection of Hawaii's Species of Greatest Conservation Need and the diverse habitats that support them. Given limited conservation dollars, management of habitats to benefit multiple species is the focus of the CWCS. Hawaii's CWCS development process sought to identify major threats affecting native wildlife and their habitat throughout the State and then defined major objectives and strategies to respond to these threats and improve native 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 resource managers and landowners to address the major conservation needs of Hawaii's native 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 public support. This overlap underscores the necessity for a landscape-level, multiple-species approach to conservation of Hawaii's wildlife. These seven objectives address the overall goal and the legislative mandate of the CWCS. Future assessment of their effectiveness as conservation tools is discussed in Chapter 8 (Monitoring, Implementation, and Adaptive Management).

Under each objective are listed specific strategies that encompass multiple direct conservation actions that must be applied in areas currently managed for wildlife conservation and in potential areas for future conservation management. All of the strategies are high priorities; however, those that are the highest priority are identified. Additional conservation strategies and actions are identified in Chapters 5 (Marine Conservation Needs), 6 (Island Conservation Needs), and 7 (Species of Greatest Conservation Need).

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

Protection of the remaining native ecosystems and restoration of additional native habitats are necessary to conserve Hawaii's native wildlife for future generations.

<u>Highest Priority</u>

- Adequately support the implementation of conservation management plans, guidelines, and actions within currently managed areas (e.g., National Parks, National Wildlife Refuges, National Marine Sanctuaries, Natural Area Reserves, Natural Area Partnership Preserves, Forest Reserves, Watershed Partnership areas, Marine Protected Areas,

landowner preserves, and other areas committed to native habitat and species conservation);
- For habitats on private land not currently protected and/or receiving management attention (e.g., middle reaches of stream corridors or coastal areas), encourage protection using appropriate tools, including acquisition, grant agreements, conservation easements, leases, technical assistance, development of safe harbor agreements or habitat conservation plans, and other tools;
- 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.

<u>High Priority</u>
- Remove introduced mammals (e.g., goats, pigs, deer, mouflon, rats, feral cats, mongooses) from important habitats to establish ungulate and predator free areas on each island;
- Develop recovery and management plans where needed to guide management, including short-term implementation plans, for species, species groups, or habitats;
- Implement effective habitat management through a variety of activities: landscape-level predator management; invasive plant control, fencing and ungulate removal, predator control, wetland enhancement, riparian restoration, native species outplanting, fire threat mitigation, and management of human activity in sensitive areas;
- Support the development and implementation of statewide programmatic Safe Harbor Agreements;
- Decrease in number of stream diversions and channelized streams;
- Review the status of all Marine Managed Areas (MMAs) and consider altering boundaries or adding new MMAs;
- Develop a handbook on restoration specific to Hawai‘i;
- Support development of an expanded CWCS that more fully integrates plants and algae;
- Develop plans to respond to natural disasters and climate change.

2. Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
Invasive alien species have the capacity to degrade and destroy remaining native habitat and eliminate native species. Continual monitoring and responsive management is needed to prevent the establishment of invasive plants, algae, marine invertebrates, predators, parasites and pathogens in priority areas and to control or remove invasive plant and animal species from areas managed for natural resources protection. Prevention and rapid response to novel threats is critical to preventing the establishment of new threats into the State.

<u>Highest priority</u>
- Increase inspection and implement other “prevention” measures to identify and prevent high-risk invasive species and diseases (e.g., brown treesnake, West Nile virus) from entry into the State or between islands. This must include implementation of appropriate measures for the pet, poultry, agriculture, aquaculture, and horticulture industries, for domestic and international mail and shipments, especially from Asia, for military transport, and for the tourism industry.

High priority

- Continue coordination of invasive species prevention, management, and control programs for county, State, Federal, and private sector entities through existing mechanisms, including the Hawai‘i Invasive Species Council, the Coordinating Group on Alien Pest Species, individual island invasive species committees, the Aquatic Invasive Species Management Plan, and topic-specific working groups (e.g., the West Nile Virus Prevention Group and the Brown Treesnake Rapid Response Team);
- 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;
- Strengthen quarantine and treatment of imported plants, especially known vectors for non-native invertebrates (e.g., Christmas trees);
- Provide adequate funding for effective statewide early detection and rapid response to new introductions of invasive species;
- Control already established priority invasive plants, such as fountain grass, miconia, kāhili ginger, Australian tree fern, mangrove, and others, to prevent the spread into pristine habitats;
- Decrease the number of invasive species or the total area of invasive species coverage in aquatic and marine ecosystems;
- Continue research on effective management methods and tools (e.g., control methods for introduced vertebrates (e.g., mongooses, rats, cats, mallards), invertebrates (e.g., *Vespula* spp., wasps, ants, and carnivorous snails [*Euglandina rosea*]), and for introduced predatory fish;
- Support a coordinated statewide invasive species public outreach program with shared resources and responsibilities among cooperating entities;
- Continue to support research on biocontrol (including prescreening to limit unintentional secondary impacts) as one method that addresses priority invasive species.

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

Existing knowledge on the statewide distribution, abundance, population trends, and limiting factors of native wildlife is inadequate for all species. Similarly, detailed information on vegetation structure and composition is lacking for many native habitats. Funding to adequately maintain and analyze data is frequently insufficient. Addressing these shortfalls in monitoring, research, and information management is critical if resource managers and landowners are to take effective steps to conserve native wildlife.

Highest priority

- Identify priorities for research and monitoring to document distribution, abundance, population trends, limiting factors, demography, and behavior of native species in order to guide conservation management and recovery programs.

High priority

- Establish and implement information collection and data sharing protocols through interagency cooperative efforts, building upon existing resources such as the Hawai‘i

Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program), the Pacific Basin Information Node, the Western Pacific Fisheries Information Network, the Coral Reef Information System, the Bishop Museum Hawai‘i Biological Survey, and the HI-GAP and Hawai‘i Marine GAP projects;
- Development and linkage of existing databases to create a central repository for use by resource managers containing biological information on native species and habitats and corresponding management-relevant information;
- Complete HI-GAP and Marine GAP analyses and integrate into the decision-making processes of Federal, State, and local agencies, non-governmental organizations, and private landowners that manage significant tracts of land in the State;
- Develop a stream GAP analysis program that quantifies stream habitats and organisms and adjacent land uses and management;
- Develop standards for data collection for projects funded by conservation grants, through partnership and collaboration among funding agencies, to facilitate monitoring of progress and success across landscapes and across funding programs.

4. Strengthen existing and create new partnerships and cooperative efforts.

Several species of Hawaii's native wildlife owe their continued existence to formal and informal partnerships among natural resource agencies, military agencies, other Federal, State, and county agencies, non-governmental organizations, academic researchers, private landowners, community organizations, and individuals. From watershed partnerships covering thousands of acres of land to single-species working groups, these cooperative efforts are valuable ways to share information, coordinate management actions, and pool resources for the benefit of Hawaii's native wildlife.

<u>Highest priority</u>
- Expand and strengthen existing partnerships (e.g., by increasing communication, formalizing partnerships, or adding new partners).

<u>High priority</u>
- 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);
- Maintain the partnership between government agencies and the University of Hawai‘i (e.g., through the Pacific Cooperative Studies Unit or the Hawaii-Pacific Islands Cooperative Ecosystems Studies Unit) to implement many on-the-ground conservation and research projects;
- Explore areas of common ground and future collaboration with agricultural industries and research facilities (e.g., University of Hawai‘i College of Tropical Agriculture and Human Resources);
- Collaborate with the Federal 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;
- Coordinate with inter-state agencies and stakeholders in the U.S. Pacific Islands (Commonwealth of Northern Mariana Islands, Guam, American Samoa) and with Alaska to develop and support population goals for migratory shorebirds and seabirds;
- Improve coordination among and within funding agencies to strategically select projects for funding based on their contribution to overall native species and habitat conservation needs;
- Support and emphasize voluntary and incentive-based programs for native wildlife and habitat conservation on private lands.

5. Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawai'i.

Comprehensive education, outreach, and information services programs contribute to a sense of responsibility for native wildlife conservation among the public and help to ensure voluntary compliance with conservation rules, regulations, and laws. Public support is critical to successful conservation management as well as to the continued protection of all of Hawaii's natural resources. Education and outreach is vital to providing residents and visitors with the information needed to take action to protect Hawaii's native wildlife for future generations.

<u>Highest priority</u>

- 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).

<u>High priority</u>

- Secure permanent dedicated funding for native wildlife conservation education and outreach;
- Provide lawmakers and citizens with the information necessary to effectively legislate and provide funding for the conservation of native species and their habitats;
- Encourage public participation and stewardship by expanding volunteer opportunities to contribute to native wildlife conservation, including invasive species control and participation in monitoring;
- Continue support for the Youth Conservation Corps, the Hawaiian Internship Program, and other youth programs, recognizing the value of these programs in teaching students about conservation in Hawai'i;
- Build upon existing efforts to develop conservation management curricula for kindergarten through twelfth grade, compatible with current statewide educational requirements, and conduct training for teachers on how to use curricula in the classroom;
- Encourage and support business sector-led initiatives to incorporate native wildlife considerations into their business models, with a focus on agriculture, forestry, horticulture, aquaculture, fisheries, and tourism industries;
- 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.

6. Support policy changes aimed at improving and protecting native species and habitats.
Adequate protection of native wildlife may require changes to existing policies. The changes range from enforcing existing rules that have a direct impact on the overall state of Hawaii's native wildlife to developing new policies to address emerging threats.

Highest priority
- Increase conservation enforcement efforts on all State-owned land and waters through increased funding for trained enforcement officers;
- Collaborate with the Department of Agriculture on needed policy changes to prevent the introduction of non-native plant and animal species by air or water and to prevent spread of non-native species instate and beyond Hawaii's borders;
- 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).

High priority
- Review and evaluate existing State policies and Administrative Rules for gaps in protection;
- Review and revise existing rules and regulations dealing with extractive uses of aquatic animals, plants, and terrestrial snails;
- Review and revise existing DOFAW management guidelines regarding game management to ensure consistency with existing management plans and recovery plans and to reflect native species and habitat conservation needs;
- Support development and implementation of a comprehensive coastal policy;
- Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
- Identify species, particularly invertebrates, in need of additional protection and evaluate for inclusion on the State threatened and endangered species list;
- Collaborate with the Office of Conservation and Coastal Lands to update Conservation District rules to encourage conservation management activities while ensuring continued protection of Conservation District;
- Administer and award State Wildlife Grant funds through a joint partnership of DOFAW and DAR;
- Explore opportunities to streamline the EPA label process for new control methods for invasive species;
- Identify constraints on research and management actions to control non-native pests in remote field operations and develop appropriate policies to minimize response time delay.

7. Enhance funding opportunities to implement needed conservation actions.
Without sufficient, sustained, and long-term funding, the actions outlined in this CWCS cannot be implemented for the benefit of native species and their habitats.

Highest priority

- Develop new sources of funding to support and expand conservation management in the State, particularly on State lands and waters.

High priority

- 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;
- Explore cooperative opportunities to accomplish needed conservation actions with existing funding, such as by training Transportation Security Administration inspectors to recognize priority invasive species;
- 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 additional funding dedicated to recovery priorities for listed species.

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CHAPTER 5: 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. However, introduced mangroves have altered native habitat in a number of places. 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 Kaho‘olawe 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 Hawai'i, where the value of coral reefs to the Hawai'i 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 Hawai'i with large Naval installations located on estuarine and coastal areas such as Pearl Harbor and Kāne'ohe Bay on O'ahu and the Pacific Missile Range Facility on the south shore of Kaua'i. 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 Hawai'i 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 Hawai'i 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 *ahupua'a* (watersheds) impact the ocean and play a large role in the health of marine habitats and species.

Appendices A and 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 Hawai'i 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 Hawai'i. The SGCN list includes 154 marine fishes. Over 5,000 marine invertebrates are known from Hawai'i 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-hundred and ninety seven species of marine invertebrates are listed in the SGCN list. Six marine reptiles occur in Hawai'i. 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 4 (Statewide 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;
- Urbanization and coastal alteration including harbors, seawalls and other structures, land reclamation, 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 strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet below) and throughout Chapter 6 (Island Conservation Needs), additional 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 CWCS 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.
- 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;
    - 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 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;
    - 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;
    - 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.
- Expand and strengthen outreach and educational efforts to improve understanding of our native wildlife resources among the people of Hawai‘i.

    - 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;
    - 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;
    - 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.

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. The discussion of future management needs is highlighted within each current managed area.

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 4 (Statewide Conservation Needs) and Chapter 6 (Island 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 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.

***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 Proposed**

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.

***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*:** ʻOpihi 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.

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CHAPTER 6: ISLAND CONSERVATION NEEDS

Moving from a statewide perspective to an island region perspective, Chapter 6 addresses individual islands with regard to native wildlife and habitat priorities and strategies. Each island discussion will provide an overview section, identify habitats and species of importance, summarize key threats of particular importance to the island, outline island strategies linked with the seven statewide objectives, identify plans and tools to aid management, and finally, discuss existing management actions and highlight potential new areas for increased conservation management. The Northwestern Hawaiian Islands (NWHI), also included in this chapter, will be treated as an entire region and follow a similar format for discussion. This chapter addresses elements 1-5 at the island level.

KAUA‘I

Kaua‘i is the northernmost and oldest of the eight Main Hawaiian Islands (MHI) and is characterized by deep eroded canyons and valleys and steep cliffs. There is a wide diversity of unique natural communities, from montane bogs, montane wet forest, lowland mesic forest, lava tube caves, long stretches of sandy beach, and many streams and rivers. Because of the age of the island and its relative isolation, levels of endemism are higher on Kaua‘i than elsewhere in the State. Hurricanes Iwa (1982) and Iniki (1992) damaged forest cover and encouraged the spread and establishment of introduced invasive weeds. As the only island where the mongoose (*Herpestes auropunctatus*) has not become established, Kaua‘i hosts greater populations of several ground-nesting birds than other islands.

OVERVIEW

Geology and Hydrology

Most of the island was formed from the eruptions of a single shield volcano between 3.6 million and 5.6 million years ago. Since that time, rain, streams, and waves have eroded the 143,226 hectares (353,920 acres) island, creating steep sea cliffs, deep canyons and valleys that extend from the interior of the island to the coast, a mountainous interior, and a broad coastal plain with deep soil and extensive beaches. Approximately 35 percent of the island is below 150 meters (500 feet) in elevation, and approximately 24 percent is above 610 meters (2,000 feet) in elevation. Kaua‘i has 61 perennial streams, 45 of which are continuous. Wailua and Hanalei have the largest discharges, 200 and 140 million gallons per day (mgd), respectively. Kaua‘i also has three offshore islets.

Climate

Elevation ranges from sea level to 1,598 meters (5,243 feet). Kaua‘i is directly exposed to the prevailing tradewinds that deliver rain, conditions which make Mount Wai‘ale‘ale one of the wettest spots on earth, with an average 1,120 centimeters (444 inches) of rainfall per year. However, not all the island is wet: average rainfall in Kekaha on the leeward side is only 52 centimeters (20 inches) per year.

Land and Water Use

Approximately 38 percent of the island remains dominated by native vegetation, and approximately 15 percent of the island has been designated as critical habitat for Kaua‘i plants.

More than half the island (56% or 156,619 acres) is located in the State Conservation District, approximately 40 percent is in the State Agricultural (128,839 acres) or State Rural District (1,253 acres), and the remaining is in the State Urban District (100,730 acres). Twenty-five streams are diverted and 12 have altered channels. Kauaʻi has 11 impaired streams under the Environmental Protection Agency (EPA) Clean Water Act 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.

Human Landscape

In 2003, the County of Kauaʻi had a population of nearly 61,000 residents. The total County population amounted to almost five percent of the State population, the smallest of the four counties. Most residents live in towns around the perimeter of the island, primarily along the east and south sides of Kauaʻi, with smaller populations living in towns on the north shore. The principal economic driving forces are tourism, agriculture, and defense expenditures. Tourism counts declined during the 1990s, due largely to the destruction caused by Hurricane Iniki in 1992, but visitor numbers have since increased, with Kauaʻi hosting nearly one million visitors in 2003. Visitor accommodations are located throughout the island, but are primarily at Poipu, Princeville, and Waimea/Kapaa. Agriculture has shifted recently from primarily sugarcane, with the closure of four of five plantations, to diversified agriculture and aquaculture. Defense expenditures stem from the Pacific Missile Range Facility, located in the southwest corner of the island.

SPECIES AND HABITATS OF IMPORTANCE

Habitats on Kauaʻi are composed of montane wet communities, montane mesic communities, lowland wet communities, lowland mesic communities, lowland dry communities, and coastal communities, resulting in a diverse range of natural vegetation. While just over one-third of the island remains dominated by native vegetation, many native-dominated areas contain smaller pockets of non-native invasive species that became established following Hurricanes Iwa and Iniki. The island has a network of perennial and intermittent streams and several rivers. Unique habitat types and major associated landscapes for wildlife include the montane bogs located in the Alakaʻi Wilderness Preserve, montane wet forest, lowland mesic forest, lava tube caves, steep sea cliffs, wetlands, coastal zones, and long stretches of mountain streams. Two offshore islands, Lehua and Kaula, are particularly important for nesting seabirds. In addition, 21,266 hectares (52,549 acres) have been designated as critical habitat for 83 endangered plants on Kauaʻi. Partially overlapping with the plant critical habitat designation are the 110 hectares (272 acres) designated for the Kauaʻi cave wolf spider (*Adelocosa anops*) and Kauaʻi cave amphipod (*Spelaeorchestia koloana*) and the 20 kilometers (12 miles) of stream segments and 1,812 hectares (4,479 acres) of adjacent riparian area designated as critical habitat for the Newcomb's snail (*Erinna newcombi*). Recovery habitat has been identified for the puaiohi (*Myadestes palmeri*), ʻakikiki (*Oreomystis bairdi* [Kauaʻi creeper]), and the presumed extinct Kauaʻi ʻakialoa (*Hemignathus procerus*), Kauaʻi nuku puʻu (*Hemignathus lucidus hanapepe*), Kauaʻi ʻōʻō (*Moho braccatus* [ʻōʻō ʻāʻā]), kāmaʻo (*Myadestes myadestinus* [large Kauaʻi thrush]), and ʻōʻū (*Psittirostra psittacea*). Three offshore islands support more than 15 species of breeding seabirds, including the largest ʻā (*Sula leucogaster* [brown booby]) colony in the State.

Appendix A provides information on what wildlife Species of Greatest Conservation Need are present on Kauaʻi and its associated offshore islands. Species endemic to Kauaʻi include the

puaiohi, ʻakikiki (Kauaʻi creeper), ʻanianiau (*Hemignathus parvus* [lesser ʻamakihi]), ʻakekeʻe (*Loxops caeruleirostris* [Kauaʻi ʻākepa]), Newcomb's snail, the Kauaʻi cave wolf spider, and the Kauaʻi cave amphipod. Other forest birds include the ʻiʻiwi (*Vestiaria coccinea*), ʻapapane (*Himatione sanguinea*), and Kauaʻi ʻelepaio (*Chasiempis sandwichensis sclateri*). Waterbirds and migratory shorebirds utilize remnant wetlands, with 80 percent of the State's koloa maoli (*Anas wylvilliana* [Hawaiian duck]) population, and 50 percent of the State's nēnē (*Branta sandvicensis* [Hawaiian goose]) population found on Kauaʻi. Two Hawaiian endemic seabirds, the ʻaʻo (*Puffinus auricularis newelli* [Newell's shearwater]) and ʻuaʻu (*Pterodroma sandwichensis* [Hawaiian petrel]), and the ʻakēʻakē (*Oceanodroma castro* [band-rumped storm-petrel]) are believed to nest on upper elevation sea cliffs. Kauaʻi is also home to a diverse number of terrestrial invertebrates, most of which have been poorly studied. Notable invertebrates include several endemic species of native bees in the genus *Hylaeus* and of native damselflies in the genus *Megalagrion*. In addition, diversity within most families of beetles (Coleoptera) is among the highest in the State. In recent years, the number of ʻīlio-holo-i-ka-uaua, or Hawaiian monk seals (*Monachus schauinslandi*), basking on Kauai's beaches has increased. Finally, Kauaʻi is believed to have historically supported populations of the endangered Blackburn's sphinx moth (*Manduca blackburni*).

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats more acute or specific to Kauaʻi are listed below.

- Populations of feral pigs (*Sus scrofa*) and goats (*Capra hircus*) that distribute introduced invasive plants (such as strawberry guava [*Psidium cattleianum*]) and eat, trample, or uproot native plants, degrading habitat, contributing to soil erosion, and impairing stream quality;
- Habitat-modifying invasive plants, including kāhili ginger (*Hedychium gardnerianum*), Australian tree fern (*Sphaeropteris cooperi*), and strawberry guava;
- Populations of feral cats (*Felis silvestris*) that kill waterbirds and ground-nesting seabirds;
- Introduced smallmouth bass, a predatory fish that eat a number of native stream fishes and invertebrates and may also compete with some of them;
- Potential introduction of non-established pests, such as the mongoose;
- Restricted mosquito-free habitat, making Kauai's forest birds highly vulnerable to habitat degradation;
- Stream diversions, dams, or channelizations;
- Insufficient in-stream flows to insure the biological integrity of many stream systems;
- Development of formerly undeveloped areas and increased urbanization leading to loss and degradation of terrestrial, freshwater, and marine habitat (e.g., increased nutrients in coastal areas leads to non-native algal blooms which affect fish populations and coral habitats, sedimentation from development near stream corridors);
- Hybridization between koloa maoli (Hawaiian duck) and introduced mallards;
- Limited information on genetically modified organisms (GMO) research by private agricultural engineering firms on State and private lands and the possible interaction of GMOs with native wildlife;
- Recreational overuse in some areas along the Nā Pali Coast and in the Poʻipū area;

- Human interactions with monk seals which are much more common off Kauaʻi than off the other Main Hawaiian Islands.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Kauaʻi 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 conservation actions identified in the 'Potential Areas for Enhanced Conservation Management' subsection;
    - Develop and/or implement recovery plans for threatened and endangered species on Kauaʻi;
    - Protect remaining lava tube and cave habitats;
    - Increase active management in, or acquisition of, extremely rare habitats on Kauaʻi;
    - Increase the total acreage of ungulate-free and predator-free areas;
    - Implement fire suppression measures and protocols for post-fire restoration;
    - Decrease in 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;
    - Collaborate in efforts to reduce pollution threats from recreational boats and cruise ships;
    - Develop management plans for all Marine Managed Areas;
    - Support the Local Action Strategies project to deal with non-point source pollution in Hanalei Bay and support expansion of successful methods to other areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Improve early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on Kauaʻi (e.g., mongooses);
    - Increase efforts to prevent establishment of priority invasive plants in pristine areas (e.g., kāhili ginger, Australian tree fern) and to eradicate from areas with recovery potential;
    - Decrease in the overall number of streams negatively impacted by invasive species;
    - Support efforts to strengthen marine alien species prevention and control.
- 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;

    - Assess impact of eco-tourism activities on terrestrial and aquatic native wildlife and associated habitats.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Continue implementation of the successful Save Our Shearwaters (SOS) program and complete and implement the SOS Procedures Plan;
    - Continue development of an island-wide Habitat Conservation Plan (HCP) addressing the take of seabirds on Kauaʻi;
    - Expand partnership with hunting community to reduce ungulate population;
    - Collaborate with NOAA to ensure the protection of marine mammal populations.
- Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawaiʻi.
    - Maintain existing outreach and educational programs at managed conservation areas;
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
    - Assess ways to support increased enforcement capacities, including cross-deputization between agencies;
    - Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
    - Improve integration of policies to address linkages between terrestrial and marine habitats and their shared conservation threats and needs.

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 and include the following:

- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Revised Recovery Plan for the Nēnē (Hawaiian goose) (2004), the Draft Recovery Plan for the Kauaʻi Cave Arthropods (2004), the Draft Recovery Plan for the Newcomb's Snail (2004), the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003), the Hawaiian Endangered Bird Partnership for Captive Propagation Five Year Workplan (2002), the Draft Revised Recovery Plan for Hawaiian waterbirds (1999), and the Recovery Plan for the Hawaiian Hoary Bat (1998);
- Critical habitat designations by the USFWS for the Kauaʻi cave arthropods, for Newcomb's snail, and for threatened and endangered plants on Kauaʻi.
- Management Plans for the State Natural Area Reserves (NAR): Kuia NAR (1989) and Hono o Na Pali NAR (1989);
- The Division of Forestry and Wildlife's (DOFAW) Draft Management Guidelines, which coarsely rate vegetation quality and provide guidelines for land use (public hunting, recreation, and forest products) for State lands managed by DOFAW;
- The Kauaʻi Watershed Alliance Management Plan (2005);
- The National Tropical Botanical Gardens (NTBG) have developed a master plan for Limahuli Garden and Preserve;

- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- The Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach;
- Coastal Zone Management plans, including Hawai‘i Implementation Plan for Polluted Runoff Control (2000), Hawai‘i Unified Watershed Assessment (1998);
- Hawaii's Local Action Strategy to Address Land-based Pollution Threats to Coral Reefs (2004);
- Bishop Museum has a comprehensive database of invertebrates;
- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawai‘i;
- The Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on Kaua‘i. The discussion of future management needs is highlighted within each current managed area. Some areas on Kaua‘i are already under active management or protection through designation as a State Natural Area Reserve (NAR), State Wilderness Preserve, or National Wildlife Refuge (NWR). The Kaua‘i Watershed Alliance (KWA) was recently formed to identify and implement conservation actions needed to preserve Kauai's watershed resources on both public and private land, and the natural and cultural resources within these watersheds. In addition, other partnerships, such as the Save Our Shearwaters program, the Kaua‘i Endangered Bird Recovery Team (KEBRT), the Kaua‘i Invasive Species Committee (KISC), and the partnership formed to develop a Seabird Habitat Conservation Plan have been formed to address specific species conservation needs.

***Hono o Na Pali NAR* (3,150 acres), DOFAW**

***Species*:** Forest birds, pueo, seabirds, ‘ōpe‘ape‘a (Hawaiian hoary bat), terrestrial invertebrates, freshwater fishes, freshwater invertebrates, 46 rare plant taxa.

Habitats: Montane wet communities, lowland mesic communities, lowland wet communities, coastal communities, continuous perennial streams (Hanakāpī‘ai, Hanakoa, Waiahuakua 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, rare plant monitoring, baseline survey work in Waiahuakua stream.

***Ku‘ia NAR* (1,636 acres), DOFAW**

Species: Forest birds, pueo, seabirds, ‘ōpe‘ape‘a, terrestrial invertebrates, 28 rare plant taxa.

Habitats: Montane mesic system, lowland mesic system.
Current Management: Management plan exists. Small-scale fencing, ungulate control through public hunting seasons, invasive weed species removal, monitoring.
Future Needs: Construction of proposed fencing, increased ungulate control, increased invasive weed species removal, outplanting, monitoring. Identify areas of intact lowland mesic forest for protection.

Alakaʻi Wilderness Preserve **(9,939 acres*)*, DOFAW**
***Species*:** Forest birds, pueo, koloa maoli, terrestrial invertebrates, rare plant taxa.
Habitats: Montane wet communities.
***Current Management*:** Ungulate control through public hunting, invasive weed (including kāhili ginger, Australian tree fern) control.
Future Needs: Fencing and ungulate control, increased invasive weed species removal, monitoring.

Kauaʻi Watershed Alliance **(142,000 acres), Public-Private Partnership (County of Kaua'i Department of Water, DLNR-DOFAW, DLNR-State Parks, DLNR-Land, Kamehameha Schools, McBryde Sugar Company, Ltd., Grove Farm Company, Inc., Līhuʻe Land Company, Kealia Ranch, LLC, B.A. Dyer, and Princeville Development, LLC)**
Species: Forest birds, seabirds, pueo, ʻōpeʻapeʻa, terrestrial invertebrates, freshwater fishes, freshwater invertebrates, rare plant taxa.
Habitats: Montane wet communities, lowland wet communities, lowland mesic communities, lowland dry communities.
Current Management: Management plan exists. Planned management includes fencing, ungulate control through variety of methods, suppression, containment, and eradication of priority and secondary weeds, monitoring (ungulate activity, weed distribution, vegetation cover, stream turbidity).
Future Needs: Adequate funding to implement management plan.

Hanalei NWR **(917 acres), USFWS**
Species: Waterbirds, ʻōpeʻapeʻa.
Habitats: Lowland wet communities (wetlands).
Current Management: Management plan in development. Endangered species management (habitat enhancement, predator control, invasive weed control, monitoring).
Future Needs: Continued management for wildlife needs.

Hulēʻia NWR **(241 acres), USFWS**
Species: Waterbirds, ʻōpeʻapeʻa.
Habitats: Lowland wet communities (wetlands).
Current Management: Management plan in development. Endangered species management (habitat enhancement, predator control, invasive weed control, monitoring).
Future Needs: Continued management for wildlife needs.

Kīlauea Point NWR **(199 acres), USFWS**
Species: Waterbirds, seabirds, nēnē, migratory shorebirds.
Habitats: Coastal communities.

Current Management: Management plan in development. Feasibility study underway regarding acquisitions to Refuge. Endangered species management (habitat enhancement, predator control, invasive weed control, monitoring), outreach and education.
Future Needs: Acquire and manage additional habitat once Feasibility Study complete.

Kawaiele Wildlife Sanctuary **(37 acres), DOFAW**
Species**:** Waterbirds, migratory shorebirds, seabirds, migratory waterfowl.
Habitats: Coastal communities.
Current Management**:** Eliminate tilapia from ponds, habitat restoration through native plantings, public education, and monitoring of bird and plant populations.
Future Needs: Complete addition of adjacent 105 acres (Mānā Plains Wetland Sanctuary) to create Mānā Plains Forest Reserve, continued habitat restoration and management, monitoring.

Limahuli Preserve **(1,005 acres), NTBG**
Species: Forest birds, seabirds, pueo, rare plants.
Habitats: Lowland wet communities.
Current Management: Outplanting of native plants, fencing and ungulate removal, predator control.
Future Needs: Continue existing management.

State Seabird Sanctuary **(3 offshore islets: Lehua, Kaʻula, and Moku ʻAeʻae), DOFAW**
Species: Nesting seabirds: ʻuaʻu kani (wedge-tailed shearwater), ʻou (Bulwer's petrel), ʻā (red-footed booby), ʻā (brown booby),ʻā (masked booby), mōlī (Laysan albatross), kaʻupu (black-footed albatross), noio (black noddy), noio-kōhā (brown noddy), manu-o-Kū (fairy tern), Christmas shearwater, ʻaʻo (Newell's shearwater), koaʻe ʻula (red-tailed tropicbird), koaʻe kea (white-tailed tropicbird), ʻiwa (great frigatebird), ʻakēʻakē (band-rumped storm petrel).
Habitats: Coastal communities.
Current Management: Surveys and monitoring, planned eradication of rats and rabbits on Lehua, and habitat restoration.
Future Needs: Continued monitoring of seabird populations, follow-up monitoring of predator populations to prevent re-establishment.

Kauaʻi Resource Conservation Program**, Public-Private Partnership**
Species/Habitats**:** All species and habitats present in Kōkeʻe State Park and surrounding State lands affected by invasive species issues.
Current Management**:** Invasive species removal and control.
Future Needs: Adequate funding for ongoing control actions.

Kauaʻi Endangered Bird Recovery Team**, DOFAW, USFWS, UH**
Species/Habitats: Montane-nesting forest birds and seabirds, particularly endangered and critically endangered species and their habitats.
Current Management: Implementation of Draft Revised Recovery Plan for Hawaiian Forest Birds, Draft Five-year Implementation Plan for puaiohi and ʻaʻo (Newell's Shearwater).

Future Needs: Adequate funding to implement endangered species recovery plan and implementation plans.

***Kaua'i Invasive Species Committee*, Public-Private Partnership**

***Species/Habitats*:** All species and habitats affected by invasive species issues.
***Current Management*:** Invasive species prioritization, control, and removal island-wide.
***Future Needs*:** Increased invasive plant and animal prevention capacity, improved detection and rapid response capacity, and additional resources to address established threats to native habitats.

***Save Our Shearwaters*, DOFAW, USFWS, Kaua'i Island Utility Cooperative**

***Species*: '**A'o (Newell's Shearwater), 'ua'u (Hawaiian petrel), 'akē'akē (band-rumped storm-petrel).
***Current Management*:** Recovery and release into the wild of downed seabirds. During its first 26 years the program recovered more than 29,000 Newell's shearwaters, 220 Hawaiian petrels, and 15 band-rumped storm petrels, as well as a few wedge-tailed shearwaters and white-tailed tropicbirds. Overall, 92 percent of the birds have been released back into the wild.
Future Needs: Finalize and implement Save Our Shearwaters Implementation Guidelines and Operation Manual.

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

***Species*:** Humpback whale.
Habitats: Marine ecosystem.
***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.

***Four Fishery Management Areas (FMA),* DAR** (Hanamā'ulu Bay, Nāwiliwili Harbor, Port Allen, Waimea Bay).

***Species*:** Some or all regulated fish species.
Habitats: Marine and estuary ecosystems.
***Current Management*:** Limited take, gear, size, season, and/or area restrictions.
***Future needs*:** Evaluate all FMAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

***Two Bottomfish Restricted Areas (BRA),* DAR**

***Species*:** Seven bottomfish species.
Habitats: Marine ecosystem.

***Current Management*:** No Take of bottomfish.
***Future needs*:** Evaluate all BRAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Potential Areas for Enhanced Conservation Management

In addition to maintaining and enhancing existing conservation actions, additional efforts are needed for the long-term conservation of Kauai's native wildlife. The following section identifies areas where enhanced conservation management would significantly benefit native species or their habitats. Areas are discussed in habitat order from the mountains to the sea.

Montane Wet Forest

***Species*:** Puaiohi, ʻakikiki, ʻiʻiwi, Kauaʻi ʻelepaio, ʻanianiau, Kauaʻi ʻamakihi, ʻakekeʻe (Kauaʻi ʻākepa), ʻapapane, pueo, ʻaʻo (Newell's shearwater), terrestrial invertebrates, freshwater invertebrates, rare plants.

***Basis for Priority Designation*:** Identified in Forest Bird Recovery Plan as core area for conservation; DOFAW Management Guidelines recognized as highest quality native vegetation; identified for protection in Kauaʻi Watershed Alliance Management Plan. Last remaining suitable habitat for puaiohi, ʻakikiki; last known habitat for Kauaʻi ʻakialoa, Kauaʻi nuku puʻu, Kauaʻi ʻōʻō, kāmaʻo, and ʻōʻū; habitat for ʻakekeʻe (Kauaʻi ʻākepa) and ʻapapane.

Potential Conservation Actions: Coordinate and implement existing management plans (Draft Revised Recovery Plan for Hawaiian Forest Birds, Draft Five-year Implementation Plan for Puaiohi and Newell's Shearwater, Kauaʻi Watershed Management Plan, DOFAW Management Guidelines). Increase funding and staffing for implementation of identified actions, fencing, ungulate (pig and goats) removal, predator control, invasive weed control, habitat restoration through native plantings, and monitoring.

***Wetland Habitat* (including Kīlauea River, Hanalei River Valley and taro fields, Lumahaʻi Valley, Wainiha River Valley and taro fields, Haʻena State Park wetlands and loʻi, Mānā Plains, Waimea River and taro fields, Hanapēpē Coastal Ponds (Hanapēpē Salt Ponds, Kaumakani Gulch Ponds, Olokele Settling Ponds), Lāwaʻi Kai Estuary, Kōloa district reservoirs (Waita Reservoir), Waiopili Stream, Hulēʻia stream and associated watershed, Līhuʻe area wetlands (including Nāwiliwili wetlands, Pualu wetlands), Hanamāʻulu wetlands, Wailua River and associated watershed (including Opaekaʻa wetlands), Kapaʻa area wetlands)**

***Species*:** Aeʻo (Hawaiian stilt), ʻalae keʻokeʻo (Hawaiian coot), ʻalae ʻula (Hawaiian moorhen), koloa maoli (Hawaiian duck), nēnē (Hawaiian goose), shorebirds, including the kōlea (Pacific golden plover), ʻakekeke (ruddy turnstone), hunakai (sanderling), freshwater fishes, freshwater invertebrates.

***Basis for Priority Designation*:** Identified in Hawaiian Waterbird Draft Revised Recovery Plan as core or supporting wetlands or identified by biologists as important potential wetland habitat. With demise of sugar, wetland habitat is being reduced as former irrigation ditches are no longer maintained.

Needed Conservation Actions: Implement Waterbird Recovery Plan. Protect, restore, and manage additional wetland habitat through coordination with private or public landowners, removal of invasive plants, and institution of predator control. Remove

threat of feral mallard and kola maoli (Hawaiian duck) hybridization by supporting research, outreach, regulation/legislation, and control of feral mallards. Research on ecosystem function of taro *lo'i* to identify management actions that support both taro growth and quality wildlife habitat. Expand outreach efforts to neighboring landowners to encourage voluntary protection (conservation easements) or implementation of best management practices. Continue existing waterbird surveys.

Kōloa Lava Tube/Cave Ecosystem

***Species*:** Kaua'i cave wolf spider, Kaua'i cave amphipod.

***Basis for Priority Designation*:** Designated as critical habitat for endangered cave wolf spider and cave amphipod, may be only known habitat. Areas near these caves are under consideration for development.

Potential Conservation Actions: Support for current protection of existing inhabited cave on private land, continued monitoring of population.

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NI‘IHAU

Ni‘ihau is a small, privately owned island located approximately 27 kilometers (17 miles) west of Kaua‘i. The island’s highest point is 390 meters (1,281 feet). Among Ni‘ihau’s most unique natural features are several intermittent lakes, which provide habitat for ‘alae ke‘oke‘o (*Fulica alai* [Hawaiian coot]), ae‘o (*Himantopus mexicanus knudseni* [Hawaiian stilt]), and koloa maoli (*Anas wyvilliana* [Hawaiian duck]). Due to restricted access, there is limited biological information available about Ni‘ihau (e.g., the percent cover of native vegetation, the distribution and abundance of native species, and the condition of habitats used by wildlife species). While the seasonal lakes are known to be an important natural wetland feature for waterbirds, the use and importance of this island by other species groups, such as seabirds or invertebrates, is largely unknown.

OVERVIEW

Geology and Hydrology

Ni‘ihau was formed from a single shield volcano approximately 4.89 million years ago, making it slightly younger in age than Kaua‘i. It is approximately 18,130 hectares (70 square miles or 44,800 acres), and sea cliffs are a prominent feature of the eastern coast. Approximately 78 percent of the island is below 150 meters (500 feet) in elevation. Ni‘ihau has no perennial streams. Halulu Lake is a natural freshwater lake covering approximately 74 hectares (182 acres) and Halāli‘i Lake is an intermittent lake covering approximately 340 hectares (841 acres).

Climate

Located inside Kauai’s rain shadow, Ni‘ihau receives only about 50 to 100 centimeters (20 to 40 inches) of rain per year.

Land and Water Use

The entire island is located in the State Agricultural District. The primary economic activities are cattle and sheep ranching, commercial game hunting, and limited military training exercises.

Human Landscape

Part of the County of Kaua‘i, Ni‘ihau is privately owned. A Native Hawaiian community of approximately 160 people lives there in relative isolation. There are no resorts, and public access is allowed only with permission of the owners.

SPECIES AND HABITATS OF IMPORTANCE

Habitat on Ni‘ihau includes only lowland dry systems and coastal systems. It is thought that Ni‘ihau may have some of the best coastal habitats in the State.

Information on species’ distribution on Ni‘ihau is limited. Appendix A provides information on the wildlife Species of Greatest Conservation Need present on Ni‘ihau. There are no wildlife species known to be endemic to Ni‘ihau. Known species present are primarily waterbirds, seabirds, and migratory shorebirds. The U.S. Fish and Wildlife Service has designated critical habitat for one plant, *Brighamia insignis.*

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats more acute or specific to Niʻihau are listed below. Because Niʻihau has no perennial streams, there are no identified threats specific to freshwater species on Niʻihau.

- Lack of permanent conservation status for known wetland habitat;
- Habitat degradation (loss of vegetation and subsequent erosion) caused by domestic and feral ungulates;
- Limited information on species presence or abundance, habitat conditions, or the importance of existing habitat for wildlife.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Niʻihau 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/or implement recovery plans for threatened and endangered species on Niʻihau;
    - Encourage long-term protection and management of known wetland habitat (including ephemeral playa lakes) for nesting waterbirds;
    - Encourage long-term protection of remaining native-dominated coastal or lowland vegetation from degradation by ungulates;
    - Develop management plans for all Marine Managed Areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Inventory existing terrestrial and aquatic invasive species and prioritize control actions.
- Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs.
    - Complete an inventory of native wildlife and plants;
    - Determine population estimates for rare or unique species of native wildlife;
    - Coordinate research to assess threats and conservation needs of species.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Establish a partnership with the private landowner to protect the wetland habitat and improve knowledge about native species and their habitats;
    - Explore opportunities for partnership with local community.
- Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawaiʻi.
    - Explore opportunities for community-based wildlife surveys and monitoring.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Assess ways to support increased enforcement capacities, including cross-deputization between agencies;

- Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas.

PLANS AND TOOLS TO AID MANAGEMENT

No management plans and tools specific to Niʻihau exist to address some of the threats listed in the Summary of Key Threats to Species and Habitats section.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on Niʻihau. The discussion of future management needs is highlighted within each current managed area. Unlike other islands, Niʻihau is entirely privately owned and has no State or Federal management presence. There are no formalized or long-term conservation management actions currently occurring on terrestrial Niʻihau. In the marine waters surrounding Niʻihau, there is one Bottomfish Restricted Area (BRA).

Bottomfish Restricted Area, DAR

***Species*:** Seven bottomfish species.
Habitats: Marine ecosystem.
***Current Management*:** No Take of bottomfish.
Future Needs: Evaluate all BRAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

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O‘AHU

O‘ahu is the most developed and populated island in the Hawaiian chain. As a result of the pressures of population and economics, native forest is found primarily along mountainous ridges unsuitable for development. These mountain ridges are highly dissected by erosion, resulting in a rich array of habitats (from montane wet forest to lowland dry forest) with localized distributions of many species, particularly of native invertebrates. O‘ahu contains several wetlands important to waterbirds and migratory shorebirds, including the Kawai Nui and Hāmākua Marsh complex. Thanks to grassroots support and community involvement, the Kawai Nui and Hāmākua Marsh complex was designated a Wetland of International Importance under the Ramsar Convention of Wetlands in 2005, the 22nd such designation in the United States and the first in Hawai‘i. Several offshore islands and several protected and managed coastal sites support seabird colonies. O‘ahu also has a number of large estuaries and bays and one of only two barrier reef complexes in the State. Many areas managed for wildlife conservation are accessible to the public, giving residents and visitors the opportunity to view and appreciate examples of the native wildlife of the State.

OVERVIEW

Geology and Hydrology

The island of O‘ahu was created by two large shield volcanoes, the younger Ko‘olau volcano to the east and the older Wai‘anae volcano to the west. Subsequent extensive erosion has since fashioned these volcanoes into long, narrow, ridge-like mountain ranges, connected by the Schofield Plateau. Nearly half (45%) of the island is below 150 meters (500 feet) in elevation, and for the most part, the island is surrounded by coastal plain and sandy beaches, rather than steep sea cliffs. Just under five percent of the island is over 610 meters (2,000 feet) in elevation; Mt. Ka‘ala in the Wai‘anae range, is the highest point on the island at 1,220 meters high (4,003 feet) high. The island has 57 perennial streams, 29 of which are continuous. Kahana and Waikele streams have the largest discharges, 35 and 27 million gallons per day (mgd), respectively. Wahiawā Reservoir (including Lake Wilson) and Nu‘uanu Reservoir are significant freshwater lakes on the island.

Climate

The Wai‘anae and Ko‘olau mountain ranges combine to produce distinctive windward and leeward climates. Average annual rainfall exceeds 635 centimeters (250 inches) per year on the crest of the Ko‘olau Range. In contrast, some areas on the leeward coast, located in the rain shadow of the Ko‘olaus, receive less than 50 centimeters (20 inches) per year. The Ko‘olau Mountains form the primary watershed for the island, providing approximately 133 mgd of recharge to the Pearl Harbor aquifer.

Land and Water Use

O‘ahu is the third largest island at 156,284 hectares (386,188 acres). The island’s land area is almost evenly divided between the Conservation District (41%; 63,381 hectares or 156,619 acres), Agricultural District (33%; 52,139 hectares or 128,839 acres), and the Urban District (26%; 40,764 hectares or 100,730 acres). The Conservation District encompasses most of the Ko‘olau and Wai‘anae mountain ranges. About 13,853 hectares (34,232 acres), primarily in the Conservation District, are managed by the DLNR Division of Forestry and Wildlife (DOFAW)

(9% of the total land area). Approximately 35,942 hectares (88,817 acres) of conservation-zoned forest land is under private ownership or management. The Agricultural District covers primarily the plateau between the two mountain ranges. The Urban District covers the primary urban center of Honolulu, extending west along the leeward coast, east to include the developed areas of Kāneʻohe and Kailua, and north to include the developments along the H-2 Highway, such as Mililani.

Approximately 36,853 hectares (91,066 acres, 24% of the total land area) is under the control (through ownership or lease) of the military. The largest private landowners are Kamehameha Schools, Dole Food Company, Damon Estate, Campbell Estate, and Amfac.

Thirty-one streams are diverted and 31 have altered channels. The largest altered stream is Waikele, and the Waiāhole Ditch system is the largest man-made stream system. Oʻahu has 34 impaired streams under Environmental Protection Agency Clean Water Act standards.

Human Landscape

In 2004, the total resident population of Oʻahu was estimated at 899,593, accounting for 72 percent of the State's population. This number is supplemented by an average daily visitor population of 82,121. The population is spread around the island, with most residents living on the south side, east of Pearl Harbor on the coastal plain, valleys, and lower mountain ridges. Oʻahu is the State's governmental, service, commercial, and transportation center, and accounts for about 80 percent of the State's economic output. The large visitor industry, military activities, and to a lesser extent, agriculture contribute to this output. Oʻahu's sugar industry closed in 1996, and many former sugar lands have been converted to residential communities. The recent decision to base one of the six U.S. Army Stryker Brigades in Hawaiʻi will likely result in increased military activity on Oʻahu, involving purchase of additional land, construction of range complexes, and improvement of roads.

SPECIES AND HABITATS OF IMPORTANCE

Habitats on Oʻahu are composed of montane wet communities, lowland wet communities, lowland mesic communities, lowland dry communities, and coastal communities. The island has a network of perennial and intermittent streams, many of which have been altered. Habitat types include ʻakiʻaki (*Sporobolus virginicus*) coastal dry grassland, naupaka (*Scaevola sericea*) mixed coastal dry shrubland, ʻuki (*Cladium jamaicense*) lowland wet sedgeland, ʻōhiʻa (*Metrosideros polymorpha*) lowland wet and mesic forest, and wet cliffs. The dry to mesic habitats located in the Waiʻanae mountains are considered to contain high concentrations of federally endangered plant species, including both species that are naturally rare as well as species exhibiting human-induced rarity. A system of wetlands situated along the windward coast south to Pearl Harbor provide important habitat for endemic waterbirds and migratory shorebirds and waterfowl. Many of the seventeen offshore islands are important for nesting seabirds, with Moku Manu and Mānana supporting the greatest diversity of species and the highest number of individuals. Ulupaʻu Wildlife Management Area (at Kāneʻohe Marine Corps Base) supports one of the two colonies of ʻā (*Sula sula* [red-footed booby]) in the Main Hawaiian Islands. Approximately 22,274 hectares (55,040 acres) have been designated as critical habitat for 99 endangered plants on Oʻahu, which partially overlaps with the 26,661 hectares (65,879 acres) designated as critical

habitat for the Oʻahu ʻelepaio (*Chasiempis sanwichensis ibidis*). Habitat essential for the recovery of the Oʻahu tree snails (*Achatinella* spp.) has also been identified.

Appendix A provides information on what wildlife Species of Greatest Conservation Need are present on Oʻahu and its associated offshore islands. Known taxa endemic to Oʻahu include the Oʻahu ʻelepaio (endemic at the subspecies level), Oʻahu ʻalauahio (*Paroeomyza maculata* [Oʻahu creeper], potentially extinct), Oʻahu ʻamakihi (*Hemignathus flavus*), the damselfly *Megalagrion leptodemas*, several endemic bees (*Hylaeus* spp.), and the Oʻahu tree snails (*Achatinella* spp.). The endangered ʻōpeʻapeʻa (*Lasiurus cinereus semotus* [Hawaiian hoary bat]) occurs on the island, as do the following birds: ʻapapane (*Himatione sanguinea*), ʻiʻiwi (*Vestiaria coccinea*) (State listed as endangered on Oʻahu), and pueo (*Asio flammeus sandwichensis* [Hawaiian short-eared owl]) (State listed as endangered on Oʻahu). Significant populations of endangered waterbirds occur on Oʻahu, including the aeʻo (*Himantopus mexicanus knudseni* [Hawaiian stilt]), ʻalae keʻokeʻo (*Fulica alai* [Hawaiian coot]), ʻalae ʻula (*Gallinula chloropus sandvicensis* [Hawaiian moorhen]), and the koloa maoli (*Anas wyvilliana* [Hawaiian duck]). The seabird, ʻaʻo (*Puffinus auricularis newelli* [Newell's shearwater]), is believed to nest in the Koʻolau mountains, mōlī (*Phoebastria immutabilis* [Laysan albatross]) nest at Kaʻena Point Natural Area Reserve, and eight species of seabirds nest on the offshore islands. Oʻahu is also home to a diverse number of terrestrial invertebrates, most of which have been poorly studied. Several species of land snails from the genera *Auriculella*, *Leptachatina*, and *Amastra* have been observed, while diversity within most families of beetles (Coleoptera) is among the highest in the State. ʻŌpaeʻula (*Holocaridina rubra*) occur in natural and man-made anchialine and aquaculture ponds. Native freshwater fishes, including several species of ʻoʻopu, native freshwater invertebrates, including *Oahuhawaiian kazukolinda*, and several species of crustaceans, are found within several stream systems. Finally, honu (*Chelonia mydas agassizi* [green sea turtles]) are regularly observed around the island.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife and habitats are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats that are more acute or specific to Oʻahu are listed below.

- Primary entry point for new invasive species into the State;
- Insufficient acreage of managed wetland habitat to support expansion of waterbird populations;
- Wildfire, especially in drier leeward areas, due to humans and exacerbated by invasive non-native plants (increasing fuel loads);
- Recreational use of offshore islets, deterring seabird nesting or destroying existing nests and habitats;
- Predation by introduced animals (e.g., feral cat colonies and mongooses preying on waterbirds, shorebirds, and seabirds; introduced fish preying on native freshwater species and terrestrial invertebrates; introduced snails preying on native land snails);
- Disturbance of forested habitat and rare plants by feral pigs;
- Stream diversions, dams, or channelizations;
- Development of formerly undeveloped areas and increased urbanization leading to loss and degradation of terrestrial, freshwater, and marine habitat (e.g., increased nutrients in

coastal areas leads to non-native algal blooms which affect fish populations and coral habitats, sedimentation from development near stream corridors);
- Insufficient in-stream flows to insure the biological integrity of many stream systems;
- Human impacts on anchialine ponds;
- Localized excessive recreational use at places like Hanauma Bay and Waikīkī;
- Localized point source pollution originating from recreational boats and cruise ships;
- Fisheries bycatch of green sea turtles and seabirds;
- Introduction of invasive marine species in ports and harbors;
- Human and boat interactions with marine mammals along the Waiʻanae Coast;
- Land-based sources of pollution.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Oʻahu 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 conservation actions identified in the 'Potential Areas for Enhanced Conservation Management' subsection;
    - Develop and/or implement recovery plans for threatened and endangered species on Oʻahu;
    - Enhance resources to expand management capacity at existing protected wetland habitat (e.g., Kawai Nui and Hāmākua Marsh);
    - Increase active management in, or acquisition of, extremely rare habitats on Oʻahu;
    - Protect remaining intact native forest, wetland habitat, and coastal areas from development through a combination of acquisition, conservation easements, or cooperative agreements with landowners;
    - Increase the total acreage of ungulate-free and predator-free areas;
    - Decrease in 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;
    - Implement fire suppression measures and protocols for post-fire restoration;
    - Protect remaining anchialine ponds;
    - Collaborate in efforts to reduce pollution threats from recreational boats and cruise ships;
    - Develop management plans for all Marine Managed Areas;
    - Support ongoing projects to deal with non-point source pollution in Kāneʻohe Bay and other watersheds and support expansion of successful methods to other areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Improve prevention capacity through increased airport inspection and containment barriers around cargo unloading areas;

    - Improve early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on O‘ahu;
    - Increase efforts to prevent establishment of priority invasive plants in pristine areas (e.g., miconia) and to eradicate from areas with recovery potential (e.g., mangrove in tidal flats);
    - Expand control of mammalian predators (e.g., feral cats, rats) in waterbird, seabird, and ‘elepaio habitat;
    - Decrease in the overall number of streams negatively impacted by invasive species;
    - Support efforts to strengthen marine alien species prevention and control.
- 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;
    - Assess impact of eco-tourism activities on terrestrial and aquatic native wildlife and associated habitats.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Formalize partnerships with military agencies to manage areas (including State land) for habitat conservation;
    - Encourage additional landowner participation and involvement in Ko‘olau Mountains Watershed Partnership to facilitate conservation actions on these lands;
    - Develop new partnerships with non-traditional partners such as smart growth initiatives to address loss of habitat through development;
    - Expand partnership with hunting community to reduce ungulate populations;
    - Expand current firefighting capacity through greater interagency cooperation (e.g., sharing equipment, training, and fighting capacity);
    - Collaborate with NOAA to ensure the protection of marine mammal populations.
- 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 at managed conservation areas (e.g., National Wildlife Refuges, Wildlife Sanctuaries);
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas;
    - Expand and broaden public education and outreach to take advantage of the large science and management community on the island;
    - Improve education regarding the destructive impact of nesting seabird disturbance and reef trampling;
    - Develop and provide technical support for the implementation of pilot or demonstration projects by citizen groups, small businesses, or landowners, in areas close to where people live to provide an opportunity to connect residents with O‘ahu’s native wildlife and their needs.
- Support policy changes aimed at improving and protecting native species and habitats.

- Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
- Assess ways to support increased enforcement capacities, including cross-deputization between agencies;
- Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
- Review other species and habitat for inclusion in Hawaiian Islands Humpback Whale National Marine Sanctuary, increase research, education, and enforcement.
- Obtain and implement the plans of an Incidental Take Permit for sea turtle and Hawaiian monk seal bycatch;
- Improved integration of policies to address linkages between terrestrial and marine habitats and their shared conservation threats and needs;
- Develop and implement strategies and policies to encourage proper management of coastal dune system.

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 and include the following:

- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Revised Recovery Plan for the Nēnē (Hawaiian goose) (2004), the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003), the Hawaiian Endangered Bird Partnership for Captive Propagation Five Year Workplan (2002), the Draft Revised Recovery Plan for Hawaiian waterbirds (1999), the Recovery Plan for the Hawaiian Hoary Bat (1998), and the Recovery Plan for the Oʻahu Tree Snails of the Genus Achatinella (1992);
- Critical habitat designations by the USFWS for the Oʻahu ʻelepaio and for threatened and endangered plants on Oʻahu;
- Management Plans for the State Natural Area Reserves (NAR): Kaʻena Point NAR (1989) and Mt. Kaʻala NAR (1990);
- Integrated Natural Resources Management Plans have been developed by the U.S. Army, U.S. Marine Corps, and U.S. Navy to cover their respective installations on Oʻahu;
- The Division of Forestry and Wildlife's (DOFAW) Draft Management Guidelines, which coarsely rate vegetation quality and provide guidelines for land use (public hunting, recreation, and forest products) for State lands managed by DOFAW;
- The Koʻolau Mountains Watershed Partnership Management Plan (2002);
- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- The Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach;
- Coastal Zone Management plans, including Hawaiʻi Implementation Plan for Polluted Runoff Control (2000), Hawaiʻi Unified Watershed Assessment (1998);
- Hawaii's Local Action Strategy to Address Land-based Pollution Threats to Coral Reefs (2004);
- Bishop Museum has a comprehensive database of invertebrates;

- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawai‘i;
- The Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on O‘ahu. The discussion of future management needs is highlighted within each current managed area. Some areas on O‘ahu are already under active management or protection through designation as a State Natural Area Reserve (NAR), State Wildlife Sanctuary, National Wildlife Refuge (NWR), or Marine Corps Wildlife Management Area. The Ko‘olau Mountains Watershed Partnership (KMWP) was formed to identify and implement conservation actions needed to preserve the watershed resources of the Ko‘olau mountains, and initial steps are underway to establish a similar partnership in the Wai‘anae mountains. In addition, other partnerships, such as the O‘ahu Invasive Species Committee (OISC) have been formed to address specific species conservation needs.

Ko‘olau Mountains Watershed Partnership **(97,760 acres), Public-Private Partnership (DLNR-DOFAW, DLNR-State Parks, Department of Hawaiian Home Lands, U.S. Army, USFWS, Honolulu Board of Water Supply, Agribusiness Development Corporation, Queen Emma Foundation, Kamehameha Schools, Bishop Museum)**

Species**:** Forest birds, pueo, terrestrial invertebrates, including land snails, damselflies, bees, beetles, spiders, freshwater fishes (‘o‘opu), freshwater invertebrates, rare plants.
Habitats: Lowland wet communities, lowland mesic communities.
Current Management**:** Management plan exists. Fencing, ungulate control, invasive weed control.
Future needs**:** Funding to implement management plan, fencing, ungulate control, invasive weed control, predator control, outplanting.

O‘ahu Forest NWR **(4,525 acres), USFWS**

Species**:** Forest birds, pueo, terrestrial invertebrates, including land snails, rare plants.
Habitats: Lowland wet communities, lowland mesic communities.
Current Management**:** Invasive weed control, ungulate control, predator control.
Future needs**:** Continued management including ungulate and predator control, forest restoration.

Pahole Natural Area Reserve **(658 acres), DOFAW**

Species**:** Forest birds, terrestrial invertebrates, including land snails, spiders, rare plants.
Habitats: Lowland communities.
Current Management**:** No management plan exists. Fencing, ungulate removal from fenced areas, predator control, invasive plant removal, outplanting.

***Future Needs*:** Completion of proposed Kapuna fencing, develop management plan, formalize partnership with U.S. Army for habitat and rare plant management, continue existing management.

***Mt. Ka'ala Natural Area Reserve* (1,100 acres), DOFAW**

***Species*:** Forest birds, terrestrial invertebrates, including land snails, spiders, rare plants.
Habitats: Montane wet communities, lowland wet communities, lowland mesic communities, lowland dry communities.
***Current Management*:** Management plan exists. Fencing, invasive plant removal, maintenance of fencing.
***Future Needs*:** Formalize partnership with U.S. Army for habitat and rare plant management, continue existing management, ungulate and predator control.

***Honouliuli Preserve* (3,582 acres), The Nature Conservancy**

***Species*:** Forest birds, terrestrial invertebrates, rare plants.
Habitats: Lowland communities.
***Current Management*:** Fencing, fire prevention, predator (rat) control, invasive weed removal, ungulate control, habitat restoration, monitoring, research.
***Future Needs*:** Continue existing management.

***Kawailoa Training Area*, U.S. Army**

Species: Birds, snails, rare plants.
Habitats: Lowland wet communities, lowland mesic communities.
Current Management: Management plan exists, ungulate control, fencing.
Future Needs: Implement Integrated Natural Resources Management Plan.

***Kawai Nui and Hāmākua Marsh Complex* (850 acres), DOFAW**

***Species*:** Waterbirds, migratory shorebirds, ʻoʻopu, ʻōpae kalaʻole (shrimp).
Habitats: Lowland communities.
***Current Management*:** Hydrologic studies, habitat restoration, including invasive plant removal and native wetland planting, predator control.
***Future Needs*:** Continue existing management, secure adequate funding to support expanded management (increased predator control, invasive weed removal, habitat restoration, educational opportunities).

***Nu'upia Pond Wildlife Management Area* (482 acres), U.S. Marine Corps Base Hawai'i**

***Species*:** Waterbirds, migratory shorebirds, seabirds, particularly ʻuaʻu kani (wedge-tailed shearwater).
Habitats: Wetlands and ponds.
***Current Management*:** Implementation of Integrated Natural Resources Management Plan (INRMP): predator control, invasive plant (e.g., mangrove) removal, wetland improvements, monitoring.
Future Needs: Continue existing management.

***James Campbell NWR* (222 acres), USFWS**

***Species*:** Waterbirds, migratory birds, terrestrial invertebrates, anchialine pond fauna.

Habitats: Lowland communities, coastal communities.
***Current Management*:** Habitat restoration and endangered species protection: predator control, weed control, monitoring.
***Future Needs*:** Continue existing management. Increase the area protected and managed in order to accommodate growing populations of endangered waterbirds and migratory birds. Restoration of lowland wet and other coastal plant species.

***Pearl Harbor NWR* (62 acres), USFWS**
***Species*:** Waterbirds, migratory birds, terrestrial invertebrates, ʻōpaeʻula (anchialine pond shrimp).
Habitats: Lowland communities, anchialine pools.
***Current Management*:** Habitat restoration and endangered species protection: predator control, weed control, monitoring.
***Future Needs*:** Continue existing management.

***Paikō Lagoon* (40 acres), DOFAW**
***Species*:** Migratory shorebirds.
Habitats: Coastal communities.
***Current Management*:** Volunteer opportunities to participate in non-native plant (e.g., mangrove) control, trash removal, predator control, outplanting.
***Future Needs*:** Continue existing management.

***Pouhala Marsh Wildlife Sanctuary* (70 acres), DOFAW**
***Species*:** Waterbirds, particularly Hawaiian stilt.
Habitats: Lowland communities.
***Current Management*:** Habitat management: predator control, trash removal, mangrove removal, pond restoration.
***Future needs*:** Continue existing management.

***Kaʻena Point Natural Area Reserve* (36 acres), DOFAW**
***Species*:** Seabirds, particularly nesting mōlī (Laysan albatross) and ʻuaʻu kani (wedge-tailed shearwater), migratory shorebirds, monk seal, rare plants.
Habitats: Coastal communities.
***Current Management*:** Management of human access and activities, invasive weed removal, predator control, outplanting, monitoring, research.
***Future Needs*:** Continue existing management, increase monitoring and visitor education.

***Ulupaʻu Wildlife Management Area* (23 acres), U.S. Marine Corps Base Hawaiʻi**
***Species*:** Seabirds, particularly ʻā (red-footed booby).
Habitats: Coastal communities.
***Current Management*:** Implementation of INRMP: fire risk reduction, habitat enhancement.
Future Needs: Continue existing management.

***State Seabird Sanctuary* (13 offshore islets), DOFAW**

***Species*:** Seabirds: ʻuaʻu kani (wedge-tailed shearwater), Christmas shearwater, ʻewaʻewa (sooty tern), pākalakala (gray-backed tern), noio (black noddy), noio-kōhā (brown noddy), manu-o-Kū (white tern), bonin petrel, ʻiwa (great frigatebird), ʻā (red-footed booby), ʻā (brown booby), ʻā (masked booby), koaʻe ʻula (red-tailed tropicbird), koaʻe kea (white-tailed tropicbird), mōlī (Laysan albatross), kaʻupu (black-footed albatross), ʻou (Bulwer's petrel), migratory shorebirds.
Habitats: Coastal communities, marine ecosystems.
***Current Management*:** Ongoing surveys, predator removal, invasive weed control
***Future Needs*:** Continue existing management, identify priority islands for predator eradication and implement, include offshore waters as part of Marine Managed Area.

***Oʻahu Invasive Species Committee*, Public-Private Partnership**
***Species/Habitats*:** All species and habitats affected by invasive species.
***Current Management*:** Identification of priority invasive species, then implementation of control and/or eradication. Current priority species include: miconia, Caribbean frogs, Himalayan blackberry, fountain grass, fire tree, bushy beardgrass, manuka, Indian rhododendron, smoke bush.
***Future Needs*:** Adequate funding to support priority OISC actions.

***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.

***Three Marine Life Conservation Districts (MLCD),* DAR: Hanauma Bay, Pūpūkea, Waikīkī**
***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, and fish monitoring.
***Future needs*:** Evaluate all MLCDs for purpose and management effectiveness and consider need for new Marine Managed Areas.

***Five Fishery Management Areas (FMA),* DAR*:* He'eia Kea Wharf, Honolulu Harbor, Pōkaʻi Bay, Waialua Bay, Waikīkī-Diamond Head Shoreline**
***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 FMAs.
***Future needs*:** Evaluate all FMAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

***Nearshore waters surrounding Kāne'ohe Marine Corps Base,* U.S. Marine Corps Base Hawai'i**

Species: Marine invertebrates, coral reef fishes, and sea turtles.
Habitats: Marine ecosystems: seagrass bed, coral reef.
Current management: 500 foot (150 meter) safety buffer around Kāne'ohe Marine Corps Base enforced for public safety due to proximity to firing range.
Future needs: None at this time.

***Coconut Island Wildlife Sanctuaries,* DAR**

***Species*:** Marine species.
Habitats: Marine ecosystems: shallow coral reef, sandy beach, and rocky habitats.
***Current Management*:** Limited access. No Take.
***Future needs*:** Evaluate all Sanctuaries for purpose and management effectiveness and consider need for new Marine Managed Areas.

***Four Bottomfish Restricted Areas (BRA),* DAR**

***Species*:** Seven Bottomfish species.
Habitats: Marine ecosystems.
***Current Management*:** No Take of bottomfish.
***Future needs*:** Evaluate all BRAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Potential Areas for Enhanced Conservation Management

In addition to maintaining and enhancing existing conservation actions, additional efforts are needed for the long-term conservation of O'ahu's native wildlife. The following section identifies areas where enhanced conservation management would significantly benefit native species or their habitats. Areas are discussed in habitat order from the mountains to the sea.

Ko'olau Forested Watershed

***Species*:** Forest birds, terrestrial invertebrates, rare plants.
***Basis for Priority Designation*:** Habitat for rare species, significant acreage of intact lowland wet forest, tracts of remnant lowland dry forest, opportunities for partnership with numerous private landowners.
Potential Conservation Actions: Expand participation in KMWP, facilitate conservation on private lands through technical assistance and funding opportunities, increased ungulate management through fencing and control, invasive weed control and removal, rodent control.

Manoa stream riparian corridor

Species: *Oahuhawaiiana kazukolinda*.
***Basis for Priority Designation*:** Few intact stream corridors remaining statewide.

Potential Conservation Actions: Secure additional protection, fencing, support voluntary and incentive based programs for conservation on private lands.

Wai‘anae Forested Watershed

***Species*:** Forest birds, native invertebrates, rare plant taxa.
***Basis for Priority Designation*:** Habitat for rare species, intact lowland mesic forest, emerging public-private partnership currently encompassing 5,800 acres involving DOFAW, Board of Water Supply, non-governmental organizations, community. Opportunities for expanded partnerships. Multiple planning efforts underway (U.S. Army Mākua Mitigation Plan; Board of Water Supply watershed plans).
Potential Conservation Actions: Expand and strengthen emerging partnership, integrate existing conservation management, ungulate control, invasive weed control, fire prevention.

Wetland Habitats

Species: Waterbirds, migratory shorebirds and waterfowl, terrestrial invertebrates, freshwater fishes, freshwater invertebrates.
***Basis for Priority Designation*:** Insufficient number of protected and managed wetlands to support growth of endangered waterbird populations.
Potential Conservation Actions: Increase active management of areas currently used by waterbirds using predator control, invasive plant removal, and wetland restoration, identify priority areas for protection and management, secure adequate funding for management and restoration of wetlands, develop emerging partnership of landowners (DLNR, Hawai‘i Community Development Authority, Kamehameha Schools) at He‘eia into model for cooperative management across an *ahupua‘a* (from the mountains to the ocean).

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MOLOKA‘I

Moloka‘i is the fifth largest of the Main Hawaiian Islands. While fairly small in geographic size, the island supports a wide-range of native habitats and a diversity of native wildlife. The mountains of eastern Moloka‘i are cut into deep valleys by perennial streams, and due largely to their inaccessibility, these valleys contain high-quality native habitat for stream fauna, forest birds, and native snails and insects. The coastal strand along the island’s northwest coast contains one of the State’s last intact dune systems and is important to nesting seabirds and marine animals. Habitat community types found on Moloka‘i include lava tube caves, montane bogs, and wet forests. Important geographic features include the State’s third largest perennial stream, and the highest sea cliffs in the world.

OVERVIEW

Geology and Hydrology

Moloka‘i is approximately 1.8 million years old and 68,000 hectares (170,240 acres) in size. Three shield volcanoes comprise most of the island, with the East Moloka‘i Mountains making up half of the island area. The highest point on the island is 1,515 meters (4,970 feet), and steep cliffs characterize the northern windward coast with inaccessible deep valleys dissecting the coastal area. The leeward slopes descend to a narrow coastal plain fronting an extensive shallow offshore reef flat. The terrain of western Moloka‘i was formed by an older volcano, and has a maximum elevation of 421 meters (1,351 feet). This side of the island is typically dry and windy. The Kalaupapa peninsula, formed by the third volcano, extends from the north-central coast, below the steep sea cliffs of eastern Moloka‘i. Approximately 37 percent of the island is below 150 meters (500 feet) in elevation, and about 18 percent of the island is above 610 meters (2,000 feet) in elevation. Moloka‘i has 36 perennial streams, 16 of which are continuous. Wailau-Pulena and Pelekunu have the largest discharges, 27 and 25 million gallons per day (mgd), respectively. Moloka‘i has nine offshore islets.

Climate

Annual rainfall ranges from 406 centimeters (160 inches) at the top of the East Moloka‘i Mountains, to 38 centimeters (15 inches) along the coasts of the leeward side of the island.

Land and Water Use

The majority of land on the island is in the State Agricultural District (67% or 44,651 hectares/111,627 acres). Approximately 30 percent (or 19,907 hectares/49,768 acres) is in the State Conservation District, primarily covering the East Moloka‘i Mountains and the coastlines. The remaining land is either in the Urban (2% or 1,016 hectares/2,539 acres) or Rural (1% or 746 hectares/1,866 acres) Districts. Ten percent of the island (6,412 hectares/16,030 acres) is in Forest Reserve. There are also 10,308 hectares (25,769 acres) of Department of Hawaiian Home Lands (16% of the island). Within native dominated landscapes, major landowners include the State of Hawai‘i and private entities such as The Nature Conservancy of Hawai‘i, Kamehameha Schools, Pu‘u O Hoku Ranch, and Moloka‘i Ranch. One stream (Kamalo) 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.

Human Landscape
Total resident population on the island is estimated at 7,500, with an average daily visitor count of 955. A majority of the population is centered in the Kaunakakai and Hoʻolehua areas in central Molokaʻi. Molokaʻi has the second highest percentage of Native Hawaiians in the State, and many of these residents engage in traditional practices of subsistence gathering. In 1999, the island was named an "Enterprise Community" through the USDA Empowerment Zone program, a designation which provides Federal funds to support economic growth and community development. The major industries are agriculture, ranching, and flower cultivation.

SPECIES AND HABITATS OF IMPORTANCE
Molokaʻi is home to a variety of habitats. Major habitat types include montane wet forests and shrublands, coastal system (including dunes and grasslands), perennial streams, lava tubes and caves, cliffs, bog communities, and nine offshore islets. Molokaʻi contains recovery habitat identified by the USFWS for the Maui parrotbill (*Pseudonestor xanthophrys*) and ʻākohekohe (*Palmeria dolei* [crested honeycreeper]). Additionally, 1,242 hectares (3,105 acres) in East Molokaʻi has been designated by the USFWS as critical habitat for the Blackburn's sphinx moth (*Manduca blackburni*), which partially overlaps with 9,733 hectares (24,333 acres) designated as critical habitat for 41 endangered plants on Molokaʻi.

Appendix A provides information on what wildlife Species of Greatest Conservation Need are present on Molokaʻi and its associated offshore islands. Most of Molokai's endemic forest birds are likely extinct; however ʻiʻiwi (*Vestiaria coccinea*), ʻamakihi (*Hemignathus virens*), and ʻapapane (*Himatione sanguinea*) still persist at low numbers. In addition, Molokaʻi supports populations of several endangered and threatened species, such as ʻōpeʻapeʻa (*Lasiurus cinereus semotus* [Hawaiian hoary bat]), the nēnē (*Branta sandvicensis* [Hawaiian goose]), aeʻo (*Himantopus mexicanus knudseni* [Hawaiian stilt]), ʻalae keʻokeʻo (*Fulica alai* [Hawaiian coot]), ʻuaʻu (*Pterodroma sandwichensis* [Hawaiian petrel]), ʻaʻo (*Puffinus auricularis newelli* [Newell's shearwater]), and the Blackburn's sphinx moth. Other species groupings that can be found on Molokaʻi are terrestrial invertebrates, freshwater fishes, freshwater invertebrates, seabirds, migratory birds, and raptors.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS
Many general threats to native wildlife and habitats are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats that are more acute or specific to Molokaʻi are listed below.

- Large numbers of goats (*Capra hircus*) occur at mid-elevations on the south slope of east Molokaʻi, denuding vegetation, pushing back the forest line, and contributing to soil erosion and runoff onto the nearshore reefs, thereby affecting both forest and marine species;
- Range expansion by invasive plants threatens the native-dominated core of east Molokaʻi;
- The presence of pigs (*Sus scrofa*) and axis deer (*Axis axis*) in areas of pristine, high-quality native forest degrades important habitat for the remaining arthropods, forest birds, and snails;
- The relative isolation and small size of forest bird populations makes these species extremely vulnerable to disturbances and unexpected disasters such as hurricanes or

wildfires that could lead to their extinction. The degree to which this is also true for arthropods and snails is unknown;
- Development of formerly undeveloped areas (especially along the southeastern coast) leading to loss and degradation of terrestrial, freshwater, and marine habitat (e.g., increased nutrients in coastal areas leads to non-native algal blooms which affect fish populations and coral habitats, sedimentation from development near stream corridors);
- Introduced predators (vertebrate and invertebrate) in native landscapes that prey on native birds, snails, and other invertebrates either directly, or indirectly, through competition for food and other resources;
- Nest burrow usurpation, or trampling by ungulate and human traffic, and disease by arthropod vectors for seabirds;
- Wildfire;
- Lack of enforcement for existing rules and regulations;
- Expanding eco-tourism activities that disrupt animal behaviors and habitats.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Molokaʻi 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 conservation actions identified in the 'Potential Areas for Enhanced Conservation Management' subsection;
    - Develop and/or implement recovery plans for threatened and endangered species on Molokaʻi;
    - Increase active management in, or acquisition of, extremely rare habitats on Molokaʻi;
    - Increase DOFAW capacity to support on-site management and coordination with Molokaʻi partners;
    - Implement fire suppression measures and protocols for post-fire restoration;
    - Increase the total acreage of ungulate-free and predator-free areas;
    - Assess potential reintroduction of native birds historically found on Molokaʻi;
    - 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;
    - Develop management plans for all Marine Managed Areas;
    - Support Local Action Strategies project to deal with non-point source pollution off the south coast and support expansion of successful methods to other areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Improve early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on Molokaʻi (e.g., *Tibouchina herbacea* and *Miconia calvescens*);

    - Increase efforts to prevent establishment of priority invasive plants in pristine areas and to eradicate from areas with recovery potential;
    - Support efforts to strengthen marine alien species prevention and control.
- 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;
    - Increase bat surveys to better assess bat distribution;
    - Assess impact of eco-tourism activities on terrestrial and aquatic native wildlife and associated habitats.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Support ongoing and future projects to deal with Non-Point Source Pollution;
    - Support community based management of terrestrial and aquatic habitats;
    - Collaborate with NOAA to ensure the protection of marine mammal populations.
- 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 at managed conservation areas;
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
    - Assess ways to support increased enforcement capacities, including cross-deputization between agencies;
    - Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
    - Improve integration of policies to address linkages between terrestrial and marine habitats and their shared conservation threats and needs.

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 and include the following:

- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Revised Recovery Plan for the Nēnē (Hawaiian goose) (2004), the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003), the Hawaiian Endangered Bird Partnership for Captive Propagation Five Year Workplan (2002), the Draft Revised Recovery Plan for Hawaiian waterbirds (1999), and the Recovery Plan for the Hawaiian Hoary Bat (1998), the Draft Recovery Plan for the Blackburn’s sphinx moth (2003);
- Critical habitat designations by the USFWS for the Blackburn’s sphinx moth and for threatened and endangered plants on Moloka‘i;
- Management Plans for the State Natural Area Reserves (NAR): Olokui NAR (1991), Pu‘u Ali‘i NAR (1991);

- Long-Range Management Plans for Natural Area Partnership Preserves (NAPP): Moʻomomi NAPP (2000); Kamakou NAPP (2000); Pelekunu NAPP (2003);
- The Division of Forestry and Wildlife's (DOFAW) Draft Management Guidelines, which coarsely rate vegetation quality and provide guidelines for land use (public hunting, recreation, and forest products) for State lands managed by DOFAW;
- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- The Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach;
- Coastal Zone Management plans, including Hawaiʻi Implementation Plan for Polluted Runoff Control (2000), Hawaiʻi Unified Watershed Assessment (1998);
- Hawaii's Local Action Strategy to Address Land-based Pollution Threats to Coral Reefs (2004);
- Bishop Museum has a comprehensive database of invertebrates;
- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawaiʻi;
- The Hawaiʻi Biodiversity and Mapping Program (formerly the Hawaiʻi Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on Molokaʻi. The discussion of future management needs is highlighted within each current managed area. Some areas on Molokaʻi are already under active management or protection through designation as a State Natural Area Reserve (NAR), Natural Area Partnership Preserve, National Park, or National Wildlife Refuge (NWR). The East Molokla'i Watershed Partnership (EMoWP) extends similar management over private lands, resulting in the protection of a contiguous 760 hectare (19,000 acre) block of the most intact portion of the native-dominated landscape. The Molokaʻi subcommittee of the Maui Invasive Species Committee (MoMISC) addresses high priority invasive species on an island-wide basis. Additional conservation management benefiting native wildlife occurs on a more localized basis, based on funding availability and landowner or community support. Examples include nēnē re-introduction on private lands and Moʻomomi coastal strand restoration. Finally, DOFAW working with USFWS has a programmatic Safe Harbor Agreement for nēnē on Molokaʻi, allowing the agency to enroll individual landowners who enhance, restore, or maintain habitat to benefit nēnē, protecting them from Endangered Species Act requirements if nēnē numbers increase due to their conservation actions.

East Molokaʻi Watershed Partnership (EMoWP) **(19,000 acres), Public-Private Partnership (NPS, TNC, DOFAW, Kamehameha Schools, Kapualei Ranch, Kawela Plantation, Ke Aupuni Lōkahi Enterprise Community Governance Board, individual private landowners, Hawaiʻi Department of Health, Maui County, Maui County Department of Water Supply,**

Molokaʻi-Lānaʻi Soil and Water Conservation District, USDA, USGS, U.S. Environmental Protection Agency)

Species: All species found on partner lands listed below.

***Habitats*:** Montane wet communities, lowland communities, coastal communities, marine systems.

Current Management: Management plan exists. Phase I fencing along the south slope of the East Molokaʻi Mountains.

Future Needs: Continue fencing excluding ungulates and predators from upper south slope of East Molokaʻi mountains in cooperation with private landowners, maintain fences.

Kalaupapa National Historic Park **(10,779 acres, in addition 2 offshore islets), NPS**

Species: ʻAmakihi, ʻapapane, ʻiʻiwi, ʻuaʻu (Hawaiian petrel), ʻaʻo (Newell's shearwater), koaʻe kea (white-tailed tropicbird), koaʻe ʻula (red-tailed tropicbird), ʻā (brown bobby), ʻou (Bulwer's petrel), ʻuaʻu kani (wedge-tailed shearwater), cave invertebrates, Hawaiian monk seal, hōnu (green and hawksbill), five native diadromous fish (goby) species, native snails, shrimp.

Habitats: Montane wet communities, lowland communities, coastal communities. Kauhakō Crater contains only known low elevation dryland forest known in the State.

Current Management: Management plan exists. One-time inventories for bats, herptofauna, vascular plants, anchialine pond fauna, and marine fishes. Invasive plant control, fencing, ungulate control, water quality monitoring. Marine and terrestrial monitoring protocols are under development (covering fishes, fisheries, marine benthos, freshwater animals, selected birds, bat, terrestrial invertebrates, vegetation, land use changes in and adjacent to park, invasive species, and water quality). ʻOpihi and reef monitoring and research, monk seal monitoring and protecting, and coral recruitment project.

Future Needs: Continue existing management. Establish monitoring program for nesting sea turtles, establish program to study oceanographic currents and marine water quality, and continue monitoring of coral reef fishes, benthic fishes, and invertebrates.

Kamakou Preserve **(2,774 acres), TNC**

Species: ʻAmakihi, ʻapapane, ʻiʻiwi, five rare native land snails, native insects.

Habitats: Montane wet communities, lowland mesic communities.

Current Management: Management plan exists. Fence maintenance, ungulate control through trapping, invasive plant control and eradication, fire prevention, monitoring, rare species outplanting, community outreach.

Future Needs: Continue existing management.

Pelekunu Preserve **(5,714 acres), TNC**

Species: ʻIʻiwi, ʻapapane, ʻamakihi, ʻaukuʻu (black-crowned night-heron), ʻūlili (wandering tattler), koaʻe kea (white-tailed tropicbird), *Partulina mighelsiana, P. tessellata*, *Megalagrion santhomelas, M. pacificum*, beetles, five native freshwater fishes, freshwater snail, hihiwai, two native crustaceans, ʻopae kalaʻole, ʻopaeʻoheaʻa, rare aquatic insects, *Campsicnemus ridiculus.*

Habitats: Montane wet communities, lowland communities, coastal communities. Free-flowing streams.
Current Management: Management plan exists. Ungulate control, invasive plant monitoring and control, natural resource and water quality monitoring.
Future Needs: Continue existing management.

Olokuʻi NAR **(1,620 acres), DOFAW**
Species: ʻApapane, ʻamakihi, ʻiʻiwi, koaʻe kea (white-tailed tropicbird), ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), native insects (crickets, katydid, flies, spiders), rare tree snails (*Achatinella* spp., *Partulina mighelsiana*, *P. tessellata, P. dwightii, Newcombia cinnamomea*).
Habitats: Montane wet communities, montane mesic communities, lowland wet communities, coastal communities, perennial streams.
Current Management: Management plan exists. Aerial and ground monitoring for feral ungulates and invasive plants.
Future Needs: Continuation of existing efforts to maintain Olokui in pristine condition.

Puʻu Aliʻi NAR **(1,330 acres), DOFAW**
Species: Olomaʻo, ʻiʻiwi, pueo, ʻapapane, ʻamakihi, ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), native invertebrates (crickets, drosophilid flies, happyface spiders, Tornatellinid snails, Succinid snails, four species of *Achatinella* land snails, *Partulina tessellata, P. redfieldii, P. proxima, P. mighelsiana*).
Habitats: Perennial streams, montane wet shrublands and forests, upper half has most intact communities.
Current Management: Management plan exists. Ungulate control, fence maintenance, invasive plant control.
Future Needs: Fencing to restrict ungulate movement in a larger portion of the NAR, ungulate removal, continuation of existing efforts.

Kakahaiʻa NWR **(45 acres), USFWS**
Species: Aeʻo (Hawaiian stilt), ʻAlae keʻokeʻo (Hawaiian coot), migratory shorebirds.
Habitats: Contains 15-acre freshwater pond, seven-acre impoundment, and marshy thicket of bulrushes.
Current Management: Environmental education, habitat restoration, invasive species removal.
Future Needs: Continue existing management.

Moʻomomi Preserve **(921 acres), TNC**
Species: Pueo, hunakai (sanderling), kōlea (Pacific golden plover), ʻiwa (great frigatebird), mōlī (Laysan albatross), Hawaiian monk seal, honu (green sea turtle).
Habitats: Coastal communities.
Current Management: Management plant exists. Nonnative species control, weed control, resource monitoring and research, community outreach, and rare species protection.
Future Needs: Continue existing management.

***State Seabird Sanctuary* (Seven offshore islands), DOFAW**

Species: ʻAukuʻu (black-crowned night-heron), ʻuaʻu kani (wedge-tailed shearwater), ʻou (Bulwer's petrel), koaʻe kea (white-tailed tropicbird), koaʻe ʻula (red-tailed tropicbird), ʻā (brown booby), kōlea (Pacific golden plover), ʻūlili (wandering tattler), ʻakekeke (ruddy turnstone), yellow-faced bees (*Hylaeas* spp.).
Habitats: Coastal communities.
Current Management: Monitoring, surveys.
Future Needs: Removal of small mammalian predators and native vegetation habitat restoration.

***Molokaʻi Invasive Species Committee*, Public-Private Partnership**

Species/Habitats: All species and habitats affected by invasive species.
Current Management: Invasive species prevention and control.
Future Needs: Continued support to identify, control, and eradicate high priority invasive species, increase prevention surveillance.

***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.

One Fishery Management Area (FMA),* DAR*: Kaunakakai Harbor

Species: Some or all regulated fish species.
***Habitats*:** Marine and estuary systems.
***Current Management*:** Limited take, gear, size, season, and/or area restrictions.
***Future needs*:** Evaluate all FMAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

***One Bottomfish Restricted Area (BRA),* DAR**

Species: Seven bottomfish species.
***Habitats*:** Marine ecosystems.
***Current Management*:** No Take of bottomfish.
***Future needs*:** Evaluate all BRAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Potential Areas for Enhanced Conservation Management

In addition to maintaining and enhancing existing conservation actions, additional efforts are needed for the long-term conservation of Molokai's native wildlife. The following section identifies areas where enhanced conservation management would significantly benefit native species or their habitats. Areas are discussed in habitat order from the mountains to the sea.

Moloka'i Forest Reserve **(16,030 acres), DOFAW**

Species**:** Forest birds, terrestrial invertebrates.

Basis for Priority Designation**:** Good quality native forest, lowland mesic shrubland, part of EMoWP adjacent to core forested areas, little active management for native wildlife conservation.

Potential Conservation Actions: Control of invasive plants (biocontrol was introduced to halt spread of *Clidemia* to pristine areas), more intensive management for conservation in upper Waimanu and Mokomoko sections, review management policies to bring in line with quality of habitat.

Watershed area east of Kapualei

Species**:** Forest birds, terrestrial invertebrates.

Basis for Priority Designation**:** Relatively intact native habitat, protection against browsing by feral goats would reduce vegetation loss and soil erosion, thereby reducing sedimentation onto nearshore reefs.

Potential Conservation Actions: Assess future partnership opportunities and create incentives for conservation management.

Stream corridors (**Wailau*****)***

Species**:** Freshwater fishes, freshwater invertebrates, terrestrial invertebrates.

Basis for Priority Designation**:** One of the major stream corridors on the island not impacted by ungulates and invasive plants.

Potential Conservation Actions: Monitor stream health, assess for future management needs.

Cave Ecosystems **(Kalaupapa and montane rain forest on the slopes of Kawela)**

Species**:** Invertebrates.

Basis for Priority Designation**:** Unique ecosystems – only habitat for certain endemic invertebrates.

Potential Conservation Actions: Protection from human intrusion, invasive alien species, invasive microorganisms, wild fires, and ungulates.

Coastal Wetlands **(Paialoa Pond**, Pālaau wetlands, **Kaunakakai** Sewage Treatment Plant, '**Ōhi'apilo** Playa, coastal fishponds, **Kualapu'u** Reservoir, Ho'olehua wetlands)

Species**:** Waterbirds, migratory birds.

Basis for Priority Designation**:** These areas have been identified by the USFWS and the Pacific Coast Joint Venture as core (bolded) and supporting areas for waterbird recovery.

Potential Conservation Actions: Restoration and management: increase and create open water surface, establish permanent water sources, control weeds, and restore native vegetation, conduct predator control.

North and West Shore Coastal Strand

***Species*:** Seabirds, Hawaiian monk seal, honu (sea turtle).

***Basis for Priority Designation*:** Important, heavily used habitat for seabirds and marine animals.

Potential Conservation Actions: Restoration of native vegetation, limit human disturbance, predator control.

***ʻĪlio Point,* State Land**

***Species*:** Seabirds.

***Basis for Priority Designation*:** Lithified sand dunes support quality intact mixed coastal shrubland. Used by nesting seabirds. Threatened by axis deer, invasive plants, feral cats, and pigeons. High restoration potential for coastal strand ecosystem and seabird habitat.

Potential Conservation Actions: Presence of unexploded ordnance limits conservation activities. Deer-proof fencing and predator control needed.

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LĀNA‘I

Lāna‘i is the third smallest of the Main Hawaiian Islands. Because of the history of overgrazing by cattle, goats, and axis deer, most of the island has suffered from extensive soil erosion and few native-dominant natural communities remain. Though many species once native to Lāna‘i are now gone, the last major remnant of the olopua/lama dryland forest that once covered large portions of the lowlands of Maui Nui (composed of Maui, Lāna‘i, Moloka‘i, and Kaho‘olawe) occurs on Lāna‘i. This forest is habitat to several taxa of native invertebrates. The upland area surrounding the island’s highest point, Lāna‘ihale, contains most of the remaining native-dominated mesic forest and is habitat for the ‘ua‘u (*Pterodroma sandwichensis* [Hawaiian petrel]), ‘apapane (*Himatione sanguinea*), and rare land snails. Waterbird species rely primarily on man-made reservoirs (e.g., the Lāna‘i Sewage Treatment Plant), rather than natural wetlands.

OVERVIEW

Geology and Hydrology

Lāna‘i was formed from a single dome-shaped shield volcano that last erupted over one million years ago. Only 29 kilometers (18 miles) long and 21 kilometers (13 miles) wide, the island is approximately 36,520 hectares (90,500 acres). The highest point is Lāna‘ihale, at 1,027 meters (3,370 feet). The northeastern coast is fringed with broad sandy beaches, while the southwestern coast is marked by sea cliffs. Approximately 25 percent of the island is below 150 meters (500 feet) in elevation; only 6 percent of the island is above 610 meters (2,000 feet) in elevation. Lāna‘i has five offshore islets. There are no perennial streams or lakes.

Climate

Located in the rain shadow of Maui, Lāna‘i is generally dry, with an average rainfall of 75 to 100 centimeters (30 to 40 inches) over Lāna‘ihale and less than 25 centimeters (ten inches) on the southwestern (leeward) side of the island. A large portion of the water in the island’s aquifer comes from “fog drip,” moisture pulled from clouds by trees and ferns in upper elevations. Strong tradewinds funneled from Maui and Moloka‘i increase evaporation of moisture and contribute to soil erosion, particularly on the western side of the island.

Land and Water Use

Approximately 42 percent (15,457 hectares or 38,197 acres) of the island is in the Conservation District, located primarily around Lāna‘ihale and on the western end of the island. This area partly overlaps the Lāna‘i Cooperative Game Management Area. Most of the remaining acreage is in the Agricultural District (52%), with about four percent in the Urban District (concentrated around Lāna‘i City, Mānele Bay and the airport) and two percent in the Rural District (located primarily along remote coastlines). Nearly the entire island (98%) is privately owned by Castle and Cooke, Inc. Four of the five offshore islands are in the State Seabird Sanctuary. Approximately 12,140 hectares (30,000 acres) are leased by State Division of Forestry and Wildlife (DOFAW) for use as the Lāna‘i Cooperative Game Management Area.

Human Landscape

In 2000, the residential population of the island was estimated at 3,193 persons. A majority of the population is centered in Lānai City. In the early 1990s, with the closure of a large pineapple plantation and opening of two resorts at Kō‘ele and Mānele Bay, the island’s economic base

shifted from agriculture to tourism and resort-residential development. The number of annual visitors grew from 46,052 in 1990 to a high of 106,036 in 1997.

SPECIES AND HABITATS OF IMPORTANCE

Habitats on Lānaʻi are primarily lowland dry communities and coastal communities. While few areas of native-dominant vegetation remain, there are opportunities for habitat restoration through a combination of fencing to exclude ungulates (hooved animals), outplanting of native species, and invasive plant control.

Appendix A provides information on the wildlife Species of Greatest Conservation Need present on Lānaʻi and its associated offshore islands. Species endemic to Lānaʻi include several species of Lānaʻi tree snail (*Partulina* spp.). Although once abundant, these species are currently near extinction due to loss of habitat, recreational collecting, and predation by non-native carnivorous snails. Waterbirds and migratory shorebirds use remnant wetlands, and the ʻuaʻu (*Pterodroma sandwichensis* [Hawaiian petrel]) is believed to nest on the sea cliffs. Historically, Lānaʻi was home to eight species of forest birds. Although several are now extinct, the possibility exists for re-introduction of ʻiʻiwi (*Vestiaria coccinea*), ʻamakihi (*Hemignathus virens*), and ʻōʻū (*Psittirostra psittacea*). The U.S. Fish and Wildlife Service (USFWS) has designated critical habitat for two plants: *Tetramolopium remyi* and *Bidens micrantha kalealaha*.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats more acute or specific to Lānaʻi are listed below. Because Lānaʻi has no perennial streams, there are no identified threats specific to freshwater species on Lānaʻi.

- Habitat degradation caused by feral ungulates, specifically axis deer (*Axis axis*), sheep (*Ovis aries*), and goats (*Capra hircus*), which contributes to erosion and sedimentation of near-shore reefs;
- Introduction of invasive species via the ferry from Maui;
- Degradation of habitat by introduced plant species, with kāhili ginger (*Hedychium gardnerianum*), strawberry guava (*Psidium cattleianum*), fountain grass (*Pennisetum setaceum*), and molasses grass (*Melinis minutiflora*) among the most important;
- Threat of fire, exacerbated by non-native grasses;
- Predation of nesting ʻuaʻu (Hawaiian petrel) by feral cats (*Felis silvestris*), dogs (*Canis familiaris*), barn-owls (*Tyto alba*), cattle egrets (*Bubulcus ibis*), and rodents (e.g., *Rattus* spp.);
- Predation of endemic tree snails by alien carnivorous snails (e.g., *Euglandina rosea*);
- Localized excessive recreational use (e.g., Mānele Bay);
- Human and boat interactions with marine mammals.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Lānaʻi 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/or implement recovery plans for threatened and endangered species on Lānaʻi;
    - Increase active management in, or acquisition of, extremely rare habitats on Lānaʻi;
    - Increase the total acreage of ungulate-free and predator-free areas;
    - Assess potential reintroduction of native birds historically found on Lānaʻi;
    - Institute landscape-level predator management (primarily rodent and feral cat) around suspected ʻuaʻu (Hawaiian petrel) nesting colonies;
    - Evaluate methods to maintain old plantation roads as firebreaks;
    - Support restoration efforts on the island, particularly of native habitats and areas adjacent to watershed;
    - Erosion control and restoration/reforestation of northeast portion of island to minimize sedimentation and runoff into coastal area and ocean;
    - Develop management plans for all Marine Managed Areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Improve early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on Lānaʻi; explore the feasibility of inspection of persons and materials arriving via the ferry from Maui;
    - Inventory existing terrestrial and aquatic invasive species and prioritize control actions.
- 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;
    - Conduct forest bird survey to update information on populations.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Support efforts to develop community-based management;
    - Support projects to deal with Non-Point Source Pollution;
    - Collaborate with NOAA to ensure the protection of marine mammal populations.
- Expand and strengthen outreach and education to improve understanding of our native wildlife resources among the people of Hawaiʻi.
    - Explore opportunities for community-based wildlife surveys and monitoring;
    - Maintain existing outreach and educational programs at managed conservation areas;
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
    - Review other species and habitat for inclusion in Hawaiian Islands Humpback Whale National Marine Sanctuary, increase research, education, and enforcement.

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 and include the following:

- Long-range management plan for Natural Area Partnership Preserve: Kānepuʻu Preserve (2004);
- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003), and the Draft Revised Recovery Plan for Hawaiian waterbirds (1999);
- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- The Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach;
- Coastal Zone Management plans, including Hawaiʻi Implementation Plan for Polluted Runoff Control (2000), Hawaiʻi Unified Watershed Assessment (1998);
- Hawaii's Local Action Strategy to Address Land-based Pollution Threats to Coral Reefs (2004);
- Bishop Museum has a comprehensive database of invertebrates;
- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawaiʻi;
- The Hawaiʻi Biodiversity and Mapping Program (formerly the Hawaiʻi Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on Lānaʻi. The discussion of future management needs is highlighted within each current managed area. In comparison to other islands, Lānaʻi has few areas managed for the long-term conservation of native wildlife. There are no National Parks or Wildlife Refuges, State Forest Reserves, Natural Area Reserves, or Wildlife Sanctuaries, and no on-island Invasive Species Committee.

Kānepuʻu Preserve (590 acres), TNC and ʻIke ʻĀina

Species: ʻApapane, pueo, kōlea (Pacific golden plover).
Habitats: Lowland dry communities, particularly olopua/lama dryland forest.
Current Management: Management plan exists. Maintenance of fencing; deer control, invasive plant control, outplanting of native plants as part of Natural Area Partnership Program.
Future Needs: Maintenance of existing fencing, weed control, community involvement.

Lānaʻi Watershed Partnership **(20,000 acres), Public-Private Partnership (Castle & Cooke, DOFAW, USFWS, NRCS, TNC, County of Maui Department of Water Supply, Bishop Museum)**

Species: ʻApapane, ʻuaʻu (Hawaiian petrel), tree snails.
Habitats: Lowland mesic communities, lowland dry communities.
Current Management: Management strategy exists but no formalized plan. Fencing of 1,450 hectare (3,600 acres) at Lānaʻihale summit, ungulate (primarily deer) removal, native outplanting and reforestation.
Future Needs: Funding to complete fencing and ungulate removal, reforestation.

State Seabird Sanctuary **(4 offshore islets), DOFAW**

Species: Nesting seabirds, primarily noio (black noddy), koaʻe ʻula (red-tailed tropicbird).
Habitats: Coastal community.
Current Management: No management plan exists. Surveys and monitoring of seabird populations.
Future Needs: Continue surveys, predator control.

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.

Mānele-Hulopoʻe Marine Life Conservation District (MLCD), **DAR**

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, and rocky habitats.
Current Management**:** Allow fishing throughout MLCD and fish monitoring.
Future Needs: Evaluate all MLCDs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Mānele Harbor Fishery Management Area (FMA), **DAR**

Species**:** Some or all regulated fish species.
Habitats: Marine and estuary ecosystems.
Current Management**:** Limited take, gear, size, season, and/or area restrictions.

Future Needs: Evaluate all FMAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

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MAUI

Maui is the second largest island in the State of Hawai‘i and is known as the Valley Isle. Thirty percent of the island is dominated by native vegetation with most of this habitat in east Maui. The upper elevation slopes and summits of both east and west Maui are typically native dominated, with coastal and lower elevation areas dominated by non-native vegetation. Three notable areas contain continuous native vegetation spanning a range of habitats, forming a landscape with a high diversity of total species: summit and leeward west Maui (wet forests and bogs transitioning to lowland mesic communities), windward east Maui (subalpine shrubland transitioning to wet forest), and leeward east Maui (subalpine community transitioning to remnant montane mesic then lowland and coastal dry communities). In addition, large tracts of intact native-dominated montane forests remain, with a canopy composed primarily of ‘ōhi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*) and a well-developed sub-canopy layer of mixed native understory trees and shrubs. Habitat types are highly diverse, including coastal and wetland habitats, lava tube caves, aeolian habitats, and bogs. Maui also has ten offshore islets that are significant habitats for seabirds. Anchialine ponds, which host a unique fauna of amphipods and shrimp, are found in young lava fields. As a result of the range of habitats, a diversity of species can be found including cave insects, endangered forest birds, marine mammals, and endemic freshwater fishes.

OVERVIEW

Geology and Hydrology

At 186,163 hectares (465,408 acres), Maui was formed between 750,000 and 1.3 million years ago, as first west Maui then east Maui emerged from two large shield volcanoes (West Maui and Haleakalā). Haleakalā is the tallest peak at 3,055 meters (10,023 feet), with Pu‘u Kukui in West Maui coming in second at 1,764 meters (5,788 feet). Maui is the only island (other than Hawai‘i) containing alpine and subalpine communities. Approximately 25 percent of the island is below 150 meters (500 feet) in elevation; just over 40 percent is above 610 meters (2,000 feet) in elevation. Major streams include Palikea (the second largest perennial stream in the State), Kalialinui-waialae gulch (the State’s second longest stream), Honokohau stream (the longest stream channel in west Maui), and ‘Īao stream. Maui has 90 perennial streams, 56 of which are continuous. Waihe‘e and ‘Īao streams have the largest discharges - 60 and 43 million gallons per day (mgd) respectively. Many streams are diverted; Maui has the highest diversion of natural stream flows in the State. 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. Maui has ten offshore islets.

Climate

Because of the size and elevation range of Haleakalā, climate and vegetation communities vary dramatically. Warm trade winds meet the windward side of the volcano and leave most of their moisture behind as rain or cloud drip on the windward side. At high elevations and on the leeward slopes of Haleakalā, dry conditions predominate. The geologically older West Maui mountains receive an average rainfall of 1,016 centimeters (400 inches) per year, making it the second wettest spot in the State.

Land and Water Use

Land use designations according to the State Land Use Commission are 53 percent Agricultural District, 42 percent Conservation District, five percent Urban District, and less than one percent Rural District. Major land owners in West Maui include the State of Hawai‘i, Maui Land and Pineapple, Inc., C. Brewer, Inc., AMFAC/JMB Hawai‘i, Kamehameha Schools, and Maui County (Department of Water Supply). In East Maui, major land owners are the State of Hawai‘i (including the Department of Hawaiian Home Lands), the National Park Service, Alexander and Baldwin, and Haleakalā Ranch. Fifty-seven streams are diverted and seven have altered channels. ‘Īao is the largest altered stream. Maui has ten impaired streams under EPA Clean Water Act standards. The East Maui canal system in Central Maui is the largest man-made stream system at 164 million gallons per day.

Human Landscape

Estimated human population for the island is 117,000 with most of the island’s population located in central, south, and west Maui in areas such as Kahului and Wailuku, Kīhei, and Lahaina and Ka‘anapali. The average daily visitor population is approximately 44,000. Major industries are tourism, agriculture, ranching, and flower cultivation.

SPECIES AND HABITATS OF IMPORTANCE

Given the five elevation zones present on Maui, the island has a diversity of habitats for native wildlife. Particular habitats associated with native wildlife include alpine deserts, subalpine and montane forests and bogs, lowland forests, coastal communities, anchialine pools, and lava tube caves. Additionally, parts of East Maui have healthy freshwater aquatic systems on the slopes of ridges, in the streams of lower Hanawī, and the streams of the Kipahulu and Kaupō area. These habitats support a diversity of native species including forest birds, invertebrates, ‘ōpe‘ape‘a (*Lasiurus cinereus semotus* [Hawaiian hoary bat]), pueo (*Asio flammeus sandwichensis* [Hawaiian short-eared owl]), waterbirds, freshwater species, and seabirds. Plant endemism for Maui is estimated at 20 percent. Beaches provide habitat for a few nesting sea turtles. Offshore islets provide important habitats for seabirds, migratory birds, raptors, invertebrates, and marine fauna. Approximately 9,398 hectares (23,496 acres) of critical habitat has been designated by the USFWS for Blackburn’s sphinx moth (*Manduca blackburni*) and 50,612 hectares (126,531 acres) for 59 endangered plants on Maui. Recovery habitats for the Maui parrotbill and ‘ākohekohe have also been identified by the USFWS.

Appendix A provides information on what wildlife Species of Greatest Conservation Need are present on Maui and its associated offshore islands. Maui is important habitat for several native forest birds, including the following Maui endemic species: ‘ākohekohe (crested honey creeper), Maui ‘alauahio (creeper), po‘ouli, and Maui parrotbill. Maui is also home to the second largest population of nēnē (Hawaiian goose) in the State. Other federally listed species include the ‘alae ke‘oke‘o (Hawaiian coot), ae‘o (Hawaiian stilt), koloa maoli (Hawaiian duck), ‘ua‘u (Hawaiian petrel), ‘ōpe‘ape‘a (Hawaiian hoary bat), Hawaiian monk seal, hawksbill turtle, and green sea turtle. For invertebrates, in general, Maui is characterized by high levels of endemism and diversity representing many orders. For example, along with the federally endangered Blackburn’s sphinx moth, Maui also hosts several endemic native bees (*Hylaeus* spp.), tree snails, and high levels of diversity within most families of beetles (Coleoptera). Maui also has endemic anchialine amphipods. Other species groupings that can be found on Maui are freshwater fishes, freshwater invertebrates, migratory birds, and raptors.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife and habitats are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats that are more acute or specific to Maui are listed below.

- The population of axis deer is slowly spreading across east Maui into west Maui, causing habitat degradation and loss;
- High pig densities in upper remote watershed degrade sensitive bog communities and wet forest, habitat for endemic birds and invertebrates;
- Presence of habitat-modifying invasive plants, including miconia;
- Introduction of invasive species at airports, ports, and harbors;
- Invasive algae in Lahaina and Kīhei areas;
- Introduced reptiles and amphibians, such as coqui frog and veiled chameleons, prey on native invertebrates and likely compete with native birds for food resources;
- Populations of feral cats and cat colonies kill waterbirds and seabirds across the island;
- Avian disease transmitted by mosquitoes restricts forest birds to habitat located above the mosquito-line;
- Wildfire, particularly for low elevation dry habitats and exacerbated by non-native invasive plants that increase fuel loads;
- Hybridization between koloa maoli (Hawaiian duck) and introduced mallards;
- Development of formerly undeveloped areas and increased urbanization leading to loss and degradation of terrestrial, freshwater, and marine habitat (e.g., increased nutrients in coastal areas leads to non-native algal blooms which affect fish populations and coral habitats, sedimentation from development near stream corridors);
- Stream diversions, dams, or channelizations;
- Insufficient in-stream flows to insure the biological integrity of many stream systems;
- Localized point source pollution originating from recreational boats and cruise ships;
- Fisheries bycatch of green sea turtles and seabirds;
- Human disturbance of sensitive ecosystems such as lava tube caves or anchialine pools;
- Localized excessive recreational use at places like ʻĀhihi Kīnaʻu Natural Area Reserve, Honolua Bay, and Molokini Shoal;
- Human and boat interactions with marine mammals and sea turtles along the leeward coast.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Maui 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 conservation actions identified in the ‘Potential Areas for Enhanced Conservation Management’ subsection;
    - Develop and/or implement recovery plans for threatened and endangered species on Maui;

    - Increase active management in, or acquisition of, extremely rare habitats on Maui;
    - Protect remaining intact native forest, wetland habitat, and coastal areas from development through a combination of acquisition, conservation easements, or cooperative agreements with landowners;
    - Implement fire suppression measures and protocols for post-fire restoration;
    - Increase the total acreage of ungulate-free and predator-free areas;
    - Decrease in 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 and lava tube and cave habitats;
    - Collaborate in efforts to reduce pollution threats from recreational boats and cruise ships;
    - Support ongoing projects to deal with non-point source pollution like those in the watershed partnerships and Honolua Bay and support expansion of successful methods to other areas;
    - Develop management plans for all Marine Managed Areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Improve prevention capacity through increased airport inspection and containment barriers around cargo unloading areas;
    - Improve early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on Maui;
    - Increase efforts to prevent establishment of priority invasive plants in pristine areas (e.g., miconia) and to eradicate from areas with recovery potential;
    - Revive and fund the Maui Axis Deer Group or similar partnership to address the need to fence existing populations of axis deer and to control deer outside of fenced areas;
    - Expand control of mammalian predators (e.g., feral cats, rats) in waterbird and seabird habitat;
    - Decrease in the overall number of streams negatively impacted by invasive species;
    - Support efforts to strengthen marine alien species prevention and control.
- 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;
    - Assess impact of eco-tourism activities on terrestrial and aquatic native wildlife and associated habitats;
    - Expand surveys to monitor population status and trends of under-researched species groups such as seabirds, pueo (Hawaiian short-eared owl), ʻōpeʻapeʻa (Hawaiian Hoary bat), Blackburn's sphinx moth, Maui *Partulinid* spp. and other native invertebrates;
    - Survey native wildlife community in koa-dominated forests in East Maui;

    - Research role of alien bird (cattle egret and barn owl) predation and best control strategies.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Encourage additional landowner participation and involvement in East Maui Watershed Partnership, West Maui Mountains Watershed Partnership, and Leeward Haleakalā Watershed Restoration Partnership;
    - Work with interested communities to address conservation threats and needs and develop appropriate actions;
    - Expand partnership with hunting community to reduce ungulate population;
    - Collaborate in efforts to reduce pollution threats from recreational boats and cruise ships;
    - Collaborate with NOAA to ensure the protection of marine mammal populations.
- 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 at managed conservation areas;
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas;
    - Expand and broaden public education and outreach to take advantage of the large science and management community on the island.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
    - Assess ways to support increased enforcement capacities, including cross-deputization between agencies;
    - Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
    - Review and revise DOFAW management guidelines to better reflect habitat conservation needs, followed by review and revision of game animal hunting regulations;
    - Improve integration of policies to address linkages between terrestrial and marine habitats and their shared conservation threats and needs;
    - Obtain and implement the plans of an Incidental Take Permit for sea turtle and monk seal bycatch.

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 and include the following:

- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Revised Recovery Plan for the Nēnē (Hawaiian goose) (2004), the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003), the Draft Recovery Plan for the Blackburn’s sphinx moth (2003), the Hawaiian Endangered Bird Partnership for Captive Propagation Five Year Workplan (2002), the Draft Revised Recovery Plan for Hawaiian Waterbirds (1999), and the Recovery Plan for the Hawaiian Hoary Bat (1998);

- Critical habitat designations by the USFWS for the Blackburn's sphinx moth (*Manduca blackburni*) and for threatened and endangered plants on Maui;
- Management Plans for the State Natural Area Reserves (NAR): ʻAhihi-Kīnaʻu NAR (Draft 1992), Kanaio NAR (1993), West Maui NAR (1988), and Hanawī NAR (1989);
- Long-range management plans for Natural Area Partnership Preserves (NAPP): Kapunakea NAPP (2003), Waiakamoi NAPP (2000), Puʻu Kukui NAPP (2005);
- The Division of Forestry and Wildlife's (DOFAW) Draft Management Guidelines, which coarsely rate vegetation quality and provide guidelines for land use (public hunting, recreation, and forest products) for State lands managed by DOFAW;
- The East Maui Watershed Partnership Management Plan and the West Maui Mountains Watershed Partnership Management Plan;
- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- The Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach;
- Coastal Zone Management plans, including Hawaiʻi Implementation Plan for Polluted Runoff Control (2000), Hawaiʻi Unified Watershed Assessment (1998);
- Hawaii's Local Action Strategy to Address Land-based Pollution Threats to Coral Reefs (2004);
- Bishop Museum has a comprehensive database of invertebrates;
- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawaiʻi;
- Fleming Arboretum is in the process of compiling an electronic database reflecting native dryland forest species that can be found at www.flemingarboretum.org;
- The Hawaiʻi Biodiversity and Mapping Program (formerly the Hawaiʻi Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on Maui. The discussion of future management needs is highlighted within each current managed area. Many areas on Maui are already under active management or protection through designation as State Natural Area Reserves (NAR), a National Wildlife Refuge (NWR), a State Wildlife Sanctuary, a National Park (NP), land trusts, and several public-private partnerships in the form of watershed partnerships, and natural area preserve partnerships. Each of these managed areas receives some level of agency or other support, including field teams composed of staff personnel or specific mission-oriented teams such as the Maui Invasive Species Committee and the Maui Forest Bird Recovery Project. Management of most of these areas is guided by existing management plans. These plans strongly emphasize conservation and restoration with a focus on controlling ungulates, predatory small mammals, and invasive alien species (both flora and fauna). In total, approximately 79,315 hectares (198,288 acres) or 43 percent of the island is under some form of conservation management (e.g., management plan exists) or protection.

***East Maui Watershed Partnership* (100,000 acres), Public-Private Partnership (NPS, DOFAW, TNC, Hanā Ranch Partners, LLC, East Maui Irrigation, Haleakalā Ranch, County of Maui Department of Water Supply)**

Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), forest birds, pueo, kōlea (Pacific golden plover), nēnē (Hawaiian goose), ʻuaʻu (Hawaiian petrel), endemic land snails and hundreds of endemic terrestrial, aquatic, and semi aquatic arthropods, rare plants. Outstanding invertebrates include one of only nine species of flightless flies found worldwide, and several species of rare long-horned beetles.

Habitats: Montane wet communities. Largest intact native forest on the island (20%) and recovery habitat for 21 species of rare forest birds.

Current Management: Management plan exists. Continue fencing across East Maui, ungulate control, invasive weed control, monitoring (particularly for stream and water quality), 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).

***Haleakalā NP* (30,183 acres), NPS**

Species: Highly significant for ʻuaʻu (Hawaiian petrel), nēnē (Hawaiian goose), and cave invertebrates. Forest birds, ʻōpeʻapeʻa (Hawaiian hoary bat), rare plants.

Habitats: Alpine communities, subalpine communities, montane communities, lowland communities, subterranean communities.

Current Management: Management plan exists. Maintains high level of staff support for predator, ungulate, and alien vegetation control and removal, fencing, vegetation sampling transects, yearly surveys for threatened and endangered species, nest protection and monitoring for nēnē and ʻuaʻu. One-time inventories for bats and herptofauna, marine and terrestrial monitoring protocols are under development (covering fishes, fisheries, marine benthos, freshwater animals, selected birds, bat, terrestrial invertebrates, vegetation, land use changes in and adjacent to park, invasive species, and water quality).

Future Needs: Continue existing management.

***Hanawī NAR* (7,500 acres), DOFAW**

Species: Supports one of the highest number and densities of endangered forest birds in the State. Core populations of poʻouli, Maui ʻākepa, Maui parrotbill, ʻākohekohe, Maui nuku puʻu, and ʻōʻō. Other forest birds, pueo, native invertebrates, rare plants.

Habitats: Subalpine communities, montane wet communities, perennial streams.

Current Management: Management plan exists. Control of pig populations, weed-control activities, fencing, resource monitoring, public education and volunteer program, Maui Forest Bird Recovery Project activities.

Future Needs: Predator control. Continue existing management as this area is critical for native forest birds.

***Waiakamoi Preserve* (5,230 acres), TNC**

Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), forest birds, native invertebrates, rare plants.

Habitats: Montane wet communities.

Current Management: Management plan exists. Ungulate control, invasive plant species control and eradication, research and monitoring, outreach.
Future Needs: Continue existing management.

Leeward Haleakalā Watershed Restoration Partnership **(43,175 acres), Public-Private Partnership (DOFAW, DHHL, NPS, James Campbell, Haleakalā Ranch, Kaʻonoʻulu Ranch, Kaupō Ranch, ʻUlupalakua Ranch, Nuʻu Mauka Ranch, Living Indigenous Forest Ecosystems (LIFE), individual private landowners, Hawaiʻi Community Foundation, Trust for Public Land (TPL), USFS, USGS, USFWS, NRCS, County of Maui Department of Water Supply**)

Species: ʻŌpeʻapeʻa, forest birds, possibly ʻuaʻu (Hawaiian petrel), terrestrial invertebrates, including Blackburn's sphinx moth, rare plants.
Habitats: Montane mesic communities, montane dry communities. Priority recovery habitat for endangered forest birds.
Current Management: Management plan for resource management from Makawao Forest Reserve to Kaupō above 3,500 feet (1,067 meters) in development, to include monitoring, fencing, ungulate removal, and koa reforestation. Related projects include fencing of Kahikinui Forest Reserve (DOFAW) and adjacent DHHL lands.
Future Needs: Develop and implement partnership management plan for reforestation. Continue fencing. Expand management into other areas within the partnership boundaries (e.g., Kula Forest Reserve).

Kanaio NAR **(876 acres), DOFAW**

Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), pueo, kōlea (Pacific golden plover), nēnē (Hawaiian goose), ʻuaʻu (Hawaiian petrel), terrestrial invertebrates, including Blackburn's sphinx moth, yellow-faced bees, endemic wasps *Odynerus spp*. and *Ectemnius spp*., potentially cave invertebrates, rare plants.
Habitats: Lowland dry communities. Significant remaining tract of dryland forest and shrubland.
Current Management: Management plan exists. Fencing, invasive plant removal, ungulate control.
Future Needs: Complete proposed addition of adjacent unencumbered land to NAR, complete proposed boundary fencing of upper section. Continue existing management.

West Maui Mountains Watershed Partnership **(52,940 acres), Public-Private Partnership (DOFAW, TNC, Maui Land and Pineapple, Inc., Amfac, C. Brewer, Kahoma, Kamehameha Schools, Makila land, County of Maui Department of Water Supply)**

Species: ʻŌpeʻapeʻa, forest birds, pueo, nēnē (Hawaiian goose), koloa maoli (Hawaiian duck), ʻuaʻu (Hawaiian petrel), ʻaʻo (Newell's shearwater), terrestrial invertebrates, including Blackburn's sphinx moth, *Megalagrion spp*., rare achatinellid land snails, freshwater fishes, freshwater invertebrates, rare plants.
Habitats: Montane wet communities, lowland wet communities, lowland mesic communities.
Current Management: Management plan exists. Fencing, ungulate and predator control, reduction of invasive alien weeds. The Hawaiʻi Unified Watershed Assessment proposed the West Maui Mountains as a Tier 1 Watershed in Need of Restoration under

the EPA Clean Water Act.
Future Needs: Secure funding to implement management plan. Identification of areas in need of active management and/or fencing to protect quality native forests. Expand management into other native-dominated forests within the partnership boundaries (e.g., West Maui Forest Reserve).

West Maui NARS **(6,702 acres-3 parcels), DOFAW**
Species: Forest birds, migratory birds, terrestrial invertebrates, including rare land snails, freshwater fishes, freshwater invertebrates, rare plants.
Habitats: Montane wet communities, perennial 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.

Pu'u Kukui Preserve **(8,661 acres), Maui Land and Pineapple, Inc.**
Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), forest birds, pueo, nēnē, migratory birds, seabirds, terrestrial invertebrates, including rare land snails, freshwater fishes, freshwater invertebrates, rare plants.
Habitats: Montane wet communities, lowland wet communities, lowland mesic communities.
Current Management: Management plan exists. Fencing, ungulate removal, small mammal and non-native invertebrate control, weed control monitoring, and rare species protection.
Future Needs: Continue existing management.

Kapunakea Preserve **(13,000 acres), TNC**
Species: Forest birds, pueo, seabirds, terrestrial invertebrates, including rare tree snails.
Habitats: Montane wet communities, lowland mesic communities, lowland dry communities.
Current Management: Management plan exists. Ungulate control, invasive plant control, small mammal control, resource monitoring, community outreach, rare species protection and research.
Future Needs: Continue existing management.

Kanahā Wildlife Sanctuary **(235 acres), DOFAW**
Species: Seabirds, waterbirds, migratory birds, terrestrial invertebrates.
Habitats: Lowland wet community including saline wetland.
Current Management: Currently developing a management plan. Habitat restoration through invasive weed removal, predator control, surveys and monitoring.
Future Needs: Continue existing management, install perimeter predator-proof fencing and eradicate predators within.

Old Waiheʻe Dairy **(277 acres), Maui Coastal Land Trust**
Species: Migratory birds, terrestrial invertebrates.
Habitats: Coastal communities.
Current Management: Developing management plan.
Future Needs: Implement management plan.

***Mū'olea Point* (70 acres), Trust for Public Land**

Species: Seabirds, migratory birds, invertebrates, marine fauna, raptors.
Habitats: Coastal communities.
Current Management: Recent acquisition for permanent protection.
Future Needs: Develop and implement management plan.

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

Species: Waterbirds, migratory birds, turtles.
Habitats: Coastal communities including saline wetland habitat.
Current Management: Beach patrol, dune restoration, environmental education, fencing to keep turtles away from road, nest monitoring and protection.
Future Needs: Continue existing management.

***Maluaka and Paniaka Wetlands*, State Parks**

***Species*:** Endangered waterbirds, migratory birds.
Habitats: Coastal communities.
Current Management: Maluaka wetland is being fenced for predator control management and revegetated with native vegetation after alien plant removal. However, Paniaka remains unmanaged.
Future Needs: Fence Paniaka ponds with predator-proof fencing, enhance native vegetation, continue collaboration with State Parks on species management and support DOFAW's yearly waterbird counts and breeding season monitoring of the waterbirds.

***'Āhihi Kīna'u NAR* (2,045 acres including marine), DOFAW**

Species: Migratory birds, waterbirds, terrestrial invertebrates, anchialine pond fauna, marine mammals, marine fishes, marine invertebrates.
Habitats: Coastal communities, marine systems, includes unusual communities associated with recent lava flows including anchialine pools, subterranean lava tubes, and aeolian systems on the surface of the flows.
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. No Take of terrestrial or marine resources.
Future Needs: Management of human activity, monitoring, education, and outreach.

***State Seabird Sanctuary* (8 offshore islands), DOFAW**

Species: Seabirds, migratory birds.
Habitats: Coastal communities.
Current Management: Removal of small mammalian predators and native vegetation habitat restoration.
Future Needs: Increase surveys and monitoring.

***Maui Invasive Species Committee*, Public-Private Partnership**

Species/Habitats: All species and habitats affected by invasive species.
Current Management: Invasive species prevention and control.

Future Needs: Increased invasive plant and animal prevention capacity, improved detection and rapid response capacity, and additional resources to address established threats to native habitats.

***Maui Forest Bird Recovery Project*, USFWS, DOFAW, UH**

Species/Habitats: Endemic forest birds, particularly endangered and critically endangered species and their habitats.

Current Management: Research and conservation management implementation of Draft Revised Recovery Plan for Hawaiian Forest Birds, development and implementation of five-year implementation plans.

Future Needs: Adequate funding to implement recovery plan and implementation plans.

***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.

***Two Marine Life Conservation Districts (MLCD),* DAR: Honolua-Mokuleia, Molokini Shoal**

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.

***Current Management*:** Limited access in most MLCDs, eight MLCD include at least some No Take area, fish monitoring.

***Future needs*:** Evaluate all MLCD's for purpose and management effectiveness and consider need for new Marine Managed Areas.

One Fishery Management Areas (FMA),* DAR*: Kahului Harbor

Species: Some or all regulated fish species.

***Habitats*:** Marine and estuary ecosystems.

***Current Management*:** Limited take, gear, size, season, and/or area restrictions.

***Future needs*:** Evaluate all FMA's for purpose and management effectiveness and consider need for new Marine Managed Areas.

***Three Bottomfish Restricted Areas (BRA),* DAR**

Species: Seven bottomfish species.

***Habitats*:** Marine ecosystems.

***Current Management*:** No Take of bottomfish.

***Future needs*:** Evaluate all BRAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Potential Areas for Enhanced Conservation Management

In addition to maintaining and enhancing existing conservation actions, additional efforts are needed for the long-term conservation of Maui's native wildlife. The following section identifies areas where enhanced conservation management would significantly benefit native species or their habitats (previously identified areas of the Makawao Forest Reserve and Kanaio can be found under the future needs discussion in the management needs section). Areas are discussed in habitat order from the mountains to the sea.

***Kīpahulu Forest Reserve (Upper portion above 3,500 feet between Kaupō Gap and Kīpahulu Valley)*, DOFAW**

Species: Forest birds, invertebrates, rare plants.

***Basis for Priority Designation*:** Remnant native forests still intact, but high densities of feral goats are rapidly destroying the understory, clearing their way into wet forests. Habitats include, from west to east, drier koa-dominated into wet ʻōhiʻa dominated. Mesic koa forest is highly rare on Maui.

Potential Conservation Actions: Fencing of the most-intact areas, removal of feral goats, and developing public hunting access (currently no public hunting access allowed) through adjacent landowners (e.g., the national park Kaupō trail).

***Dryland habitats* (leeward Haleakalā down to coast of southern Maui)**

Species: Wiliwili (*Erythrina sandwichensis)* forests, koa (*Acacia koa*) forests, diverse dryland forests, terrestrial invertebrates, rare plants.

Basis for Priority Designation: Low elevation dryland forest is highly imperiled and significantly reduced from historic range. Tracts of native wiliwili groves remain primarily in undeveloped private parcels in the coastal areas of Makena and the *ahupuaʻa* of Maluaka, Kaʻeo, Papaʻanui, Waipao, and Keauhou. Remnant diverse dryland forest remains in the Auwahi area. Threatened by the potential for development. The full impacts of the recent introduction of the *Erythrina* gall wasp are not yet known. Wiliwili are a keystone species in native dryland forest and are host to several species of native terrestrial invertebrates, while in general, the dryland forest hosts many rare plant species.

Potential Conservation Actions: Fencing intact tracts of dryland forest, removal of deer and goats, invasive plant removal, fire suppression, outplanting.

***Wetland habitats (*Kīhei Coast, Ukumehamehe, North Shore, Cape Hanamanioa, Nuʻu, Pauwalu Point, Keʻanae Peninsula, East Maui stream, loʻi)**

***Species*:** Waterbirds, migratory birds.

***Basis for Priority Designation*:** These areas have been identified by the USFWS and the Pacific Coast Joint Venture as areas for waterbird recovery.

Potential Conservation Actions: Small mammal predator control, invasive species control; where private lands occur, support voluntary and incentive based programs for potential conservation.

Coastal Areas on State Lands in the North and Northwest Portions of West Maui; other intact coastal areas (South, East Maui)

***Species*:** Wetland birds, migratory shorebirds and waterfowl, seabirds, native invertebrates, native plants.

***Basis for Priority Designation*:** Hawai‘i has few native coastal vegetation areas still left intact and these areas have a diverse coastal vegetation system. However, it is being threatened by ungulates (mostly cattle).

Potential Conservation Actions: Identify best intact areas and assess for appropriate conservation measures including fencing, removal and control of ungulates, and redesignation of coastal area for conservation purposes.

***Kanahā Beach,* Maui County**

***Species*:** Native invertebrates, native plants.

***Basis for Priority Designation*:** An area that is rich with native plants and native invertebrates, but is faced with immediate threats by human activities such as off-road vehicles. Existing actions have been removal of invasive plants, restoration of native plants, public education, and construction of a vehicle barrier to protect quality areas. This area could serve as a public education model for the need to protect and restore coastal areas.

Potential Conservation Actions: Continue existing management.

Anchialine Pond Habitat

***Species*:** Anchialine shrimp, endemic anchialine amphipods (*Grandidierella palama, Paramoera rua, Rotomelita ana*).

***Basis for Priority Designation*:** Anchialine pool habitats are experiencing degradation as a result of invasive species and human disturbance leading to decreasing populations of anchialine species in these habitats.

Potential Conservation Actions: Prevent introduction of non-native fish (tilapia), manage human disturbance.

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KAHOʻOLAWE

Kahoʻolawe is the smallest of the eight Main Hawaiian Islands. The island was historically inhabited by several hundred Native Hawaiians who farmed and fished for subsistence. Kahoʻolawe also was important as a religious center where the navigators and *kahuna* (priests) responsible for guiding the ocean voyages of early Hawaiians were trained. Consequently, Kahoʻolawe is listed on the National Register for Historical Places, containing 544 archaeological and historical sites with over 2,000 features including some of the largest and oldest *heiau* (Hawaiian shrines) in the State. After the arrival of Europeans, the island was used as a penal colony, for ranching, and for military training, including extensive bombing practice. These activities resulted in severe ecological degradation, and much of the soil (particularly on the eastern side and along the ridge crests) is exposed and lost to strong, easterly winds. Alien-dominated vegetation covers most of the island and includes kiawe forest and buffel grasslands. Remaining native habitats include coastal dry shrubland dominated by maʻo (*Gossypium tomentosum* [Hawaiian cotton]), ʻilima (*Sida fallax*), and ʻakiʻaki (*Sporobolus virginicus*), lowland dry grassland, mixed shrub coastal dry cliff, a high salinity anchialine pool, intermittent streams, and ephemeral pools. Nearshore marine resources include substantial coral reefs and intertidal natural communities. Native wildlife species on the island include an endangered moth, seabirds, and monk seals.

OVERVIEW

Geology and Hydrology

Kahoʻolawe is 11,520 hectares (28,800 acres) in total area, 17.6 kilometers (11 miles) long and 11.2 kilometers (seven miles) wide at its broadest point. The island is gently sloped with a diagonal ridge running across it. Steep sea cliffs mark the southern and eastern coastlines while sloping ridges with bays and beaches characterize the northern and western coasts. The highest point of the island is on the northeast end, at 450 meters (1,477 feet). Approximately 39 percent of the island is below 150 meters (500 feet) in elevation. Kahoʻolawe has two offshore islands. There are no perennial streams.

Climate

Located in Maui's rain shadow, Kahoʻolawe is very dry and arid, receiving no more than 65 centimeters (25 inches) of rain annually with most occurring on the eastern side of the ridge.

Land and Water Use

The Navy had used Kahoʻolawe for several decades of military bombing exercises which ceased in 1990. The following ten year Navy clean-up resulted in approximately ten percent subsurface clearance of the island and 69 percent surface clearance of unexploded ordnance from the island. In 2003, management and ownership of the island was officially transferred from the U.S. Navy to the Kahoʻolawe Island Reserve Commission (KIRC), a State agency administratively attached to DLNR, for management. The entire island is designated Conservation District under the State Land Use Code.

The island of Kahoʻolawe and the waters two miles from the shoreline are designated as the Kahoʻolawe Island Reserve, owned by the State of Hawaiʻi. KIRC manages Kahoʻolawe in trust for a future Native Hawaiian sovereign entity. Access to the island is restricted due to

unexploded ordnance, and commercial use is strictly prohibited. The island is managed and maintained in perpetuity for the following purposes: 1) preservation and practice of all rights customarily and traditionally exercised by the Native Hawaiians for cultural, spiritual, and subsistence purposes; 2) preservation and protection of its archaeological, historical, and environmental resources; 3) rehabilitation, revegetation, habitat restoration, and preservation; and 4) education. Overall activities on the island are guided by the following principles: traditional ecological knowledge, ecosystem succession, strategic restoration, keeping practices in line with the island's geography and natural systems, and integrated research and action.

Human Landscape

Although the island has no permanent residents, barracks provide accommodations for about 50 workers who are flown in for conservation and management activities or visitors coming to volunteer for conservation activities or participate in cultural practices.

SPECIES AND HABITATS OF IMPORTANCE

Historically, Kahoʻolawe was home to a range of vegetation communities that included dry forest and shrublands, grasslands, coastal vegetation, and possibly a mesic forest. However, due to 200 years of grazing by introduced ungulates, followed by decades of military bombings, the habitat on the island has been reduced to over 80 percent barren or hardpan soil and/or alien-dominated vegetation. In addition to the two islets, the western coastal area is the only area where native vegetation remains. Despite this, Kahoʻolawe is still home to 14 rare plants as well as a new species, *Kanaloa kahoolawensis*, in a new genus. Under the island's management plan, five native terrestrial communities have been identified: ʻAkiʻaki Coastal Dry Grassland, the Hawaiian Mixed Shrub Coastal Dry Cliff, the ʻIlima Coastal Dry Shrubland, the Maʻo Coastal Dry Shrubland, and the Pili Lowland Dry Grassland. Most of the rare plant populations that are known can be found on the southern and eastern seacliffs.

For wildlife in particular, important areas on the island include coastal areas such as Honokanaiʻa, Kūheia, Lae o Kuikui, Hakioawa, and the uplands. In addition, the USFWS designated 1,701 hectares (4,252 acres) of critical habitat for Blackburn's sphinx moth (*Manduca blackburni*). Vegetation within this area consists of mixed-species, mesic and dry grass and shrubland communities with a high percentage of non-native vegetation interspersed with native vegetation. There are also several wetland areas on the island (e.g., Lua Keālialalo, Lua Keālialuna, Lua Makika) that can provide habitat for migratory shorebirds and waterbirds. Kahoʻolawe is also home to two islets, Puʻu koae and ʻAleʻale, both of which are significant habitats for nesting seabirds (e.g., ʻuaʻu [*Pterodroma sandwichensis* or Hawaiian petrel], ʻakēʻakē [*Oceanodroma castro* or band-rumped storm petrel]) and migratory birds (e.g., kioea [*Numenius tahitiensis* or bristle-thighed curlew]) and contain native shrub coastal dry cliff communities.

Appendix A provides information on the wildlife Species of Greatest Conservation Need present on Kahoʻolawe and its associated offshore islands. KIRC has plans to also reintroduce species such as birds, invertebrates, ʻōpeʻapeʻa (*Lasiurus cinereus semotus* [Hawaiian hoary bat]), and marine reptiles.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats more acute or specific to Kahoʻolawe are listed below. Because Kahoʻolawe has no perennial streams, there are no identified threats specific to freshwater species on Kahoʻolawe.

- Feral cats (*Felis silvestris*), barn owls (*Tyto alba*), and rodents that prey on ground nesting seabirds;
- Established populations of alien ants, wasps, and parasites that negatively affect native invertebrates;
- Wide-spread non-native vegetation and soil erosion threaten habitat restoration (an estimated 1.9 million tons of soil is lost each year);
- Unexploded ordnance that limit conservation activities;
- Fire that can exacerbate the distribution of alien vegetation and disrupt current native vegetation restoration efforts;
- Marine debris accumulation;
- Sedimentation due to historic grazing and land degradation;
- Lack of compliance with fishing regulations.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for Kahoʻolawe 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/or implement recovery plans for threatened and endangered species on Kahoʻolawe;
    - Secure permanent, long-term funding for KIRC;
    - Eradication of mammalian predators, particularly feral cats, and avian predators (e.g., barn owls, cattle egrets) from the island;
    - Enhance existing wetlands (e.g., fencing, restoration, control of alien vegetation);
    - Reintroduce appropriate native species (e.g., waterbirds, Laysan duck, native passerines, native invertebrates, Hawaiian hoary bat, native plants);
    - Implement fire suppression measures and protocols for post-fire restoration;
    - Increase marine debris removal capacity and collaborate with experts on marine debris issues;
    - Suppress fires and implement fire management protocols.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.
    - Improve prevention measures and early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on Kahoʻolawe;
    - Support efforts to strengthen marine alien species prevention and control.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Support ongoing projects to address Non-Point Source Pollution.

- 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 at managed conservation areas.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
    - Increase enforcement capacity and education on the value of the Reserve.

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 and include the following:

- Specific management plans developed by KIRC, including the Kaho‘olawe Use Plan (1995), the Kaho‘olawe Ocean Management Plan (1997), the Kaho‘olawe Environmental Restoration Plan (1998), and the Draft Access and Risk Management Plan (2001);
- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Recovery Plan for Blackburn’s sphinx moth (2003);
- Critical habitat designations by the USFWS for the Blackburn’s sphinx moth;
- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- Bishop Museum has a comprehensive database of invertebrates;
- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawai‘i;
- The Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on Kaho‘olawe. The discussion of future management needs is highlighted within each current managed area. Unlike other islands (except Ni‘ihau), Kaho‘olawe is managed by one entity, the Kaho‘olawe Island Reserve Commission (KIRC).

Kaho‘olawe Island Reserve (28,800 terrestrial acres-entire island), KIRC

Species: Native invertebrates including Blackburn’s sphinx moth and koa butterfly, seabirds, migratory birds.

Habitats: Coastal dry grasslands, dry cliff, dry shrublands, anchialine pool, wetlands.

Current Management: Management plans exist. Erosion control, revegetation and habitat restoration, predator control.

Future Needs: Continue existing management. Adequate funding to implement management plan. Eradication of cats.

***Kaho'olawe Island Reserve* (marine waters up to two miles from shoreline), KIRC**

Species: Hawaiian monk seals, coral reef organisms, pelagic and bottomfishes, green sea turtles.

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

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

***Future needs*:** Additional monitoring, increased enforcement.

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HAWAIʻI

The island of Hawaiʻi is the largest, highest, and youngest in the Hawaiian Archipelago. It has two mountains over 4,000 meters (13,000 feet), three active volcanoes, and twice the area of all the other islands combined. Hawaiʻi is also climatically diverse: Kawaihae, on the leeward Kohala coast, averages less than 26 centimeters (10 inches) of rain each year, while mid-elevation forests on the windward side of the island receive over 700 centimeters (270 inches) of rain. The highest mountains are usually snow-capped through the winter. In spite of this, they are host to a suite of endemic arthropods in an aeolian ecosystem. Lava flows from the active volcanoes isolate patches of forest called kīpuka, leading to genetic divergence between isolated populations, and ultimately, speciation. Young lava flows are colonized quickly and become habitat for specialized arthropod fauna. Lava tubes in older flows host a diverse and unique cave fauna. Wet forests are home to a spectacular radiation of endemic birds as well as many unique invertebrates such as happy-face spiders and carnivorous caterpillars. Most of the original lowland habitat on the island has been transformed by human habitation, and whole suites of bird and snail species have been extirpated and are known only from fossils. In addition, honeycreeper and honeyeater species that were adapted to low-elevation forests have disappeared, both from the loss of forests and the introduction of alien insects and diseases such as avian pox and malaria. The extent of the missing native arthropod fauna can only be guessed, but one assumes it is extensive, and that the loss of arthropod pollinators and seed dispersers likely affects forest health in the remaining habitats.

OVERVIEW

Geology and Hydrology

The island of Hawaiʻi is comprised of five shield volcanoes, all of which are less than a million years old. The youngest three of these (Hualālai, Mauna Loa, and Kīlauea) are active; therefore, the landscape includes extensive areas of seemingly barren lava flows. Continuously changing forest boundaries and interesting succession patterns are the result. The two older volcanoes (Mauna Kea and Kohala) are marked by the cinder cones characteristic of late-stage eruptions, and by deep, stream-eroded valleys on the windward side. Only 12 percent of the island is below 150 meters (500 feet) in elevation; nearly 70 percent of the island is above 610 meters (2,000 feet) in elevation. The island of Hawaiʻi has 132 perennial streams, 70 of which are continuous. Wailuku River has the largest discharge at 250 million gallons per day (mgd). Anchialine ponds, which host a unique fauna of amphipods and shrimp, are found in young, coastal lava fields. 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. Hawaiʻi has three offshore islets.

Climate

Because of its size and elevation range, Hawaii's climate and vegetation communities vary dramatically. Warm trade winds meet the island and leave most of their moisture behind as rain or cloud drip on the windward side. At high elevations and on the Kona side, dry or even arid conditions predominate. Convection-driven onshore breezes on the leeward side create upslope showers most afternoons, resulting in a broad band of mesic forest. The peaks of Mauna Loa and Mauna Kea have permanent frost.

Land and Water Use

Hawaii's 1,042,000 hectares (2,573,400 acres) include 80 percent of the State's remaining native habitat. About 51 percent of the land is in the State Conservation District, and 47 percent is in the Agricultural District. About 520,000 acres are managed by the Division of Forestry and Wildlife (DOFAW), part of the State Department of Land and Natural Resources (DLNR). Over 465,000 acres are managed by Federal agencies (three-fourths of this is managed by the National Park Service (NPS) or U.S. Fish and Wildlife Service (USFWS), and about one-fourth by the U.S. Army). Thus, approximately 38 percent of the total land area of the island is under State or Federal management. Approximately 105,000 acres of conservation-zoned forest land is under private ownership or management. The largest private landowners on the island are Kamehameha Schools, Parker Ranch Trust, and C. Brewer and Co. An additional 13 of the State's 40 largest landowners manage at least some areas that are in the conservation zone and that likely support some native wildlife populations. Seventy-four streams are diverted and four have altered channels. The largest altered stream is Wailoa. The island of Hawai‘i has 15 impaired streams under EPA Clean Water Act standards. The Lower Hāmākua Ditch system in Kohala is the largest man-made stream system at 32 million gallons per day (mgd).

Human Landscape

There are 158,000 residents on the island of Hawai‘i. This number is supplemented by an average daily visitor population of about 22,000. The island's population is centered in Hilo on the windward side and Kailua-Kona on the leeward side, with additional concentrations in Waimea and the Puna region. Tourism, agriculture, and government services are the main economic drivers. Primary agricultural products on the island include beef, coffee, macadamia nuts, papaya, and tropical flowers. Sugarcane production on Hawai‘i ended in 1996 and many former sugar lands have since been converted to lands for forestry products or for large-lot residential development. Ranching, sugar, and forestry shaped the landscape. Hawai‘i Volcanoes National Park counts over 1.2 million annual visitor days. In addition, about 50,000 visitors each year purchase tours to areas where they encounter at least some native habitat and might see terrestrial wildlife. Over half of these are visitors to Mauna Kea.

SPECIES AND HABITATS OF IMPORTANCE

Major native habitat types on the island include wet montane forest, mesic montane forest, subalpine mesic forest and shrubland. Additional but smaller areas support alpine shrubland and alpine desert, dry montane and dry lowland forests, wet lowland forest, coastal forest and coastal shrub and grasslands. Eighty percent of the known worldwide anchialine pools are on Hawai‘i. Despite this diversity of habitat types, 42 percent of the island is considered "converted" to human use. The USFWS has designated critical habitat for palila (*Loxioides bailleui*) and Blackburn's sphinx moth (*Manduca blackburni*) (nearly 146,000 acres) with much of it overlapping with critical habitat for 41 endangered plant species (208,000 acres). Over 90 percent of land designated critical habitat is managed by State or Federal agencies.

Appendix A provides information on what wildlife Species of Greatest Conservation Need are present on the island of Hawai‘i. The island of Hawai‘i supports a great number of endemic species, including forest birds (palila, ‘akiapōlā‘au (*Hemignathus munroi*), ‘ōma‘o (*Myadestes obscurus* [Hawai‘i thrush]), and Hawai‘i ‘ākepa (*Loxops coccineus coccineus*)) and terrestrial invertebrates, including several species of land snails, the wekiu bug (*Nysius wekiuicola*), and

bees. Because of its size and the loss of habitat on other islands, Hawai‘i also provides abundant habitat for species such as the ‘io (*Buteo solitarius* [Hawaiian hawk]), ‘i‘iwi (*Vestiaria coccinea*), nēnē (*Branta sandvicensis* [Hawaiian goose]), and anchialine pond fauna. Other federally listed species include the ‘ōpe‘ape‘a (*Lasiurus cinereus semotus* [Hawaiian hoary bat]), ‘alae ke‘oke‘o (*Fulica alai* [Hawaiian coot]), ae‘o (*Himantopus mexicanus knudseni* [Hawaiian stilt]), and koloa maoli (*Anas wyvilliana* [Hawaiian duck]), ‘ua‘u (*Pterodroma sandwichensis* [Hawaiian petrel]), Blackburn’s sphinx moth, and sea turtles. For terrestrial invertebrates, in general, Hawai‘i is characterized by high levels of endemism and diversity within many orders. Hawai‘i supports rare species of stink bugs, damsel bugs, plant hoppers, and kissing bugs (Heteroptera), lacewings (Neuroptera), beetles (Coleoptera), moths (Lepidoptera), flies (Diptera), yellow-faced bees (Hymenoptera), and damselflies (Odonata). Many other species, including migratory birds, seabirds, freshwater fishes, freshwater invertebrates, marine reptiles, marine fishes, and marine invertebrates are found on the island or in the near-shore waters.

SUMMARY OF KEY THREATS TO SPECIES AND HABITATS

Many general threats to native wildlife and habitats are discussed in Chapter 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats that are more acute or specific to the island of Hawai‘i are listed below.

- Alien grass domination in former dry forest and coastal habitats. These grasses (e.g., fountain grass (*Pennisetum setaceum*)) are fire-adapted and fire-prone which makes them particularly threatening to conservation of the remaining rare dry habitats in Kona. In addition, alien grasses in montane mesic and wet forests inhibit seedling recruitment among native forest plants, so that mechanical removal is required for native reforestation;
- Expanding populations of feral sheep-mouflon hybrids (*Ovis aries- Ovis musimon*) at high elevations on Mauna Loa, on Mauna Kea, and on Hualālai threaten native vegetation and regeneration, thereby indirectly affecting forest species. They may also be directly affecting nesting resources for ‘ua‘u (*Pterodroma sandwichensis* [Hawaiian petrel]) and ‘akē‘akē (*Oceanodroma castro* [band-rumped storm petrel]);
- Wide-ranging populations of pigs (*Sus scrofa*), sheep (*Ovis aries*), and goats (*Capra hircus*) continue to pose significant management challenges for habitat and species management, contributing to losses of forest cover that adversely affect groundwater retention and stream quality, ultimately increasing marine sedimentation and decreasing coral reef viability;
- Invasions of wet forests by alien plants, notably firetree (*Morella faya*), guava (*Psidium guajava*), blackberry (*Rubus* spp.) and banana poka (*Passiflora tarminiana*) change forest composition and likely affect arthropod and snail communities. Over 44,500 hectares (110,000 acres) are infested with miconia (*Miconia calvescens*);
- *Vespula* and other predatory wasps are known to affect invertebrate communities in Hawai‘i Volcanoes National Park and in palila habitat at Pu‘u Lā‘au. In addition to negative impacts on native arthropods, food availability for this and other bird species may be affected as a result. Other invasive animal species of concern are ants (*Solenopsis invicta, Wasmannia auropunctata*), carnivorous snails (*Euglandina rosea*), coqui frogs (*Eleutherodactylus coqui*), and Jackson’s chameleon (*Chamelaeleo jacksonii*);
- ‘Alalā (*Corvus hawaiiensis*) recovery has been hampered by habitat degradation and fragmentation and hostile habitat, i.e., the presence of disease and both native and introduced predators in release areas;

- The small size and isolation of forest bird populations have likely contributed to the decline and disappearance of some of these populations. The degree to which this is also true for arthropods and snails is unknown;
- Anchialine pond fauna are threatened by human activity, especially intentional release of alien fish and shrimp into these ponds and human disturbance;
- Introduced freshwater fish and invertebrates have adverse effects on native stream species;
- Stream alterations and inadequate instream flows have negative effects on native freshwater species;
- Increased stream sediment load resulting from forestry, urban development, and pasture agriculture contributes to sedimentation impacts on near-shore marine habitats;
- Management priorities are not consistent with quality of habitat across agencies;
- Current regulations require more review and approvals for control of invasive non-native species than for introduction of the non-native species into the State, causing delays and reducing effectiveness of response and control actions;
- Overharvesting for marine aquarium trade.

ISLAND STRATEGIES

In addition to the statewide strategies identified in association with the seven conservation objectives in Chapter 4 (Statewide Conservation Needs) (main bullet), additional island-specific strategies for the island of Hawai‘i 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 conservation actions identified below in the ‘Potential Areas for Enhanced Conservation Management’ subsection;
    - Develop and/or implement recovery plans for threatened and endangered species on Hawai‘i;
    - Increase active management in, or acquisition of, extremely rare habitats such as the dry forest patches, caves, anchialine ponds, and summits of the high mountains;
    - Increase the total acreage of ungulate-free and predator-free areas;
    - Protect remaining intact native forest, wetland habitat, and coastal areas from development through a combination of acquisition, conservation easements, or cooperative agreements with landowners;
    - Develop management plans for all Marine Managed Areas;
    - Implement fire suppression measures and protocols for post-fire restoration;
    - Protect remaining anchialine ponds and lava tube and cave habitats;
    - Collaborate in efforts to reduce pollution threats from recreational boats and cruise ships;
    - Support projects to deal with non-point source pollution and support expansion of successful methods to other areas.
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication.

    - Improve early detection and rapid response capacity for species not yet established in the islands (e.g., brown treesnake, West Nile virus, Argentine fire ant) or present in the MHI but not yet established on the island of Hawai‘i;
    - Increase efforts to prevent establishment of or eradicate priority invasive plants in pristine areas (e.g., miconia), to control spread of fountain grass (*P. setaceum*) and other dry grasses, and to eradicate priority invasive species from areas with recovery potential;
    - Expand control of mammalian predators (e.g., feral cats, rats) in waterbird (including nēnē (Hawaiian goose)), seabird, and forest bird habitat;
    - Decrease the overall number of streams negatively impacted by invasive species;
    - Support efforts to strengthen marine alien species prevention and control.
- 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;
    - Assess impact of eco-tourism activities on terrestrial and aquatic native wildlife and associated habitats;
    - Sampling of Ichnuemonidae in the Kohala, Kona, and Ka‘ū areas.
- Strengthen existing and create new partnerships and cooperative efforts.
    - Formalize partnerships with military agencies to manage areas (including State land) for habitat conservation;
    - Encourage additional landowner participation and involvement in ‘Ōla‘a-Kīlauea Partnership and Kohala Mountains Watershed Partnership;
    - Establish partnership covering the lands of Mauna Loa;
    - Expand current firefighting capacity through greater interagency cooperation (e.g., sharing equipment, training, and fighting capacity);
    - Collaborate with NOAA to ensure the protection of marine mammal populations.
- 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 at managed conservation areas;
    - Improve conservation education of visitors and the tourism industry on the appropriate use of natural areas, particularly sensitive habitats and areas;
    - Expand and broaden public education and outreach to take advantage of the large science and management community on the island.
- Support policy changes aimed at improving and protecting native species and habitats.
    - Organize an interagency working group to develop vision and policy analysis for stream conservation actions;
    - Assess ways to support increased enforcement capacities, including cross-deputization between Federal (including military) and State agencies;
    - Evaluate all current Marine Managed Areas for purpose and management effectiveness and consider need for new Marine Managed Areas;
    - Review and revise DOFAW management guidelines to better reflect habitat conservation needs, followed by review and revision of game animal hunting regulations;

- Improve integration of policies to address linkages between terrestrial and marine habitats and their shared conservation threats and needs;
- Obtain and implement the plans of an Incidental Take Permit for sea turtle bycatch.

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 and include the following:

- Species Conservation Plans prepared by the USFWS, including the Regional Seabird Conservation Plan (2005), U.S. Pacific Islands Regional Shorebird Conservation Plan (2004), the Draft Revised Recovery Plan for the Nēnē (Hawaiian goose) (2004), the Draft Revised Recovery Plan for Hawaiian Forest Birds (2003), the Draft Recovery Plan for the Blackburn's sphinx moth (2003), the Draft Revised Recovery Plan for the ʻalalā (Hawaiian crow) (2003), the Hawaiian Endangered Bird Partnership for Captive Propagation Five Year Workplan (2002), the Draft Revised Recovery Plan for Hawaiian waterbirds (1999), the Recovery Plan for the Hawaiian Hoary Bat (1998);
- Critical habitat designations by the USFWS for the palila, the Blackburn's sphinx moth, and for threatened and endangered plants on the island of Hawaiʻi;
- The U.S. Army has developed an Integrated Natural Resources Management Plan and Implementation Plan for the Pōhakuloa Training Area (2005);
- Management Plans for the State Natural Area Reserves (NAR): Kahaualeʻa NAR (1992), Kīpāhoehoe NAR (2002), Laupāhoehoe NAR (1989), Manukā NAR (1992), Puʻo o Umi (1989), and Puʻu Makaʻala (1989);
- DOFAW and State Parks jointly developed a management plan for the ahupuaʻa of Puʻu Waʻawaʻa and the makai lands of Puʻu Anahulu;
- The Division of Forestry and Wildlife's (DOFAW) Draft Management Guidelines, which coarsely rate vegetation quality and provide guidelines for land use (public hunting, recreation, and forest products) for State lands managed by DOFAW;
- The ʻŌlaʻa-Kīlauea Partnership Plan is updated on a regular basis as new projects are developed; the Kohala Mountains Watershed Partnership is currently finalizing a management plan (2005);
- A draft Programmatic Safe Harbor Agreement for endangered waterbirds is under development for private landowners participating in Natural Resources Conservation Service Farm Bill programs;
- The Cave Conservancy of Hawaiʻi has developed a management plan for the Kīpuka Kanohina Cave Preserve (2003);
- A summary of research and information on individual offshore islands, prepared by the Offshore Island Restoration Committee, and found at http://www.botany.hawaii.edu/gradstud/eijzenga/OIRC/;
- The Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach;
- Coastal Zone Management plans, including Hawaiʻi Implementation Plan for Polluted Runoff Control (2000), Hawaiʻi Unified Watershed Assessment (1998);
- Hawaii's Local Action Strategy to Address Land-based Pollution Threats to Coral Reefs (2004);
- Bishop Museum has a comprehensive database of invertebrates;

- The Audubon Society maintains a Sightings database of bird species observed in the State;
- The Pacific Basin Information Node maintains a database of information on species and habitats in Hawai‘i;
- The Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program) maintains a database of rare species and habitats.

MANAGEMENT NEEDS

Current Management of Species and Habitats

The following section addresses the current management actions and future needs of key habitats on the island of Hawai‘i. The island of Hawai‘i has numerous areas managed in part for long-term conservation of native wildlife. These include five National Park units (NP/NHP), two units comprising a National Wildlife Refuge (NWR) complex, eight Natural Area Reserves (NAR), two Watershed Partnerships, State Forest Reserve lands, and a number of additional private and public efforts. In addition, other partnerships, such as the Big Island Invasive Species Committee (BISC) have been formed to address issues or species specific conservation needs.

***Mauna Kea Ice Age NAR* (3,886 acres), DOFAW**

Species: Possibly ‘ua‘u (Hawaiian petrel), terrestrial invertebrates, including rare insects, rare plants.
Habitats: Alpine communities.
Current Management: Wekiu bug surveys and research. Education and on-site management of recreational and cultural users is provided by the Office of Mauna Kea Management ranger staff. Public hunting for ungulate (mouflon sheep) control in surrounding Mauna Kea Forest Reserve.
Future Needs: Complete management plan. Continue collaboration with Office of Mauna Kea Management.

***Pōhakuloa Training Area* (PTA) (109,811 acres), U.S. Army**

Species: ‘Ōpe‘ape‘a (Hawaiian hoary bat), forest birds (including palila critical habitat), ‘io (Hawaiian hawk), nēnē (Hawaiian goose), terrestrial invertebrates, rare plants.
Habitats: Subalpine communities.
Current Management: Management plan exists. Primary purpose of PTA is military training, management of natural resources and endangered species limited to exclosures and “intensive management areas.” Monitoring, fire prevention, and control.
Future Needs: Review of impact of Stryker Brigade relocation on current natural resource management activities.

***Big Island NWR* Complex, USFWS**

Hakalau Forest NWR (32,700 acres)
Species: Forest birds, ‘io (Hawaiian hawk), koloa maoli (Hawaiian duck), nēnē (Hawaiian goose), terrestrial invertebrates, including rare snails, rare plants.
Habitats: Montane wet communities.

Current Management: Habitat restoration via koa reforestation, fencing and ungulate control, alien plant species control, and propagation and outplanting of understory and endangered plant species. Annual forest bird surveys. Vegetation monitoring.
Future Needs: Continue existing management, avian disease monitoring, control of non-native mynah, Japanese white-eye, mallard, and mallard-koloa hybrids; accelerated planting of bird food resources such as ʻōhiʻa (*Metrosideros polymorpha*).

Kona Forest Unit of Hakalau Forest NWR (5,341 acres)
Species: Forest birds, ʻio (Hawaiian hawk), historically ʻalalā (tract was acquired as ʻalalā habitat).
Habitats: Montane mesic communities.
Current Management: Intermittent forest bird surveys have been completed.
Future Needs: Continue existing management. Plans include fencing, ungulate removal, and habitat restoration.

ʻŌlaʻa -Kīlauea Watershed Partnership **(420,000 acre, of which 14,000 acres jointly managed), Public-Private Partnership (NPS, USFWS, DLNR, Biological Resources Division of the U.S. Geological Survey (USGS), U.S. Forest Service, Kūlani Correctional Facility, Kamehameha Schools)**

Species: Forest birds, ʻio, highly diverse terrestrial invertebrates, including rare snails and insects, rare plants.
Habitats: Subalpine communities, montane wet communities, montane mesic communities.
Current Management: Management plan exists. Nearly 14,000 acres are currently under joint management. Habitat restoration via fencing and ungulate removal, propagation and outplanting of native endangered species, control of incipient alien weed invasions. Fencing along Keauhou Ranch boundary creates additional 30,000 acres of protected habitat connecting Kūlani with Mauna Loa Strip of Hawaiʻi Volcanoes NP.
Future Needs: Continue existing management. Secure funding to implement identified priority projects (e.g., North Kona fencing, Kūlani reforestation), effectively implement expansion of partnership boundaries to "Three-Mountains."

Hawaiʻi Volcanoes National Park **(323,431 acres), NPS**

Species: Bat, forest birds, ʻio (Hawaiian hawk), nēnē (Hawaiian goose), seabirds (including ʻuaʻu (Hawaiian petrel) and ʻakēʻakē (band-rumped storm-petrel)), diverse terrestrial invertebrates, rare plants, marine species associated with shallow coral reef and rocky habitat, hawksbill and green sea turtles.
Habitats: Alpine communities, subalpine shrubland, montane communities, lowland communities, coastal communities, cave habitat, marine ecosystems.
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 and predator control for endangered birds (nēnē (Hawaiian goose) and ʻuaʻu (Hawaiian petrel)), sea turtle research, monitoring, education. One-time inventories for bats, herptofauna, anchialine pond fauna, shoreline birds. Marine and terrestrial monitoring protocols are under development (covering fishes, fisheries, marine benthos, freshwater animals, selected birds, bat, terrestrial

invertebrates, vegetation, land use changes in and adjacent to park, invasive species, and water quality).
Future Needs: Continue existing management. Expand partnerships for complementary monitoring and management of adjacent habitat for native wildlife, especially for rare species including forest birds, seabirds, and invertebrates.

***Pu'u Maka'ala NAR* (12,106 acres), DOFAW**
Species: Forest birds, ʻio (Hawaiian hawk), terrestrial invertebrates, including rare snails and insects, rare plants.
Habitats: Montane wet communities.
Current Management: Management plan exists. Feral pig control, control of invasive non-native plants, monitoring.
Future Needs: Continue existing management. Fence remaining forest above 1,000 meters (3,000 feet), ungulate and weed control.

***Kīpuka ʻĀinahou Nēnē Sanctuary* (11,157 acres), DOFAW**
Species: Nēnē (Hawaiian goose), forest birds, terrestrial invertebrates, rare plants.
Habitats: Montane wet communities. Montane mesic communities.
Current Management: Public hunting.
Future Needs: Review of DOFAW management guidelines, identification of high-quality native habitat needing protection.

***Waiākea 1942 Lava Flow NAR* (644 acres), DOFAW**
Species: Forest birds, terrestrial invertebrates, including rare insects, rare plants.
Habitats: Montane wet communities, subterranean communities.
Current Management: Recent insect survey by Bishop Museum.
Future Needs: Complete management plan.

***Kahauale'a NAR* (16,726 acres), DOFAW**
Species: Forest birds, ʻio (Hawaiian hawk), terrestrial invertebrates, including rare insects, rare plants.
Habitats: Montane wet communities, lowland wet communities.
Current Management: Management plan exists. Trail management only. Limited invasive species control.
Future Needs: Continue existing management and expand management to include fencing and ungulate removal focusing on most intact areas, control of alien weed invasions, other non-native species control to reduce impacts of alien invertebrates.

***Manukā NAR* (25,550 acres), DOFAW**
Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), forest birds, ʻalalā (Hawaiian crow) known historically, ʻio (Hawaiian hawk), terrestrial invertebrates, including rare insects, rare plants, anchialine pond fauna.
Habitats: Subalpine communities, montane mesic communities, lowland dry communities, coastal communities, 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, coqui frog control, monitoring, *Vespula* eradication.
Future Needs: Continue existing management. Fence entire upper boundaries, removal ungulates, biocontrol for fountain grass, Christmas berry, strawberry guava, eradication of *Clidemia hirta*, coqui frog.

***Kīpāhoehoe NAR* (5,583 acres), DOFAW**
Species: Forest birds, seabirds, ʻio (Hawaiian hawk), terrestrial invertebrates, including rare snails and insects, rare plants.
Habitats: Montane wet communities, montane mesic communities, lowland mesic communities, lowland dry communities.
Current Management: Management plan exists. Fencing and ungulate removal in most pristine habitats, weed control in intact native communities (upper elevation forests and pili grasslands).
Future Needs: Continue existing management. Expand fencing to include entire NAR, biocontrol for Christmas berry, strawberry guava, *Clidemia hirta*.

***Kaʻū Preserve* (3,491 acres), TNC**
Species: Forest birds, ʻio (Hawaiian hawk), terrestrial invertebrates, rare plants. Possibly ʻōpeʻapeʻa.
Habitats: Lowland wet communities, lowland mesic communities.
Current Management: Management plan exists. Ungulate control, invasive non-native plant control, community outreach.
Future Needs: Acceptance into the Natural Area Partnership Program. Implement management plan.

***Kona Hema Preserve* (8,061 acres), TNC**
Species: Forest birds, ʻio (Hawaiian hawk), terrestrial invertebrates, rare plants.
Habitats: Montane mesic communities, lowland mesic communities.
Current Management: Management plan exists. Restoration via fencing and ungulate control. Research on koa reforestation.
Future Needs: Continue existing management, ungulate eradication from fenced units.

***Puʻu Waʻawaʻa Wildlife Sanctuary* (3,806 acres), DOFAW**
Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), forest bird, ʻio (Hawaiian hawk), pueo, nēnē (Hawaiian goose), recovery habitat for ʻalalā, terrestrial invertebrates, including rare moths and insects, rare plants.
Habitats: Montane mesic communities, montane dry communities, lowland dry communities.
Current Management: Management plan exists. Removed livestock, curtailed illegal logging. Limited fencing, ungulate and invasive species control.
Future Needs: Implement Puʻu Waʻawaʻa Management plan, DOFAW Management guidelines, revise wildlife sanctuary rules to reflect conservation status, complete fence repairs and remove all ungulates, implement fire threat mitigation, implement outplanting program.

***Kohala Mountains Watershed Partnership* (>30,000 acres), Public-Private Partnership (Parker Ranch, Inc., Kahua Ranch, Ltd., Ponoholo Ranch, Ltd., The Queen Emma Foundation, Kamehameha Schools, Laupāhoehoe Nui, LLC, DLNR, State Department of Hawaiian Home Lands (DHHL), Hawai'i County Department of Water Supply, The Nature Conservancy (TNC))**

Species: Forest birds, koloa maoli (Hawaiian duck), migratory shorebirds and waterfowl, kōlea (Pacific golden plover), terrestrial invertebrates, including rare snails and insects, rare plants.

Habitats: Montane wet communities.

***Current Management*:** The partnership formed in 2004, and a management plan for the partnership is currently being developed.

Future Needs: Secure funding to implement management plan.

***Pu'u O 'Umi NAR* (10,142 acres), DOFAW**

Species: Forest birds, 'io (Hawaiian hawk), koloa maoli, (Hawaiian duck), 'a'o (Newell's shearwater) possible, terrestrial invertebrates, including rare snails and insects, rare plants.

Habitats: Montane wet communities.

Current Management: Management plan exists. Fencing, ungulate removal, monitoring.

Future Needs: Continue existing management. Extend fencing to protect most intact bogs and forests from ungulates. Increase control of priority weed species such as banana poka.

***Laupāhoehoe NAR* (7,894 acres), DOFAW**

Species: Forest birds, 'io (Hawaiian hawk), koloa maoli (Hawaiian duck), terrestrial invertebrates, rare plants.

Habitats: Montane wet communities, lowland wet communities.

Current Management: Management plan exists.

Future Needs: Increase active management. Fencing, feral pig control, weed control, monitoring to assess management effectiveness.

***Cooperative Nēnē Sanctuaries*, Public-Private Partnership**

Species: Nēnē (Hawaiian goose).

Habitats: Forested areas and shrublands.

Current Management: There are two cooperative nēnē sanctuaries: Keauhou (Ka'ū) (KS) and Keauhou II (Hualālai) (KS). Predator control (small mammals) during breeding seasons. Release of captive bred birds. Supplemental food and water. Exclosures for nesting birds and goslings.

Future Needs: Continue existing management.

***Wetlands Restoration*, Public-Private Partnership**

Species: Koloa maoli (Hawaiian duck), nēnē (Hawaiian goose), other waterbirds and migratory birds.

Habitats: Wetland areas island-wide.

Current Management: Restoration or creation of 28 montane ponds on private lands, including fencing to exclude ungulates and feral dogs and predator control. Development of programmatic Safe Harbor Agreement to cover future participating landowners (Safe Harbor Agreement completed with one landowner).
Future Needs: Approval of programmatic Safe Harbor Agreement, technical assistance for private landowners.

Kaloko-Honokohau National Historic Park **(1,161 acres), NPS**
Species: ʻŌpeʻapeʻa (Hawaiian hoary bat), aeʻo (Hawaiian stilt), ʻalae keʻokeʻo (Hawaiian coot), migratory birds, anchialine pond fauna, species associated with shallow coral reef and rocky habitat, green sea turtle.
Habitats: Coastal communities, anchialine ponds, marine ecosystem (including shallow coral reef and rocky habitats and sandy beach).
Current Management: Management plan exists. One-time inventories for bats, herptofauna, native plants, shoreline birds. Habitat restoration at ʻAimakapā (alien weed removal), protection of wetland and anchialine habitats, reef monitoring, and research. Marine and terrestrial monitoring protocols are under development (covering fishes, fisheries, marine benthos, freshwater animals, selected birds, bat, terrestrial invertebrates, vegetation, land use changes in and adjacent to park, invasive species, and water quality).
Future Needs: Continue existing management, predator control. Expanded partnerships for complementary monitoring and management of adjacent habitat for native terrestrial and marine species.

Puʻuhonua O Honaunau NHP **(182 acres), NPS**
Species: Migratory birds, green sea turtles.
Habitats: Coastal communities, marine ecosystems.
Current Management: Management plan exists. One-time inventories for bats, herptofauna, native plants, shoreline birds. Turtle protection via public education. Marine and terrestrial monitoring protocols are under development (covering fishes, fisheries, marine benthos, freshwater animals, selected birds, bat, terrestrial invertebrates, vegetation, land use changes in and adjacent to park, invasive species, and water quality).
Future Needs: Continue existing management. Expanded partnership for complementary monitoring and management of adjacent habitat for native wildlife.

Puʻukoholā Heiau NHP **(83 acres), NPS**
Species: Migratory birds.
Habitats: Coastal communities, nearshore marine ecosystems.
Current Management: Management plan exists. One-time inventories for bats, herptofauna, native plants, shoreline birds. Marine and terrestrial monitoring protocols are under development (covering fishes, fisheries, marine benthos, freshwater animals, selected birds, bats, terrestrial invertebrates, vegetation, land use changes in and adjacent to park, invasive species, and water quality). Research on grassland habitat restoration.
Future Needs: Continue existing management.

State Seabird Sanctuary **(3 offshore islands), DOFAW**
Species: Seabirds, migratory birds.

Habitats: Coastal communities.
Current Management: Surveys and monitoring.
Future Needs: Continue surveys, develop and implement management plan.

Big Island Invasive Species Committee **(BISC), Public-Private Partnership**
Species/Habitats: All species and habitats affected by invasive species.
Current Management: Prevention of incipient invasions, invasive species control, public education.
Future Needs: Adequate funding to support priority BISC actions.

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.

Five Marine Life Conservation Districts (MLCD), **DAR: Kealakekua Bay, Lapakahi, Old Kona Airport, Wailea Bay, Waiʻopae 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 across the islands include at least some No Take areas, Old Kona Airport allows fishing throughout the MLCD, and fish monitoring.
Future needs**:** Evaluate all MLCDs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Six Fishery Management Areas (FMA), **DAR: Hilo Harbor, Kailua Bay, Kawaihae Harbor, Keauhou Bay, Kīholo Bay, Kona Coast, Puako Bay and Reef**
Species**:** Some or all regulated fish species.
Habitats: Marine and estuary ecosystems.
Current Management**:** Limited take, gear, size, season, and/or area restrictions.
Future needs**:** Evaluate all FMAs for purpose and management effectiveness and consider need for new Marine Managed Areas.

Five Bottomfish Restricted Areas (BRA), **DAR**
Species**:** Seven bottomfish species.
Habitats: Marine ecosystems.

***Current Management*:** No Take of bottomfish.
***Future needs*:** Evaluate all BRAs for purpose and management effectiveness and consider need for new or revised Marine Managed Areas.

Potential Areas for Enhanced Conservation Management

In addition to maintaining and enhancing existing conservation actions, additional efforts are needed for the long-term conservation of the native wildlife of the island of Hawai‘i. The following section identifies areas where enhanced conservation management would significantly benefit native species or their habitats. Areas are discussed in habitat order from the mountains to the sea.

Greater Mauna Loa Landscape Conservation Area

This is a multi-unit priority area comprised of the next five specific regions, as well as land already managed by the NPS, NARS, TNC and the ‘Ōla‘a-Kīlauea Partnership. Because much of the land in this area is currently managed for preservation or is conservation-zoned, there is an opportunity to prioritize management objectives under a broad goal of wildlife conservation. This area has intact or largely native ecosystems nearly from sea to summit and provides an opportunity to conserve wildlife on a landscape scale. The contiguous forests across elevation and moisture gradients in Ka‘ū district might provide habitat even under changing climate and weather conditions. On the north side of the Southwest Rift Zone, the forest landscape is patchier, but still rich in places. Additionally, the economics of ranching have changed so that some landowners are pursuing sustainable koa forestry and ecotourism as a means of generating income from the land. Both of these are compatible with enhancing wildlife habitat across a landscape scale.

Ka‘ū Forest Reserve (DOFAW) and adjacent State parcels at Kiolaka‘a, Wai‘ōhinu and Ka‘alāiki

Species: Forest birds include five common (‘amakihi, ‘apapane, ‘elepaio, ‘i‘iwi, ‘ōma‘o) and three endangered (‘akiapōlā‘au, ‘ākepa, Hawai‘i creeper) species, ‘io (Hawaiian hawk), potential habitat for release of ‘alalā. The native arthropod community is known to be diverse in some areas at lower elevations. Hawaiian hoary bat (‘ōpe‘ape‘a) is present.

Basis for Priority Designation: This is one of the most diverse and least invaded forests on the island. It supports the highest known densities of common and rare forest birds in the State. Forest supports one of the highest known vegetation biomass profiles in the State due to high stature closed canopy forests. Lower portions of the reserve are known to harbor a diverse native insect fauna. As part of a broader area which would include Kapāpala Forest Reserve and the recently expanded Hawai‘i Volcanoes NP, it provides an elevational and moisture gradient that would allow wildlife populations to move in response to changing climate or weather conditions. The southeast sections and State parcels named above, in addition to State parcels adjacent to TNC lands along Hilea Gulch support diverse and nearly weed-free lowland forest down to about 1,750 feet.

Potential Conservation Actions: Designated as highest quality native vegetation and ungulate control in DOFAW’s Management Guidelines, but presently no ungulate control ongoing. Remoteness precludes adequate control through public hunting. Maintain high quality of forest through fencing and ungulate control, prevent weed invasion, and

implement monitoring for ungulate damage and incipient invasions to facilitate adaptive management.

Kapāpala Forest Reserve (DOFAW) and Kapāpala Koa Management Area (existing and proposed)
Species: Five common and four endangered birds, ʻakiapōlāʻau, nēnē, ʻio, ʻuaʻu, possibly ʻakēʻakē, ʻōpeʻapeʻa. Invertebrate populations may be substantial. *Micromus* sp., a rare undescribed flightless lace-wing, is known from the forest reserve.
Basis for Priority Designation: As part of a broader area including Kaʻū Forest Reserve, Mauna Loa Forest Reserve, ʻŌlaʻa -Kīlauea Watershed Partnership and Hawaiʻi Volcanoes National Park, this area has potential for implementing landscape-level conservation. Koa (*Acacia koa*) kīpuka here provide habitat for a geographically distinct population of endangered ʻakiapōlāʻau, which could become important if other populations decline. Continuous and concentrated diversity in vegetation may indicate the same diversity for invertebrate populations. This is a unique mesic habitat. The western portion of the reserve has a limited degree of alien plant species invasion thus reducing the degree of management necessary.
Potential Conservation Actions: Fencing and ungulate control. At higher elevations, mouflon sheep may be inhibiting koa forest regeneration, revisit DOFAW management guidelines, establish koa regeneration throughout.

Mauna Loa Forest Reserve between Pōhakuloa and Hawaiʻi Volcanoes NP (DLNR, U.S. Army, DOFAW)
Species: ʻŌpeʻapeʻa, ʻuaʻu and ʻakēʻakē, nēnē. Diverse and rare invertebrate communities including *Hylaeus* spp., Lepidoptera, Heteroptera, and Coleoptera species known from adjacent Puʻu Waʻawaʻa. Rare *Leptachatina* sp. (snail), *Helicoverpa confusa* (moth), *Rhyncogonus stellarius* (weevil) known from adjacent Pōhakuloa Training Area.
Basis for Priority Designation: Two State endangered seabird species probably have nesting colonies in this area. Dry tropical montane and subalpine shrub is rare world-wide. The saddle between Mauna Kea, Mauna Loa, and Hualālai includes numerous endangered and endemic plant species and a completely unique habitat type on this island. Some of the insect fauna is likely to be endemic to this region. Much of the region is prone to fire as alien grasses dominate the areas below and military training exercises can start fires. Inclusion of this area would extend landscape-scale wildlife conservation management to the north side of Mauna Loa. There are also numerous caves in the area, some of which support native invertebrates and/or have pools of water at their entrances where nēnē and ʻōpeʻapeʻa have been seen.
Potential Conservation Actions: More proactive predator (e.g., feral cat) control to protect nesting seabirds. Fire prevention. Fencing in areas where plant communities are rare or largely intact. Research rare invertebrates, determine limiting factors affecting them, and conservation actions that might enhance populations.

Mesic montane forests and parklands in South Kona. **(NPS, USFWS, KS, NARS (Manukā and Kīpahoehoe), DOFAW Forest Reserves (South Kona FR), State land**

in Waiea, private lands (Yee-Hop, McCandless Ranch, Kapua Mauka, Kealakekua Ranch, TNC, Kealia Ranch, Hokukano Ranch))

Species: Common forest birds: ʻākepa, ʻakiapōlāʻau and Hawaiʻi creeper in a few locations, ʻio, last known range of ʻalalā. Likely provides habitat for native invertebrate fauna, particularly in less degraded forest patches and in lava tubes. Rare insect species in the region include two undescribed damsel bugs, stink bug, koa bug, kissing bug, lacewing, weevil, two moths and two candidate *Drosophila* species. Snails found recently in Kapua include *Pronesopupa* sp., *Elasmias fuscum,* and *Tornatellides/Tornatellaria* species.

Basis for Priority Designation: This area includes habitat ranging from intact forests to open degraded parkland and rangeland. Possible economic futures for this contiguous region include sustainable koa forestry, which has been shown to create foraging and nesting habitat for some forest species. Forest patches and young koa forest could harbor native invertebrates as well. There is a possibility for economic drivers related to diminishing returns on ranching and increased interest in koa forestry and ecotourism in this region to enhance wildlife habitat.

Potential Conservation Actions: Sustainable koa forestry. Restoration of degraded and unprofitable rangelands. Exotic ungulate control through guided private hunting. Possible ecotourism activities. Fencing and ungulate control of State lands at higher elevations where native forest communities are intact (including South Kona FR, NARs, Waiea tract), where private lands occur, support voluntary and incentive based programs for potential conservation.

Coastal strand communities at Kaʻaluʻalu (State), Manukā (DOFAW/Land), Kapua (private), and Okoe (State)

Species: Presence of seabirds and migratory waterfowl and shorebirds. Unknown, but it is assumed native arthropod communities would be associated with these diverse native vegetation communities. There may be turtles nesting in some sections. A Hawaiian monk-seal pupped at Kaʻaluʻalu a few years ago. Anchialine species.

Basis for Priority Designation: In addition to a diverse coastal vegetation community, these areas contain anchialine ponds, archeological resources, and may harbor nesting turtles. There is a high probability that there is a diverse native arthropod community associated with this uniquely diverse, and therefore rare, coastal strand community. Kapua and Okoe are contiguous with protected coastal area of Manukā NAR, presenting an unusual opportunity to protect a large section of coastal strand.

Potential Conservation Actions: Where private lands occur, support voluntary and incentive based programs for potential conservation, public/private partnerships to protect rare habitat. Predator control (rats and mongooses) to protect turtle nests and enhance arthropod populations.

***Habitat corridor between Hāmākua and ʻŌlaʻa-Kīlauea Watershed Partnership*.** **This would include upper elevation sections of Hilo Watershed and Upper Waiākea Forest Reserves, the Waiākea 1942 Lava Flow NAR, and Mauna Loa Kīpuka Mosaic areas. Could be extended to include Kīpuka ʻĀinahou Nēnē Sanctuary (DOFAW)**

Species: Forest birds including two endangered species. Diverse arthropod communities recently documented in some areas. Diverse snail community historically, present extent unknown. Cave communities.
Basis for Priority Designation: Habitat degradation due to feral ungulates and invasive forest plants in this area may be limiting populations of all species known from this area. A corridor of aggressively managed habitat between the forest bird "hot spots" of Hāmākua and Kaʻū might allow greater migration (and genetic exchange) among populations as well as expansion of existing populations. Particularly diverse arthropod communities are known to exist in the kīpuka area and along the Stainback Highway in Upper Waiākea Forest Reserve. The integrity of these areas should be preserved. Emesine Cave underlies this area and is important for numerous cave-adapted species.
Potential Conservation Actions: More aggressive management for wildlife conservation including fencing, ungulate and alien weed control. Protection of habitat integrity to ensure continued survival of invertebrates.

Pīhā tract of Hilo Forest Reserve **(DOFAW)**
Species: Forest birds including five common and three locally abundant endangered species, ʻio.
Basis for Priority Designation: Create buffer zone around key habitat at Hakalau Forest NWR; Pīhā divides this important habitat and is not currently managed for conservation. Habitat degradation by ungulates and invasive plant species in Pīhā threatens efforts at Hakalau Forest as well.
Potential Conservation Actions: Explore cooperative management with USFWS, possibly through conveyance of land or conveyance of management. Fencing, ungulate eradication, invasive weed eradication.

Kanakaleonui Corridor (State land between Mauna Kea Forest Reserve and Hakalau Forest NWR) **(Department of Hawaiian Home Lands (DHHL))**
Species: Common forest birds - especially ʻiʻiwi, ʻapapane, ʻamakihi. Possibly ʻelepaio and ʻakiapōlāʻau, ʻio.
Basis for Priority Designation: Forest birds migrate with ʻōhiʻa and māmane phenology. These species (and juveniles of these) are known to travel between wet forests and subalpine māmane forests during the bloom. DHHL lands are a corridor for this travel.
Potential Conservation Actions: Create corridors for this movement through koa and māmane reforestation. Discontinue koa logging so some native corridor remains. Discontinue reforestation with sugi pine (*Cryptomeria japonica*) as this is a known invader in koa forests. Explore potential of cooperative management with USFWS and DOFAW. Encourage planting of native species for cultural and economic benefits, in line with DHHL mission, via partnerships with schools, universities, and conservation-oriented and Hawaiian cultural groups.

Puna low elevation forests, including those in Nānāwale, Puna, Keauohana, and Malama-Kī Forest Reserves (DOFAW), and Puʻu Kaliʻu (KS)
Species: Forest birds, especially ʻapapane and ʻamakihi , unknown invertebrate populations.

Basis for Priority Designation: These are the last native lowland forest areas on the island. Native bird populations within them appear to have developed resistance to avian malaria, so these populations are important from a conservation and biological perspective even though they are common species.
Potential Conservation Actions: Establish partnership or lease agreement to facilitate reforestation. Protect old growth ʻōhiʻa (*Metrosideros polymorpha*) and lama (*Diospyros sandwichensis*). Fencing and ungulate control of "best" forest areas. Alien plant species eradication to allow regeneration of native forest species.

Dry Forest Areas including Puʻu Waʻawaʻa (DOFAW), Kaʻūpūlehu (KS), Hualālai summit area (KS), Palama Nui (Hiluhilu), State land north of Palama Nui

Species: Snails: *P. confusa, Tornatellaria spp., Lamellidea spp., Elasmius fuscum*, eight other genera collected at Pōhakuloa in 1990's. Diverse native arthropod community with numerous Lepidoptera, Heteroptera, and Coleoptera. Spiders from seven families. Rare taxa include a stink bug, plant bug, planthoppers, lacewing, beetles, moths, *Hylaeus* spp., a candidate endangered *Drosophila* species, endangered Blackburn's sphinx moth. Birds include nēnē, ʻio, pueo, common and endangered forest species.
Basis for Priority Designation: Tropical dry forests are extremely rare worldwide and are one of the most endangered habitats in Hawaiʻi. ʻUmi Manu cave system and Henahena lava tubes support many species of rare subterranean invertebrates. Habitat types in the area include subalpine and dry montane forest and shrubland, montane mesic and lowland dry forests. Many arthropods known from here are associated with specific host plants that are also only found here. Possible release area for endangered ʻalalā.
Potential Conservation Actions: Conservation partnerships. Implementation of 2003 Management Plan for the *Ahupuaʻa* of Puʻu Waʻawaʻa. Fencing and mammal control (ungulates and rats) in "best" forest areas to allow regeneration. Develop control methods for alien grasses and fire mitigation measures.

Unprotected Wetlands: Waipiʻo and Waimanu Valley, Kīholo Springs Pond and Marsh, Opaeʻula Pond, Kealakekua Bay Pond, Lokoaka Pond, Waiākea Pond, Keʻanae Pond

Species: Aeʻo (Hawaiian stilt), ʻalae keʻokeʻo (Hawaiian coot), koloa maoli (Hawaiian duck), migratory waterfowl and shorebirds, associated native invertebrates.
Basis for Priority Designation: These are core or supporting wetland areas identified in USFWS Waterbird Recovery Plan. Waipiʻo and Waimanu have extensive wetlands and taro *loʻi* which require long-term protection. Habitat for wetland bird species.
Potential Conservation Actions: Where private lands occur, support voluntary and incentive based programs for potential conservation, in all areas, enhance waterbird habitat by removing invasive vegetation. Provide technical assistance to private landowners to affect this. Control predators (rat, cat, mongooses) during nesting season, especially where endangered aeʻo and ʻalae keʻokeʻo occur. Coordinate pesticide use with DAR. Remove feral mallards to prevent potential hybridization with koloa maoli.

Anchialine areas **(DLNR, KS, NPS, NARS, private)**

Species: Anchialine amphipods and shrimp, aeʻo (Hawaiian stilt), migratory shorebirds.
Basis for Priority Designation: There are only about 700 anchialine pools worldwide, 80 percent of which are on Hawaiʻi. Anchialine ponds support a unique fauna which is

threatened by human activities ranging from coastal development and subsequent changes in hydrology to "biological pollution" by those who intentionally dump alien fish (mosquito fish and tilapia) and shrimp into ponds. Also, *Holocaridina rubra* potentially threatened by commercial harvesting.

Potential Conservation Actions: Where private lands occur, support voluntary and incentive based programs for potential conservation, improved public education regarding fragility of anchialine ecosystems. Development and implementation of ichthyocide methods to control alien fish in salt water. Divert human use away from these features.

***Streams originating in more protected areas*: below Hakalau, Wailuku River, Honolii, Pahaoehoe, Kapue, Kolekole, Kilau, Haakoa, Kaiwilahilahi, Pahale, additional protection below Kohala Watershed, and others**

Species: ʻOʻopu, *Megalagrion spp,* damselflies, koloa maoli (Hawaiian duck).

Basis for Priority Designation: Protect native freshwater fish species. Alien fish in these streams may prey on native *Megalagrion* species.

Potential Conservation Actions: Implement additional fencing and removal of ungulates to improve stream water quality and reduce erosion, benefiting stream and ocean fish.

***Caves:* Kipuka Kanohina (near Ocean View, 800-1400'), ʻUmi Manu and Henahena systems (Puʻu Waʻawaʻa), Kaʻū and Kapāpala (tubes are unsurveyed), Emesine Cave (Upper Waiākea FR), Wao Kele O Puna, Kīholo Bay, Kaʻūpūlehu and Puʻu Waʻawaʻa ahupuaʻa between Mamalahoa and Queen Kaahumanu Highways**

Species: Endemic cave-adapted fauna. A unique species is known from coastal tubes at Kīholo (*Oliarus lorettaei*). In Emesine Cave, species include *Nesidiolestes ana* (blind, cave-adapted thread-legged bug), ten other cave-adapters including planthopper *Oliarus polyphemus*, moth *Schrankia sp.*, rock crickets *Caconemobius varius* and related species, tree cricket *Thaumatogryllus cavicola,* millipede *Nannolene sp.,* rock centipede *Lithobius sp.*, springtails *Collembola* spp. At higher elevations in Kaʻūpūlehu and Puʻu Waʻawaʻa, there are planthoppers, moths, centipedes, spiders and crickets.

Basis for Priority Designation: Hawaii's cave fauna is globally unique. To protect the cave systems, land above them must be managed for conservation. Some of the caves already listed are included in other sections of this document.

Potential Conservation Actions: Protect habitat above caves as cave-adapted ecosystems depend on tree roots and moisture. Construct gates to manage human access.

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NORTHWESTERN HAWAIIAN ISLANDS

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. Six species of plants in the NWHI are federally protected under the Endangered Species Act (ESA). 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. Laysan and Nihoa also have extant populations of three other endemic birds that are endangered (Laysan finch, Nihoa finch, and Nihoa millerbird).

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. Many endemic terrestrial arthropods and land snails also occur in the NWHI. Many of the islands serve as nesting or pupping grounds for honu (*Chelonia mydas agassizi* [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.

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. Rats were eradicated from the island in the past. Introduced big-headed ants and scale insects are a potential threat as are introduced invasive plants. 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 (which led to the introduction of various species of plants and animals and the importation of an estimated 9,000 tons of topsoil for use in gardening), 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 seal, green sea turtle, large numbers of migratory seabirds, and a variety of coastal strand plants. The Refuge waters support numerous species of nearshore and other coral reef species, as well as pelagic fish, marine mammals, and sea turtles. 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. Beginning in 1902, Japanese feather poachers came to the NWHI and illegally took thousands of albatross, but the true extent of their poaching is not known. 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. The HINWR is currently trying to remove invasive *Verbesina* weed here. Populations of Laysan finch introduced to provide another population to reduce the risk of extinction of the species on its native island of Laysan do well here, but have evolved different anatomy to deal with different food sources.

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 Capt. 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. More concentrated exploitation of the island took place during the period 1904-10 by Japanese feather poachers, but this activity was apparently halted by 1911. Mice and rabbits denuded the island of vegetation. Subsequent visits to Lisianski appear to have been limited. 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. These activities were followed in

1909 to 1910 by intensive harvesting of bird skins and feathers by the Japanese, who carried out an additional poaching raid in 1915. Since that time, visits to Laysan have primarily been those of survey parties and scientific expeditions. 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. The whole island is designated as critical habitat for endangered plants. Endangered and endemic Laysan ducks and finches occur naturally only on the island (though a group of Laysan ducks was recently introduced outside its native range to Midway Atoll, and Laysan finches were introduced to Pearl and Hermes Atoll). 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). Revegetation with native plants is currently occurring as well as efforts to remove invasive *Verbesina* and *Cenchrus* weeds. 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 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. During the period of feather poaching by the Japanese early in the 20th century, patrol vessels visited Mokumanamana Island, but no evidence of harassment of the birdlife was seen. The whole island is designated as critical habitat for three endemic endangered plants. Nine insects are endemic to the island as are one trap-door spider and one land snail. About 60,000 seabirds from 16 species nest or roost on the island. There is a large colony of blue-gray noddies. Observations of 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 Necker Island, there is evidence of prehistoric human occupation. Over the years, difficulties in landing on the steep slopes of Nihoa have restricted visits and may explain why feather poachers did not attempt to exploit the island. 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. The whole island is designated as critical habitat for endangered plants including three species endemic to the island. Endemic Nihoa millerbird and endemic Nihoa finch are both ESA listed. 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 ʻiwa (great frigatebirds), ʻā (brown boobies), ʻā (red-footed boobies), noio (black noddies), blue-gray noddies, noio-kōhā (brown noddies) and manu-o-Kū (white terns). There are at least 17 insects, six ticks and mites, a trap-door spider, and six land snails endemic to just this island. Recent outbreaks of the grasshopper *Schistocerca* are a concern for endangered plants and the birds and invertebrates that rely on this habitat.

SPECIES AND HABITATS OF IMPORTANCE

Laysan, Lisianski, Necker, and Mokumanamana 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 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 4 (Statewide Conservation Needs) and Chapter 5 (Marine Conservation Needs). Threats more acute or specific to the NWHI are listed below.

- Habitat degradation from non-native vegetation (*Cenchrus*, *Verbesina*);
- 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 on land or in water (historically, rabbits on Laysan and rats on Kure; currently, *Schistocerca* grasshoppers on Nihoa, along with at least 80 other introduced insect 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 4 (Statewide Conservation Needs) (main bullet), additional 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.
    - 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;
    - Develop and/or implement recovery plans for threatened and endangered species on NWHI;
    - 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.
    - Decrease acres dominated by invasive, non-native vegetation and insects;
    - Monitor for non-native marine algae 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;
    - Conduct surveys and inventories for invertebrates in currently managed areas;
    - 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 USCG and NOAA Office of Law Enforcement.

- 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.

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), the Draft Revised Recovery Plan for the Laysan Duck (2004); the Northwestern Hawaiian Islands Passerines Recovery Plan (1984); 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 Comprehensive 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: Ka‘upu (black footed albatross), mōlī (Laysan albatross), 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, native vegetation replanting, 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*:** Laysan finch, Laysan duck, Nihoa millerbird, Nihoa finch, 18 seabirds, 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, wetlands, 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, translocation, and range expansion; native species reintroduction, seabird monitoring and research (especially at Laysan and Tern Islands), 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.

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CHAPTER 7: SPECIES OF GREATEST CONSERVATION NEED

In order to address required elements 1-5, Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS) presents information on the Species of Greatest Conservation Need through fact sheets on various taxonomic groups. 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 categories: terrestrial mammal, forest birds, raptors, waterbirds, seabirds, migratory shorebirds and waterfowl, Northwestern Hawaiian Islands passerines, terrestrial invertebrates, freshwater fishes, freshwater invertebrates, anchialine pond fauna, marine mammals, marine reptiles, marine fishes, and marine invertebrates. Appendix A provides a comprehensive list of Hawaii's Wildlife (Fauna) Species of Greatest Conservation Need and identifies the fact sheet where information on that species may be found.

Appendix B provides a comprehensive list of Hawaii's (Flora) Species of Greatest Conservation Need. Though not a required element, Hawai‘i plans to develop fact sheets for the species of flora on the list over time, beginning with the "Genetic Safety Net" plants (i.e., plants with less than 50 individuals).


Courtesy Annette Tagawa

Freshwater Fishes

ʻOʻopu nākea

Awaous guamensis

SPECIES STATUS:
IUCN Red List – Data Deficient

SPECIES INFORMATION: The indigenous ʻoʻopu nākea (*Awaous guamensisi)* is the largest of Hawaii's indigenous gobies, reaching a length of up to 36 centimeters (14 inches). It is also the most common. They are omnivores feeding on benthic algae, aquatic insects and insect larvae, worms, and crustaceans, but not fishes. They may feed on suspended food particles in the water column as well. ʻOʻopu nākea display sexual dimorphism and elaborate courtship rituals. Spawning occurs from August to November when annual spawning runs to the stream mouths are triggered by freshets. Large spawning aggregations are formed at the first riffle before the estuary. This is the only goby that migrates downstream to spawn. Males make and guard nests in crevices of the stream bed where an attracted female will lay her eggs. Females probably produce one clutch a year and also help guard nests. Eggs are one millimeter (0.04 inches) in diameter and tens of thousands make up a nest. Eggs hatch in one day, travel to the ocean over four days and spend five to six months at sea. Post-larvae or hinana are indiscriminately recruited back to streams between December and July. They can be found in schools just after recruitment to estuaries. Adult ʻoʻopu nākea are relatively good climbers and swimmers, and post-larvae use tidal inundation to move upstream. The ʻoʻopu nākea will often burrow under rocks leaving only its eyes showing.

DISTRIBUTION: Historically, ʻoʻopu nākea were found on all the Main Hawaiian Islands. Today, they are found in streams on the island of Hawaiʻi, Kauaʻi, Molokaʻi, Maui, and Oʻahu. ʻOʻopu nākea usually are found in the middle to lower reaches of streams, with a larger range in larger streams. Post-larvae are found in oceanic waters, but little is known of its oceanic distribution.

ABUNDANCE: Abundant on Kauaʻi. Populations reduced on Oʻahu.

LOCATION AND CONDITION OF KEY HABITAT: ʻOʻopu nākea are primarily found in the middle and lower reaches of streams. If a river has steep waterfalls, they cannot climb these and thus will only be found in the lower reaches. Areas of slow, deep waters with gravel or fine sediment are key habitat for them. Riffles at stream mouths are critical spawning grounds. The majority of already degraded key habitat is located on Oʻahu, although 58 percent of the 366 perennial streams in the State have been altered in some way. Specific areas that can also be considered degraded due to water diversions are streams such as Waikolu on Molokaʻi and ʻĪao on Maui. In free flowing streams, such as Pelekunu on Molokaʻi or larger rivers such as Hanalei, Waimea, and Wainiha on Kauaʻi, ʻoʻopu nākea habitat is in a more stable condition. For specific information on stream biota, the Division of Aquatic Resources of the Department of Land and Natural Resources has a database of surveyed streams. Oceanic waters are

important to the survival of post-larvae, but little is known of its oceanic distribution or habitat requirements.

THREATS:

- Habitat degradation results from water diversion, stream channelization, dams, pollution, and the introduction of exotic species and parasites. Water diversions, stream channelization, and dams result in habitat degradation through altered stream flows that lead to: the destruction of key water characteristics such as freshets, riffles and runs; higher water temperatures; and lower dissolved oxygen levels. The reduced water flows from water diversions and dams also can limit larvae from reaching the ocean and recruiting back into streams. Channelization leads to a decrease in riparian vegetation that causes a loss of shelter and erosion control;
- Non-point source water pollution, such as nutrients, sedimentation, and chemicals may threaten the ʻoʻopu nākea. The consequence of these pollutants is relatively unknown and needs to be further studied;
- Exotic species such as tilapia are another important threat to the ʻoʻopu nākea. Historical introductions of game fish and more recent unwanted exotic fish from the aquarium trade are both problems. These exotic fishes prey on native fishes, out compete native fishes for food, and spread parasites and diseases;
- Fishing could be come a more severe threat in combination with the above threats, because ʻoʻopu nākea are abundant in Kauaʻi rivers and are fished during their spawning migration.

CONSERVATION ACTIONS: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. Past actions to restore fish populations have consisted of a ban on gill, drag, draw, and seine netting; stream clean-up efforts, and public outreach. In addition to common statewide and island conservation actions, specific actions include:

- Improve altered or diverted streams;
    - Modify or remove gratings or diversions to allow for instream passage of fish;
    - Restore riparian vegetation to help decrease instream heating and reduce sediment loads;
    - Remove alien species;
    - Create pools in frequently dewatered stretches to provide safe usable habitat between flows.
- Collaborate with the Commission on Water Resources Management and the Land Board to ensure adequate Instream Flow and biological integrity of riparian areas;
- Work to clean streams with significant pollution;
- Use science-based management of recreational fishing;
- Continue developing GIS database and making it web-accessible;
- Increase education and outreach efforts, particularly on issues of fishing-related life history, water pollution, and how to deal with unwanted aquarium pets;
- Continue on-going partnerships focused on environmental and fisheries education and conservation and expand partnerships.

MONITORING:

- Establish survey schedule to determine population size and distribution;

- Monitor number of returning hinana;
- Monitor number of fish taken in recreational fishing each year.

RESEARCH PRIORITIES:

- Determine effects of pollution on populations;
- Better understand the role of estuaries in species ecology;
- Continue research efforts on marine life stage;
- Initiate research to study source-sink population structure;
- Research impacts and methodologies to deal with alien species;
- Continue researching effects of stream channelization and diversion;
- Research effect of fishing on total population size and distribution.

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Courtesy Annette Tagawa

ʻOʻopu ʻakupa or Sandwich Island sleeper

Eleotris sandwicensis

SPECIES STATUS:
IUCN Red List – Data Deficient
Endemic

SPECIES INFORMATION: ʻOʻopu ʻakupa or Sandwich Island sleeper (*Eleotris sandwicensis)* is Hawaii's only endemic eleotrid. Adult ʻoʻopu ʻakupa are ambush predators that feed on a variety of invertebrates and fishes, including other native adult and post-larval gobies and some exotic fishes. One study shows that they are also opportunistic feeders. It can grow to 33 centimeters (13 inches) in length. Unlike Hawaii's native gobies, its pelvic fins are not fused into a disc. Without this sucking disc, they are unable to hold on to substrates and are not good climbers. Spawning occurs in freshwater; nests are made in crevices at the stream bottom. Eggs hatch within a day and are washed to the sea where they spend a few months as oceanic plankton. Post-larvae or hinana recruit to streams indiscriminately, and they depend on waves and currents to bring them inshore. This recruitment occurs year round but is most prevalent in the spring and usually takes place during nighttime hours. ʻOʻopu ʻakupa usually stay hidden, but can be seen darting and diving into leaf litter or mud or searching for shelter in rocks. There are two head morphs of the species.

DISTRIBUTION: Historically, ʻoʻopu ʻakupa were found on all the Main Hawaiian Islands. Today, they also are found on all the Main Hawaiian Islands in the lower reaches of streams and in estuaries below all man-made obstructions. Post-larvae are found in oceanic waters, but little is known of its oceanic distribution, but post-larvae do not show natal stream fidelity.

ABUNDANCE: Most common on Oʻahu. One study shows that ʻoʻopu ʻakupa are present in Pelekunu stream but rare in Waikolu stream, both on Molokaʻi. ʻOʻopu ʻakupa populations are stable in both altered and unaltered streams.

LOCATION AND CONDITION OF KEY HABITAT: ʻOʻopu ʻakupa are found only in estuaries and the lower reaches of streams. Their feeding habitat is primarily on the bottom of these streams and estuaries. Although they prefer clear, cool streams like the other gobies, they are better adapted than most gobies to live in degraded habitat. They can often be found living in cans and other trash items at the bottom of streams. Condition of key habitat varies depending on whether streams flow through protected or forested areas versus urban areas, but ʻoʻopu ʻakupa populations are stable in both altered and unaltered streams. For specific information on stream biota, the Division of Aquatic Resources of the Department of Land and

Natural Resources has a database of surveyed streams. Oceanic waters are important to the survival of post-larvae, but little is known of its oceanic distribution or habitat requirements.

THREATS:

- Habitat degradation results from water diversion, stream channelization, and dams. Water diversion, stream channelization, and dams result in habitat degradation through altered stream flows, which also causes a loss of riparian vegetation, shelter and erosion control; higher water temperatures; and lower dissolved oxygen levels. Because of their higher tolerance to stress, ʻoʻopu ʻakupa are not as threatened by altered streams as other Hawaiian gobies. However, reduced water flows can still limit larvae from reaching the ocean and recruitment back into streams;
- Non-point source water pollution such as nutrients, sedimentation, and chemicals may threaten ʻoʻopu ʻakupa; however, the consequence of these pollutants is relatively unknown and needs to be further studied;
- Introduction of exotic species, diseases and parasites such as tilapia are significant threats to ʻoʻopu ʻakupa. Historical introductions of game fish and more recent unwanted exotic fish from the aquarium trade are both problems. These exotic fish species prey on native fish, they compete native fish for food, and spread parasites and diseases;
- Fishing for ʻoʻopu ʻakupa occurs today and it is used as bait. In conjunction with the above threats, overfishing could become a threat in the future.

CONSERVATION ACTIONS: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. Past actions to restore fish populations have consisted of a ban on gill, drag, draw, and seine netting; stream clean-up efforts, and public outreach. In addition to common state-wide and island conservation actions, specific actions include:

- Improve altered or diverted streams;
    - Modify or remove gratings or diversions to allow for instream passage of fish;
    - Restore riparian vegetation to help decrease instream heating and reduce sediment loads;
    - Remove alien species;
    - Create pools in frequently dewatered stretches to provide safe usable habitat between flows.
- Collaborate with the Commission on Water Resources Management and the Land Board to ensure adequate Instream Flow and biological integrity of riparian areas;
- Work to clean streams with significant pollution;
- Continue developing GIS database and making it web-accessible;
- Use science-based management of recreational fishing;
- Increase education and outreach efforts, particularly on issues of fishing related life history, water pollution, and how to deal with unwanted aquarium pets;
- Continue on-going partnerships focused on environmental and fisheries education and conservation and expand partnerships.

MONITORING:

- Establish survey schedule to determine population size and distribution;
- Monitor number of returning hinana;

- Monitor number of fish taken in recreational fishing each year.

RESEARCH PRIORITIES:

- Determine effects of pollution on population;
- Better understand the role of estuaries in species ecology;
- Continue researching effects of stream channelization and diversion-specifically how this goby is able to have high numbers in altered streams;
- Initiate research to study source-sink population structure;
- Research impacts and methodologies to deal with alien species;
- Research effect of fishing on total population size and distribution.

References:

Brasher AM. 1997. Habitat use by fish (ʻoʻopu), snails (hihiwai), shrimp (ʻopae) and prawns in two streams on the island of Moloka`i. Technical Report. Honolulu HI: Cooperative National Park Resources Studies Unit University of Hawaii at Manoa. Report no 116. 92 pp.

Hau S. 1996. Post-larval migration of three native gobies (*Lentipes concolor, Awaous guamensis,* and*Sicyopterus stimpsoni*) in Iao stream on the island of Maui. Proceedings of the October 1994 Hawaii Stream Restoration Symposium; 1994; Hawaiʻi. State of Hawaiʻi, Department of Land and Natural Resources, Division of Aquatic Resources. 159 pp.

Kinzie RA III. 1990. Species profiles: life histories and environmental requirements of coastal vertebrates and invertebrates, Pacific Ocean region; Report 3, Amphidromous macrofauna of island streams. Technical Report EL-89-10. Vicksburg, MS: US Army Engineer Waterways Experiment Station.

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Courtesy Mike Yamamoto

Freshwater Fishes

ʻOʻopu ʻalamoʻo

Lentipes concolor

SPECIES STATUS:
IUCN Red List – Data Deficient
Endemic

SPECIES INFORMATION: The endemic ʻoʻopuʻ alamoʻo (*Lentipes concolor*) can be distinguished from Hawaii's other endemic gobies by their extraordinary abilities to climb vertical waterfalls. Male ʻoʻopuʻ alamoʻo can be distinguished from females by their displays of striking sexual dimorphism with a range of color patterns that depend on its activities. Additionally, males are territorial, while females are not. ʻOʻopuʻ alamoʻo are omnivores, feeding on algae and small aquatic animals. Adults feed primarily on small aquatic animals including atyid shrimps and may graze on microalgae while they move. Juveniles feed more on plant material. Additionally, they will swim through the water column to collect drift particles or insects. ʻOʻopuʻ alamoʻo breed in upstream areas from late fall to early spring and are cued by freshets. Nests are made under rocks and in crevices away from the main river channel. Eggs hatch within two to three days of being laid and are carried to the ocean with the current. They have four days to reach the ocean or the larvae will not survive. Postlarvae or hinana remain part of the oceanic plankton for a few months and then recruit indiscriminately to a freshwater source with the incoming tide, usually after sunrise. This recruitment occurs year round but is most prevalent in the spring. They swim directly upstream spending no longer than one day in an estuary. ʻOʻopuʻ alamoʻo travel at speeds of 90 meters (295 feet) per hour. Although they cannot swim up through flowing water and must use a substrate, they are very able climbers using their suction discs to hold on to the surface and their pectoral fins to move them upwards.

DISTRIBUTION: ʻOʻopuʻ alamoʻo has been found in streams on all main islands historically. They are currently found in streams on the island of Hawaiʻi, Kauaʻi, Maui, Molokaʻi, and in seven streams on Oʻahu. Although, not as common, it is very likely that ʻoʻopuʻ alamoʻo exist in more streams on Oʻahu, in areas of high elevation and where habitat is not affected as a result of human population growth and pollution. Previously, thought only to be located on windward streams, ʻoʻopuʻ alamoʻo recently has been discovered in the upper reaches of leeward perennial streams as well. They also can be found above Akaka Falls on the island of Hawaiʻi. Dams and stream obstructions can limit their presence in upper reaches that they previously occupied. Larvae spend time in the ocean as plankton, but not much is known of their oceanic distribution.

ABUNDANCE: Abundance throughout the islands is unknown; however, populations are decreasing on Oʻahu and Maui.

LOCATION AND CONDITION OF KEY HABITAT: ʻOʻopuʻ alamoʻo do best in unobstructed, cool, fast-moving streams. They spend the majority of their life in freshwater in the upper reaches of streams. ʻOʻopuʻ alamoʻo are very well suited to the naturally variable characteristics of Hawaii's streams. However, where natural stream habitat has been altered, including decreases in forest cover, ʻoʻopuʻ alamoʻo populations have decreased. The majority of already degraded key habitat is located on Oʻahu, although 58 percent of the 366 perennial streams in the State have been altered in some way. Interestingly, the amount of plant cover within a stream affects the location of ʻoʻopuʻ alamoʻo in a stream, with fish density being the highest where plant cover is the lowest. For more information on specific stream biota, the Division of Aquatic Resources of the Department of Land and Natural Resources has a database of surveyed streams. Oceanic waters are important to the survival of post-larvae, but little is known of its oceanic distribution or habitat requirements.

THREATS:

- Habitat degradation results from water diversion, stream channelization, dams, pollution, and the introduction of exotic species and parasites. Water diversions, stream channelization, and dams result in habitat degradation through altered stream flows that lead to: the destruction of key water characteristics such as freshets, riffles and runs; higher water temperatures; and lower dissolved oxygen levels. The reduced water flows from water diversions and dams also can limit larvae from reaching the ocean and recruiting back into streams. Channelization leads to a decrease in riparian vegetation that causes a loss of shelter and erosion control;
- Non-point source water pollution such as nutrients, sedimentation, and chemicals may threaten ʻoʻopuʻ alamoʻo; however, the consequence of these pollutants is relatively unknown and needs to be further studied;
- Exotic species such as tilapia are another important threat to the ʻoʻopuʻ alamoʻo. Historical introductions of game fish and more recent unwanted exotic fish from the aquarium trade are both problems. These exotic fishes prey on native fish species, out compete native fishes for food, and spread parasites and diseases.

CONSERVATION ACTIONS: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. Past actions to restore fish populations have consisted of a ban on gill, drag, draw, and seine netting; stream clean-up efforts, and public outreach. In addition to common statewide and island conservation actions, specific actions include:

- Improve altered or diverted streams;
    - Modify or remove gratings or diversions to allow for instream passage of fish;
    - Restore riparian vegetation to help decrease instream heating and reduce sediment loads;
    - Remove alien species;
    - Create pools in frequently dewatered stretches to provide safe usable habitat between flows.
- Collaborate with the Commission on Water Resources Management and the Land Board to ensure adequate Instream Flow and biological integrity of riparian areas;
- Work to clean streams with significant pollution;
- Continue developing GIS database and making it web-accessible;
- Use science-based management of recreational fishing;

- Increase education and outreach efforts, particularly on issues of water pollution and how to deal with unwanted aquarium pets;
- Continue on-going partnerships focused on environmental and fisheries education and conservation and expand partnerships.

MONITORING:

- Establish survey schedule to determine population size and distribution;
- Monitor number of returning hinana.

RESEARCH PRIORITIES:

- Determine effects of pollution on population;
- Better understand the role of estuaries in species ecology;
- Continue research efforts on marine life stage;
- Initiate research to study source-sink population structure;
- Research impacts and methodologies to deal with alien species;
- Continue researching effects of stream channelization and diversion.

References:

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

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Courtesy Mike Yamamoto

Freshwater Fishes

ʻOʻopu nōpili

Sicyopterus stimpsoni

SPECIES STATUS:
IUCN Red List – Near Threatened
Endemic

SPECIES INFORMATION: Both male and female ʻoʻopu nōpili (*Sicyopterus stimpsoni*) vary in color based on age and activity and display elaborate courtship rituals. They feed at a lower trophic level than *Lentipes concolor*. Of all the Hawaiian gobies, ʻoʻopu nōpili post-larvae often migrate into estuaries in large schools and are most often found in schools at stream mouths. They do not recruit back to the same stream where they were born. Spawning occurs between August and March and eggs are deposited in crevices under rocks and pebbles. Nests are laid in territories defended by males. Eggs hatch within two to three days and larvae are washed out to sea, spending approximately five months as oceanic plankton. Recruitment of post-larvae or hinana occurs year round but is most prevalent in the spring. Post-larvae can be found in schools just after recruitment. After recruitment ʻoʻopu nōpili remain in estuaries for at least 48 hours before they begin migrating upstream. During this time, they undergo a significant metamorphosis. Their snouts enlarge and lengthen and their heads increase in size. Their upper lip also enlarges and their mouths move to a sub-terminal position. This metamorphosis allows the ʻoʻopu nōpili to climb waterfalls using its suction cup and lips. Prior to this metamorphosis, the post-larvae are omnivorous, but after the metamorphosis the sub-terminal mouth is better suited to scraping algae from rocks with a unique feeding behavior.

DISTRIBUTION: Historically, ʻoʻopu nōpili were found in streams on all of the Main Hawaiian Islands. Today, they also are located on all main islands, primarily in the middle reaches of streams, although they can be found in the lower reaches. On Oʻahu they commonly are found in unaltered streams such as Kaluanui, Kahana, and Waimea. Upstream distribution is limited by instream obstructions. Individual distribution within accessible stream reaches is determined based on displays of aggression during migration and establishment of territories. ʻOʻopu nōpili develop aggressive signaling colors at different rates. Those that develop them early establish territories first. These ʻoʻopu nōpili displace other non-colored ʻoʻopu nōpili further upstream. Post-larvae are found in oceanic waters, but little is known of its oceanic distribution.

ABUNDANCE: Abundant where present on all main islands except for Oʻahu where its numbers are greatly reduced from historical times.

LOCATION ANDCONDITION OF KEY HABITAT: ʻOʻopu nōpili do best in the middle reaches of streams utilizing areas with high stream velocities such as riffles and runs. Areas that are undisturbed, with high water quality and high discharge rates, are key to their survival. The majority of already degraded habitat is located on Oʻahu, although 58 percent of the 366

perennial streams in the State have been altered in some way. Additionally, ʻoʻopu nōpili have been used as an "indicator species" to signify high water quality in streams and the possible presence of ʻoʻopu ʻalamoʻo, which is rarer than the ʻoʻopu nōpili. For specific information on stream biota, the Division of Aquatic Resources of the Department of Land and Natural Resources has a database of surveyed streams. Oceanic waters are important to the survival of post-larvae, but little is known of its oceanic distribution or habitat requirements.

THREATS:

- Habitat degradation results from water diversion, stream channelization, dams, pollution, and the introduction of exotic species and parasites. Water diversions, stream channelization, and dams result in habitat degradation through altered stream flows that lead to: the destruction of key water characteristics such as freshets, riffles and runs; higher water temperatures; and lower dissolved oxygen levels. The reduced water flows from water diversions and dams also can limit larvae from reaching the ocean and recruiting back into streams. Channelization leads to a decrease in riparian vegetation that causes a loss of shelter and erosion control;
- Non-point source water pollution such as nutrients, sedimentation, and chemicals may threaten ʻoʻopu nōpili; however, the consequence of these pollutants is relatively unknown and needs to be further studied;
- Exotic species such as tilapia are another important threat to ʻoʻopu nōpili. Historical introductions of game fish and more recent unwanted exotic fish from the aquarium trade are both problems. These exotic fishes prey on native fish species, out compete native fishes for food, and spread parasites and diseases.

CONSERVATION ACTIONS: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. Past actions to restore fish populations have consisted of a ban on gill, drag, draw, and seine netting; stream clean-up efforts, and public outreach. In addition to common statewide and island conservation actions, specific actions include:

- Improve altered or diverted streams;
    - Modify or remove gratings or diversions to allow for instream passage of fish;
    - Restore riparian vegetation to help decrease instream heating and reduce sediment loads;
    - Remove alien species;
    - Create pools in frequently dewatered stretches to provide safe usable habitat between flows.
- Collaborate with the Commission on Water Resources Management and the Land Board to ensure adequate Instream Flow and biological integrity of riparian areas
- Work to clean streams with significant pollution;
- Continue developing GIS database and making it web-accessible;
- Use science-based management of recreational fishing;
- Increase education and outreach efforts, particularly on issues of water pollution and how to deal with unwanted aquarium pets;
- Continue on-going partnerships focused on environmental and fisheries education and conservation and expand partnerships.

MONITORING:

- Establish survey schedule to determine population size and distribution;
- Monitor number of returning hinana.

RESEARCH PRIORITIES:

- Determine effects of pollution on population;
- Better understand the role of estuaries in species ecology;
- Continue research efforts on marine life stage;
- Initiate research to study source-sink population structure;
- Research impacts and methodologies to deal with alien species;
- Continue researching effects of stream channelization and diversion.

References:

Brasher AM. 1997. Habitat use by fish (ʻoʻopu), snails (hihiwai), shrimp (ʻopae) and prawns in two streams on the island of Moloka`i. Technical Report. Honolulu HI: Cooperative National Park Resources Studies Unit University of Hawaii at Manoa. Report no 116. 92 pp.

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

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Courtesy Annette Tagawa

Freshwater Fishes

ʻOʻopu naniha

Stenogobius hawaiiensis

SPECIES STATUS:
IUCN Red List – Not considered
Endemic

SPECIES INFORMATION: ʻOʻopu naniha (*Stenogobius hawaiiensis*) are a smaller goby reaching ten to 13 centimeters (four to five inches) in length. As an omnivore, it feeds on algae, worms, crustaceans, and insect larvae that it takes from the bottom sediments using their snouts. ʻOʻopu naniha display sexual dimorphism and elaborate courtship rituals. Spawning occurs year round. Average-sized ʻoʻopu naniha will lay 6,000-8,000 eggs in crevices guarded by males. Eggs hatch after one day and are carried out to sea. Within five days they will develop enough to be able to begin feeding. They spend approximately 135 days as oceanic plankton. Post-larvae or hinana recruit indiscriminately back to freshwater streams during all hours, utilizing the incoming tide. Recruitment is most prevalent in the spring. ʻOʻopu naniha are poor climbers and swimmers compared to the other native gobies.

DISTRIBUTION: Historically, ʻoʻopu naniha were found on all the Main Hawaiian Islands. Today, they also are found on all the Main Hawaiian Islands in the lower reaches of streams and in estuaries that are not blocked by man-made obstructions. Post-larvae are found in oceanic waters, but little is known of its oceanic distribution.

ABUNDANCE: Most common on Oʻahu. Abundance has declined in many areas and is affected by the threats listed below.

LOCATION AND CONDITION OF KEY HABITAT: Key habitat for ʻoʻopu naniha is along margins of streams and in low flow areas in the lower reaches of streams and stream mouths. Although they prefer clear, cool streams like the other gobies, they are better adapted than most gobies to live in soft substrates in degraded habitat. For specific information on stream biota, the Division of Aquatic Resources of the Department of Land and Natural Resources has a database of surveyed streams. Oceanic waters are important to the survival of post-larvae, but little is known of its oceanic distribution or habitat requirements.

THREATS:

- Habitat degradation results from water diversion, stream channelization, and dams. Water diversion, stream channelization, and dams result in habitat degradation through altered stream flows, which also causes a loss of riparian vegetation, shelter and erosion control; higher water temperatures; and lower dissolved oxygen levels. ʻOʻopu naniha are not as threatened by altered streams as other Hawaiian gobies, although reduced water flows still can limit larvae from reaching the ocean and recruiting back into streams;

- Non-point source water pollution, such as nutrients, sedimentation, and chemicals may threaten ʻoʻopu naniha; however, the consequence of these pollutants is relatively unknown and needs to be further studied;
- Introduction of exotic species, diseases and parasites such as tilapia are significant threats to ʻoʻopu naniha. Historical introductions of game fish and more recent unwanted exotic fish from the aquarium trade are both problems. These exotic fish species prey on native fish, outcompete native fish for food, and spread parasites and diseases;
- Fishing for ʻoʻopu naniha occurs and could become a more severe threat in combination with the above threats.

CONSERVATION ACTIONS: The goals of conservation actions are to not only protect current populations, but to also establish further populations to reduce the risk of extinction. Past actions to restore fish populations have consisted of a ban on gill, drag, draw, and seine netting; stream clean-up efforts, and public outreach. In addition to common state-wide and island conservation actions, specific actions include:

- Improve altered streams;
    - Restore riparian vegetation to help decrease instream heating and reduce sediment loads;
    - Remove alien species;
    - Create pools in frequently dewatered stretches to provide safe usable habitat between flows.
- Collaborate with the Commission on Water Resources Management and the Land Board to ensure adequate Instream Flow and biological integrity of riparian areas;
- Work to clean streams with significant pollution;
- Continue developing GIS database and making it web-accessible;
- Use science-based management of recreational fishing;
- Increase education and outreach efforts, particularly on issues of fishing-related life history, water pollution, and how to deal with unwanted aquarium pets;
- Continue on-going partnerships focused on environmental and fisheries education and conservation and expand partnerships.

MONITORING:

- Establish survey schedule to determine population size and distribution;
- Monitor number of returning hinana.

RESEARCH PRIORITIES:

- Research conservation-relevant biology and ecology;
- Better understand the role of estuaries in species ecology;
- Determine effects of pollution on population;
- Continue research efforts on marine life stage;
- Initiate research to study source-sink population structure;
- Research impacts and methodologies to deal with alien species;
- Continue researching effects of stream channelization and diversion, specifically how this goby is able to have high numbers in altered streams;
- Research effect of fishing on total population size and distribution.

References:

Brasher AM. 1997. Habitat use by fish (ʻoʻopu), snails (hihiwai), shrimp (ʻopae) and prawns in two streams on the island of Moloka`i. Technical Report. Honolulu HI: Cooperative National Park Resources Studies Unit University of Hawaii at Manoa. Report no 116. 92 pp.

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

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CHAPTER 8: MONITORING, IMPLEMENTATION, AND ADAPTIVE MANAGEMENT

The need for monitoring is a consistent theme throughout Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS) and is referenced in several previous chapters (Chapters 4, 5, 6, and 7). 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 CWCS. In doing so, this Chapter addresses required elements 5, 6, and 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.

SUMMARY OF MONITORING EFFORTS AND CHALLENGES IN THE STATE

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. Examples include monitoring of State and Federal fisheries, the statewide waterbird surveys, and the Forest Bird Surveys. 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, State Wildlife Sanctuaries, 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 and Maui Land and Pineapple, Inc. and private landowners involved in conservation programs such as the State's Landowner Incentive Program and Federal programs managed by the Natural Resources

Conservation Service and the U.S. Fish and Wildlife Service (USFWS). 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 Hawai‘i Audubon Society, which has conducted annual Christmas bird counts on O‘ahu, Kaua‘i, Maui, Hawai‘i, Midway, Laysan and French Frigate Shoals, 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 State has several tools and resources available to assist with monitoring. Examples include databases and information warehouses such as the Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program) and the Pacific Basin Information Node. There are also inter-agency efforts such as the Western Pacific Fisheries Information Network, Coral Reef Information Service, and the Hawai‘i Forest Bird Interagency Database Project, which analyzes information collected during yearly forest bird surveys to determine conservation needs of these species.

The challenges facing implementation of effective monitoring are similar to those challenges faced in implementing conservation actions as discussed in Chapter 4: 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.

TAXON MONITORING

Most monitoring in the State consists of counting individuals and nests. 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 for taxa as well as identifies gaps and needs.

Terrestrial Mammal
The ʻōpeʻapeʻa (*Lasiurus cinereus semotus* [Hawaiian hoary bat]) is the only land mammal native to the Hawaiian archipelago. The USFWS recovery plan for the bat was developed in 1998 and outlines the monitoring requirements for this species. Specific recommendations center on the need for island-wide surveys and monitoring to determine bat population levels and distribution, as well as associated key habitats and potential threats affecting populations. To date, no systematic surveys of the bat have been conducted. Most monitoring has occurred on island specific areas and at different times of the year. Additionally, its wide range of habitat and the limited technology available to detect bat presence makes monitoring this species difficult. However, efforts are underway by the Hawaiian Bat Research Cooperative and Hawaiʻi Volcanoes National Park to improve monitoring of this species.

Forest Birds
Hawaii's native forest birds are perhaps the best monitored species in the State. However, monitoring efforts for even these species could be improved, particularly life history monitoring for specific species. Standardized forest bird surveys have been conducted annually since 1976 by agencies and private landowners including the State Division of Forestry and Wildlife (DOFAW), USFWS, National Park Service (NPS) and National Wildlife Refuges (NWR), Kamehameha School, and the Nature Conservancy of Hawaiʻi. Additionally, monitoring is guided by the USFWS Draft Revised Recovery Plan for Hawaiian Forest Birds, which also includes five-year implementation plans identifying monitoring needs for identified critical species. Elements of monitoring from these plans are conducted by the USFWS and its partners; however, the full range of monitoring recommendations has yet to be implemented. For non-endangered forest birds such as ʻiʻiwi (*Vestiaria coccinea*), ʻapapane (*Himatione sanguinea*), and ʻamakihi (*Hemignathus virens*), no plans have been developed, though monitoring does occur for these species during the forest bird surveys and monitoring conducted on managed lands. However, their potential dispersal in lower elevations may require different monitoring protocols.

There are no wild populations of ʻalalā (*Corvus hawaiiensis* [Hawaiian crow]) and all existing populations are in captive propagation facilities which are closely monitored by staff. Monitoring protocols for the release of ʻalalā into the wild have been developed. The ʻalalā also has a USFWS Draft Revised Recovery Plan, part of which captive propagation is an element.

Raptors
There is no systematic island-wide monitoring for pueo (*Asio flammeus sandwichensis* [Hawaiian short-eared owl]) or ʻio (*Buteo solitarius* [Hawaiian hawk]). Population assessments are based on surveys conducted on more opportunistic or piece-meal basis, such as research by graduate students, surveys of species on various managed lands, or during the Hawaiʻi Audubon counts.

Waterbirds
All endemic Hawaiian waterbirds have existing USFWS recovery plans outlining monitoring needs and actions. An updated, revised recovery plan for the nēnē (*Branta sandvicensis* [Hawaiian goose]) is currently being developed by the USFWS and should be available in December 2005. The USFWS has also recently finalized an updated Draft Revised Recovery

plan for Hawaiian waterbirds addressing the monitoring needs of koloa maoli (*Anas wyvilliana* [Hawaiian duck]), ʻalae ʻula (*Gallinula chloropus sandvicensis* [Hawaiian moorhen]), ʻalae keʻokeʻo (*Fulica alai* [Hawaiian coot]), and aeʻo (*Himantopus mexicanus knudseni* [Hawaiian stilt]). Elements of monitoring from these plans are conducted by the USFWS and its partners; however, the full range of monitoring recommendations has yet to be implemented. DOFAW also conducts twice annual statewide waterbird surveys, covering both private and public land, that include these species as well as the ʻaukuʻu (*Nycticorax nycticorax* [black-crowned night-heron]). Additionally, these species are monitored on various managed lands such as National Wildlife Refuges, military special management areas, and State Wildlife Sanctuaries as part of ongoing management or as part of research.

Seabirds

The majority of Hawaii's seabird populations are in the Northwestern Hawaiian Islands and monitoring of these species is conducted by USFWS at Midway, Laysan, and French Frigate Shoals and DOFAW at Kure Atoll. For the Main Hawaiian Islands, seabirds nest mostly on offshore islands and islets, and monitoring of these populations is conducted on some islands by DOFAW as well as by the Offshore Island Restoration Committee, an interagency organization. Seabirds are also monitored in known nesting areas on managed lands and by DOFAW's twice annual statewide waterbird surveys. Citizen monitoring occurs via the Hawaiʻi Audubon counts. Additionally, the USFWS has developed a Pacific Region Seabird Conservation Plan that also details monitoring needs at a larger scale and addresses inter-state and international levels. Elements of monitoring from these plans are currently being developed for implementation; however, the full range of monitoring recommendations has yet to be implemented. DOFAW has been awarded a grant to support future collaboration with other U.S. Pacific Islands for monitoring of shared species such as seabirds.

Migratory shorebirds and waterfowl

Regular migrants are monitored under existing programs already mentioned for other avian species groups. Examples include DOFAW's twice annual statewide waterbird surveys, Hawaiʻi Audubon counts, and monitoring occurring on various managed lands. Additionally, the USFWS has developed a Pacific Islands Regional Shorebird Conservation Plan that also details monitoring needs at a larger scale that addresses inter-state and international levels. Elements of monitoring from these plans are currently being developed for implementation; however, the full range of monitoring recommendations has yet to be implemented. DOFAW has been awarded a grant to support future collaboration with other U.S. Pacific Islands for monitoring of shared species such as migratory shorebird and waterfowl species.

Northwestern Hawaiian Islands passerines and waterbird

Given the small population levels and restricted range of these species, monitoring of these species is intensively conducted by the USFWS through the National Wildlife Refuge system. In addition, monitoring associated with translocation programs for several of these species provide further information relating to species distribution, abundance, and condition. A USFWS Draft Revised Recovery Plan for the Laysan duck (*Anas laysanensis*) also exists, from which some monitoring elements are implemented.

Terrestrial invertebrates

In contrast to the limited, but relatively consistent monitoring of terrestrial vertebrates, terrestrial invertebrate populations are not adequately monitored. Sixty to 80 percent of Hawaii's invertebrate species have yet to be surveyed. Limited baseline densities have been obtained for some taxa in a few locations. Inventories of some areas have been conducted by the Bishop Museum. Some surveys and monitoring have been conducted for certain threatened and endangered species on U.S. Army lands at Mākua, at the Nature Conservancy's Honouliuli Preserve, within certain DOFAW Natural Area Reserves and Wildlife Sanctuaries, and on National Park and National Wildlife Refuge lands. Surveys have also been conducted by academic researchers. USFWS draft recovery plans exist for O'ahu tree snails (*Achatinella* spp.), Blackburn's sphinx moth (*Manduca blackburni*), and the Kaua'i cave arthropods (*Adelocosa anops* and *Spelaeorchestia koloana*). The challenge of adequately monitoring terrestrial invertebrates lies in the sheer number of species (over 5,000) that exist in Hawai'i, the fact that these species are quite small (averaging less than five millimeters in size), and the limited number of individuals trained to identify these species. Efforts are currently being discussed as to the best approach for monitoring of these species (e.g., monitoring for species' suites in habitats) along with possible development of a statewide terrestrial invertebrates strategy.

Plants and algae

There is no systematic monitoring of rare plant populations. Instead, various land managers individually monitor the status of the plants on their lands. In highly managed areas, the existence and condition of rare plants may be well known (e.g., rare plants within fenced enclosures in a Natural Area Reserve or rare plants within Special Ecological Units in a National Park). For more remote or less actively managed areas under protection (e.g., Forest Reserves), there may be historical surveys indicating the previous existence of rare plants, but their current status is unknown. Finally, information regarding rare plant distribution or abundance is not always shared with the Hawai'i Biodiversity and Mapping Program (formerly the Hawai'i Natural Heritage Program) and may remain solely within the control of the land management agency. The USFWS has established a Hawai'i and Pacific Plants Recovery Coordinating Committee which recently completed a third draft of an Integrated Plan for the Conservation of Hawaii's Unique Plants and Their Ecosystems. This Draft Plan recognizes the importance of monitoring for rare plant conservation and identifies areas needing further field surveys to determine the current status of rare plants, totaling approximately 13 percent of the State (202,000 hectares or 500,000 acres). 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) surveys some streams across Hawai'i for monitoring and management purposes. 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. 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. Reefcheck and other volunteer organizations gather data on reef fishes. However, no systematic surveys exist for non-commercially regulated marine invertebrates and deep water species.

HABITAT MONITORING

The underlying philosophy concerning habitat monitoring is to preserve native habitats and monitor for area coverage and quality of intactness. Monitoring of the ten terrestrial habitat types outlined in Chapter 3 is conducted on managed lands through existing management plans for these areas. Most management entities monitor habitat as it relates to native habitat preservation and restoration, rare plant management, threats such as encroachment by invasive species (e.g., plants, mammalian predators, or ungulates), or management actions such as ungulate removal and fencing. Additionally, habitat monitoring related to species specific needs as outlined in USFWS draft recovery plans also exists. For many of these managed areas and species, habitat monitoring centers on threat assessments for invasive plants, ungulates, and wildfires. Managed areas with existing management plans and monitoring efforts are discussed in Chapters 5 and 6 in the Management Needs sections.

For habitats that are not in managed areas or recovery plans, the land coverage analysis developed by the Hawai‘i Gap Analysis Program (HI-GAP) will be an essential tool for monitoring habitats once completed. However, monitoring gaps will exist for habitats such as streams, lava tube and cave systems, and anchialine ponds that are not identified by HI-GAP due to technological limitations related to mapping of these habitats.

DAR monitors selected stream areas and lakes while the State Department of Health and the U.S. Environmental Protection Agency monitor water quality. NOAA monitors coral reefs in the Northwestern Hawaiian Islands and collaborates with DAR to monitor less accessible areas of the Main Hawaiian Islands. DAR monitors many coral reef areas in 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. 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. Currently, there is no monitoring of estuaries, sandy bottoms, and pelagic habitats.

Additional habitat monitoring efforts include systematic invasive species monitoring conducted by the Invasive Species Committees on each island for targeted species, and project-based monitoring conducted in connection with various work, such as the vegetation monitoring along forest bird transects.

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 habitat level in Chapters 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

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. Most terrestrial invertebrate populations are neither well-characterized nor adequately monitored. Coordinated efforts are needed to develop and implement plans to increase inventory and monitoring statewide. Taxa requiring these efforts include terrestrial arthropods, land snails, anchialine pond species, non-coral and non-regulated marine invertebrates, and deep water species. For host-specific terrestrial invertebrates, rare plant surveys are necessary. For the fishes and aquatic invertebrates, systematic monitoring needs to be expanded to all important watersheds and areas. For plants, coordination of different efforts and development of survey priorities is needed. 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 the bat, established methods and protocols for larger scale monitoring of bat populations are needed. For avian species, improvements are needed to expand scope, frequency, data management and analysis, and reporting (e.g., demographic data that will allow the construction of population models, reproductive data that will allow the determination of greatest threat to productivity). For migratory species such as shorebirds, marine mammals, marine reptiles, and seabirds, 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, such as the Audubon Christmas bird count, community-based monitoring in marine areas, and educational programs.

IMPROVE MONITORING FOR ALL HABITATS

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. Similarly, the use of remote sensing and indicators of ecosystem properties needs to be better utilized. For terrestrial monitoring, a related issue of improving integration of monitoring is encouraging the use of inter-disciplinary teams in fieldwork (e.g., including botanists and entomologists during forest bird surveys).

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 appropriate geographic scales, and monitoring at the island and statewide levels is typically non-existent and a critical gap. 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. Existing efforts that can assist this process (but need additional coordination) are the recently developed Inventory and Monitoring program developed by the National Park Service, Pacific Basin Information Node, Hawai‘i Forest Bird Interagency Database Project, the Hawai‘i Biodiversity and Mapping Program (formerly the Hawai‘i Natural Heritage Program), and HI-GAP. Nationwide initiatives such as the U.S. Geological Service's (USGS) monitoring locator and protocols library can help provide information on monitoring and inventorying protocols. The establishment of a statewide monitoring working group will facilitate the development of this initiative.

FACILITATE INFORMATION SHARING STATEWIDE

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 CWCS

Implementation of certain elements of Hawaii's CWCS has already begun. As outlined in Chapters 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 and implement the CWCS. These efforts will be continued and enhanced where possible during implementation of the CWCS using a variety of funding sources.

In the coming years, the State Wildlife Grants (SWG) program will specifically fund projects to implement the following objectives:

1) Maintain, protect, manage, and restore native species and habitats in sufficient quantity and quality to allow native species to thrive:
- Urban wetland restoration on Oʻahu;
- Sanctuary perimeter fencing repair and maintenance on Maui;
- Seabird habitat management on Lānaʻi.

2) Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response, and ongoing control or eradication:
- Predator control for Oʻahu ʻelepaio (*Chasiempis sandwichensis ibidis*) and seabirds on Oʻahu.

3) Develop and implement programs to obtain, manage, and disseminate information needed to guide conservation management and recovery programs:
- Analysis of information from statewide forest bird surveys to determine population status and trends;
- Endangered forest bird research and management on Maui, Kauaʻi, Oʻahu, and Hawaiʻi;
- Surveys for nest colony locations of ʻuaʻu (*Pterodroma sandwichensis* [Hawaiian petrel]) and ʻaʻo (*Puffinus auricularis newelli* [Newell's shearwater]);
- Research on Blackburn's sphinx moth (*Manduca blackburni*) populations.

In addition, other sources of State and Federal funding are being used to address all seven objectives in the next fiscal year. For example, the State Natural Area Reserves fund supports management of existing Natural Area Reserves and watershed management projects, and the State Legislature included a line-item of four million dollars in the State budget for each of Fiscal Years 2005 and 2006 to address invasive species issues. Federal funds through grant programs administered by the USFWS, NOAA, U.S. Environmental Protection Agency, and Natural Resources Conservation Service are used to protect habitat and control invasive species. A variety of funding sources are used to support research and outreach efforts.

Once the Strategy is approved, one of the first steps for implementation will be to identify existing efforts that can be expanded and key partners willing to take the lead on implementing specific strategies and identifying needed conservation actions. Building on this first step, Hawaii's CWCS will be incorporated into overall DOFAW management as part of implementation. Additionally, in evaluating potential DOFAW funded projects outside of SWG, Hawaii's CWCS will be incorporated as an evaluation criteria (e.g., will this project accomplish one or more objectives as outlined by the CWCS?) to further enable effective implementation of the CWCS.

ADAPTIVE MANAGEMENT AND THE TEN-YEAR REVISION

Evaluation of Hawaii's CWCS 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, the State DOFAW and DAR will jointly conduct annual reviews to assess Hawaii's CWCS 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 CWCS. This annual review will also include the annual process of determining priorities for utilizing SWG funding. The CWCS 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 CWCS.

Part of measuring the success of and adaptively managing Hawaii's 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 DOFAW and 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 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 'āina* (protecting the land) for future generations.

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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.

Depredate: prey on.

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

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

Epiphytes: a plant growing on another plant for support or anchorage rather than for water or nutrients.

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 sometimes 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.

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.

Loʻi: irrigated terrace, especially for taro, but also for rice: paddy.

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 indigenous species.

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.

Precocial: offspring that exhibit a high level of independent activity from hatching. Usually applies to birds or mammals.

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.

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APPENDIX A: WILDLIFE (FAUNA) SPECIES OF GREATEST CONSERVATION NEED

Species						Island Distribution (Current (bold) and historic (unbold))								
Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	Ni'ihau	O'ahu	Moloka'i	Lāna'i	Maui	Kaho'olawe	Hawai'i	NWHI
Mammals	T	*Lasiurus cinereus semotus*	Hawaiian hoary bat	ʻōpeʻapeʻa	ʻŌpeʻapeʻa	**X**		**X**	**X**		**X**		**X**	
Forest Birds	T	*Moho braccatus*	Kauaʻi ʻōʻō	ʻōʻō ʻāʻā	Kauaʻi ʻōʻō	X								
Forest Birds	T	*Moho bishopi*	Bishop's ʻōʻō	ʻōʻō	Bishop's ʻōʻō				X		X?			
Forest Birds	T	*Corvus hawaiiensis*	Hawaiian crow	ʻalalā	Hawaiian Crow								X	
Forest Birds	T	*Chasiempis sandwichensis sclateri*	Kauaʻi ʻelepaio	ʻelepaio	Kauaʻi ʻelepaio	**X**								
Forest Birds	T	*Chasiempis sandwichensis ibidis*	Oʻahu ʻelepaio	ʻelepaio	Oahu ʻelepaio			**X**						
Forest Birds	T	*Chasiempis sandwichensis sandwichensis*	Hawaiʻi ʻelepaio	ʻelepaio	Hawaiʻi ʻelepaio								**X**	
Forest Birds	T	*Myadestes myadestinus*	Large Kauaʻi thrush	kāmaʻo	Kāmaʻo	X								
Forest Birds	T	*Myadestes lanaiensis*	Molokaʻi thrush	olomaʻo	Olomaʻo			X?	X	X	X?			
Forest Birds	T	*Myadestes obscurus*	Hawaiʻi thrush	ōmaʻo	Ōmaʻo								**X**	
Forest Birds	T	*Myadestes palmeri*	Small Kauaʻi thrush	puaiohi	Puaiohi	**X**								
Forest Birds	T	*Psittirostra psittacea*	ʻōʻū	ʻōʻū	ʻŌʻū	**X**		X	X	X	X		**X**	
Forest Birds	T	*Loxioides bailleui*	Palila	palila	Palila								**X**	
Forest Birds	T	*Pseudonestor xanthophrys*	Maui parrotbill	kīkēkoa	Maui Parrotbill				X		**X**			
Forest Birds	T	*Hemignathus virens*	Hawaiʻi ʻamakihi	ʻamakihi	Hawaiʻi ʻamakihi				**X**	X	**X**		**X**	
Forest Birds	T	*Hemignathus flavus*	Oʻahu ʻamakihi	ʻamakihi	Oʻahu ʻamakihi			**X**						
Forest Birds	T	*Hemignathus kauaiensis*	Kauaʻi ʻamakihi	alawī kihi	Kauaʻi ʻamakihi	**X**								
Forest Birds	T	*Hemignathus parvus*	Lesser ʻamakihi	ʻanianiau	ʻAnianiau	**X**								
Forest Birds	T	*Hemignathus procerus*	Kauaʻi ʻakialoa	ʻakialoa	Kauaʻi ʻakialoa	X								
Forest Birds	T	*Hemignathus lucidus hanapepe*	Kauaʻi nuku puʻu	nuku puʻu	Kauaʻi nuku puʻu	X								
Forest Birds	T	*Hemignathus lucidus affinis*	Maui nuku puʻu	nuku puʻu	Maui nuku puʻu						X			
Forest Birds	T	*Hemignathus munroi*	ʻakiapōlāʻau	ʻakiapōlāʻau	ʻAkiapōlāʻau								**X**	
Forest Birds	T	*Oreomystis bairdi*	Kauaʻi creeper	ʻakikiki	ʻAkikiki	**X**								
Forest Birds	T	*Oreomystis mana*	Hawaiʻi creeper	none	Hawaiʻi creeper								**X**	
Forest Birds	T	*Paroreomyza maculata*	Oʻahu creeper	ʻalauahio	Oʻahu ʻalauahio			**X**						
Forest Birds	T	*Paroreomyza flammea*	Molokaʻi creeper	kākāwahie	Molokaʻi creeper				X					
Forest Birds	T	*Paroreomyza montana*	Maui creeper	ʻalauahio	Maui ʻalauahio					X	**X**			
Forest Birds	T	*Loxops caeruleirostris*	Kauaʻi ʻākepa	ʻakekeʻe	ʻAkekeʻe	**X**								

*T=terrestrial, F=freshwater, A=anchialine, M=marine
Blue: ESA threatened/endangered; Yellow: ESA Candidate

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Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	Ni'ihau	O'ahu	Moloka'i	Lāna'i	Maui	Kaho'olawe	Hawai'i	NWHI
Forest Birds	T	*Loxops coccineus ochraceus*	Mau'i 'ākepa	'ākepa	Maui 'ākepa						X			
Forest Birds	T	*Loxops coccineus coccineus*	Hawai'i 'ākepa	'ākepa	'Ākepa								**X**	
Forest Birds	T	*Vestiaria coccinea*	'i'iwi	'i'iwi	'I'iwi	**X**		**X**	**X**	X	**X**	X?	**X**	
Forest Birds	T	*Palmeria dolei*	Crested honeycreeper	'ākohekohe	'Ākohekohe				X		**X**			
Forest Birds	T	*Himatione sanguinea*	'apapane	'apapane	'Apapane	**X**		**X**	**X**	**X**	**X**		**X**	
Forest Birds	T	*Melamprosops phaeosoma*	Po'ouli	po'ouli	Po'ouli						**X**			
Raptors	T	*Buteo solitarius*	Hawaiian hawk	'io	Hawaiian Hawk	X			X				**X**	
Raptors	T	*Asio flammeus sandwichensis*	Hawaiian short-eared owl	pueo	Pueo	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Waterbirds	T/F/A	*Nycticorax nycticorax hoactli*	Black-crowned night heron	'auku'u	Black-crowned Night Heron	**X**	**X**	**X**	**X**	**X**	**X**		**X**	
Waterbirds	T/F	*Branta sandvicensis*	Hawaiian goose	nēnē	Hawaiian goose	**X**	X		**X**	X	**X**	X	**X**	
Waterbirds	T/F	*Anas wyvilliana*	Hawaiian Duck	koloa maoli	Hawaiian Duck	**X**	**X**	**X?**	X		**X?**		**X**	
Waterbirds	T/F	*Anas laysanensis*	Laysan Duck	none	Laysan Duck	X		X	X		X		X	**X**
Waterbirds	T/F	*Gallinula chloropus sandvicensis*	Hawaiian common moorhen/gallinule	'alae 'ula	Hawaiian moorhen	**X**	X	**X**	**X?**		X		X	
Waterbirds	T/F	*Fulica alai*	Hawaiian coot	'alae ke'oke'o	Hawaiian coot	**X**	**X**	**X**	**X**	**X**	**X**		**X**	
Waterbirds	T/F/A	*Himantopus mexicanus knudseni*	Hawaiian stilt	ae'o	Hawaiian stilt	**X**	**X**	**X**	**X**	**X**	**X**		**X**	
Seabirds	T	*Phoebastria immutabilis*	Laysan albatross	mōlī	Laysan Albatross	**X**		**X**						**X**
Seabirds	T	*Phoebastria nigripes*	Black-footed albatross	ka'upu	Black-footed Albatross			**X**						**X**
Seabirds	T	*Phoebastria albatrus*	Short-tailed albatross	none	Short-tailed Albatross									**X**
Seabirds	T	*Pterodroma sandwichensis*	Hawaiian petrel	'ua'u	Hawaiian Petrel	**X**		**X**	**X**	**X**	**X**	**X**	**X**	
Seabirds	T	*Pterodroma hypoleuca*	Bonin petrel	none	Bonin Petrel	X		X	X	X	X	X	X	**X**
Seabirds	T	*Bulweria bulwerii*	Bulwer's petrel	'ou	Bulwer's Petrel	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Seabirds	T	*Puffinus pacificus*	Wedge-tailed shearwater	'ua'u kani	Wedge-tailed Shearwater	**X**		**X**	**X**	**X**	**X**		**X**	**X**
Seabirds	T	*Puffinus nativitatis*	Christmas shearwater	none	Christmas Shearwater	**X**		**X**						**X**

*T=terrestrial, F=freshwater, A=anchialine, M=marine
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Seabirds	T	*Puffinus auricularis newelli*	Newell's shearwater	‘a‘o	Newell's Shearwater	**X**		**X?**	**X**	**X?**	**X?**		**X**	
Seabirds	T	*Oceanodroma castro*	Band-rumped storm petrel	‘akē‘akē	Band-rumped Storm Petrel	**X**		X	X	X	**X**	**X**	**X**	
Seabirds	T	*Oceanodroma tristrami*	Tristram's storm petrel	none	Tristram's Storm Petrel									**X**
Seabirds	T	*Phaethon lepturus*	White-tailed tropicbird	koa‘e kea	White-tailed Tropicbird	**X**		**X**	**X**	**X**	**X**		**X**	**X**
Seabirds	T	*Phaethon rubricauda*	Red-tailed tropicbird	koa‘e ‘ula	Red-tailed Tropicbird	**X**		**X**		**X**		**X**		**X**
Seabirds	T	*Sula dactylatra*	Masked (blue-faced) booby	‘ā	Masked (blue-faced) Booby			**X**			**X**			**X**
Seabirds	T	*Sula leucogaster*	Brown booby	‘ā	Brown Booby	**X**		**X**						**X**
Seabirds	T	*Sula sula*	Red-footed booby	‘ā	Red-footed Booby	**X**		**X**						**X**
Seabirds	T	*Fregata minor*	Great frigatebird	‘iwa	Great Frigatebird	**X**		**X**						**X**
Seabirds	T	*Sterna lunata*	Gray-backed tern	pākalakala	Gray-backed Tern			**X**						**X**
Seabirds	T	*Sterna fuscata*	Sooty tern	‘ewa‘ewa	Sooty Tern			**X**						**X**
Seabirds	T	*Anous stolidus*	Brown noddy	noio-kōhā	Brown Noddy			**X**			**X**			**X**
Seabirds	T	*Anous minutus*	Black noddy	noio	Black Noddy	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Seabirds	T	*Procelsterna cerulea*	Blue-gray noddy	none	Blue-gray Noddy									**X**
Seabirds	T	*Gygis alba*	White (Fairy) tern	manu-o-Kū	White (Fairy) Tern			**X**						**X**
Migratory Birds	T/F	*Anas americana*	American wigeon	none	American Wigeon	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**
Migratory Birds	T/F	*Anas clypeata*	Northern shoveler	koloa mōhā	Northern Shoveler	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**
Migratory Birds	T/F	*Anas acuta*	Northern pintail	koloa māpu	Northern Pintail	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**
Migratory Birds	T/F	*Aythya affinis*	Lesser scaup	none	Lesser Scaup	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**
Migratory Birds	T/F/A	*Pluvialis fulva*	Pacific golden plover	kōlea	Pacific Golden Plover	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

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Migratory Birds	T/F/A	*Heteroscelus incanus*	Wandering tattler	ʻūlili	Wandering Tattler	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Migratory Birds	T/F	*Numenius tahitiensis*	Bristle-thighed curlew	kioea	Bristle-thighed Curlew	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
Migratory Birds	T/F/A	*Arenaria interpres*	Ruddy turnstone	ʻakekeke	Ruddy Turnstone	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Migratory Birds	T/F	*Calidris alba*	Sanderling	hunakai	Sanderling	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
NWHI passerines	T	*Acrocephalus familiaris kingi*	Nihoa millerbird	none	Nihoa Millerbird									**X**
NWHI passerines	T	*Telespiza cantans*	Laysan finch	none	Laysan finch									**X**
NWHI passerines	T	*Telespiza ultima*	Nihoa finch	none	Nihoa finch									**X**
Invertebrates	T	*Achatinella spp.*	Oʻahu tree snails	none	Oʻahu Tree Snails			**X**						
Invertebrates	T	*Adelocosa anops*	Kauaʻi cave wolf spider	none	Kauai cave arthropods	**X**								
Invertebrates	T	*Spelaeorchestia koloana*	Kauaʻi cave amphipod	none	Kauai cave arthropods	**X**								
Invertebrates	T	*Manduca blackburni*	Blackburn's sphinx moth	none	Blackburn's Sphinx Moth	X		X	X		**X**	**X**	**X**	
Invertebrates - snails	T	Order Archaeogastropoda	Land snails	none	Land snails	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - snails	T	Order Stylommatophora	Land snails	none	Land snails	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	?
Invertebrates - arachnids	T	Order Acari	Mites and Ticks	none	Mites and Ticks	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - arachnids	T	Order Araneae	Spiders	none	Spiders	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	?

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Invertebrates - arachnids	T	Order Pseudoscorpionida	Pseudoscorpions	none	False Scorpions	**X**		**X**			**X**		**X**	**X**
Invertebrates - insects	T	Order Archaeognatha	Bristlethighs	none	Bristlethighs	**X**		**X**	**X**	**X**	**X**		**X**	?
Invertebrates - insects	T	Order Coleoptera	Beetles	none	Beetles	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Collembola	Springtails	none	Springtails	**X**		**X**	**X**	**X**	**X**		**X**	**X**
Invertebrates - insects	T	Order Dermaptera	Earwigs	none	Earwigs	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Diptera	True flies	none	True flies	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Heteroptera	True bugs	none	True bugs	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Homoptera	Aphids, plant hoppers, leaf hoppers, psyllids, whiteflies, mealybugs, scales, etc.	none	Aphids, Hoppers, Whiteflies, Mealybugs, Scale Insects	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Hymenoptera	Ants, bees, and wasps	none	Bees and Wasps	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Lepidoptera	Moths, butterflies, and hyposmocoma	none	Moths and Butterflies	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - insects	T	Order Neuroptera	Lacewings, antlions	none	Lacewings and antlions	**X**		**X**	**X**	**X**	**X**	**X**	**X**	?
Invertebrates - insects	T	Order Odonata	Damselflies, dragonflies	none	Damselflies and Dragonflies	**X**	**X**	**X**	**X**	**X**	**X**		**X**	?
Invertebrates - insects	T	Order Orthoptera	Grasshoppers, crickets, katydids	none	Crickets and Katydids	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**
Invertebrates - insects	T	Order Phthiraptera	Lice	none	Lice			**X**			**X**		**X**	**X**

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Invertebrates - insects	T	Order Psocoptera	Bark Lice, psocids	none	Bark lice and Psocids	**X**		**X**	**X**	**X**	**X**	**X**	**X**	?
Invertebrates - insects	T	Order Siphonaptera	Fleas	none	Fleas									**X**
Invertebrates - insects	T	Order Thysanoptera	Thrips	none	Thrips	**X**		**X**	**X**	**X**	**X**	**X**	**X**	?
Invertebrates - crustaceans	T	Order Isopoda	Pill-bugs, sowbugs	none	Pill-bugs, Sowbugs, Woodlice, Isopods	**X**		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - myriapods	T	Order Geophilomorpha	Centipedes	none	Centipedes	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Invertebrates - myriapods	T	Order Lithobimorpha	Centipedes	none	Centipedes			**X**		**X**			**X**	**X**
Invertebrates - myriapods	T	Order Polyxenida	Millipedes	none	Millipedes			**X**						
Invertebrates - myriapods	T	Order Spirostreptida	Millipedes	none	Millipedes	**X**		**X**	**X**	**X**	**X**	**X**		?
Fishes	F	*Awaous guamensis*	none	ʻōʻopu nākea	Awaous guamensis	**X**		**X**	**X**		**X**		**X**	
Fishes	F	*Eleotris sandwicensis*	Hawaiian sleeper	ʻōʻopu akupa	Eleotris sandwicensis	**X**		**X**	**X**		**X**		**X**	
Fishes	F	*Lentipes concolor*	ʻOʻopu alamoʻo	ʻōʻopu alamoʻo	Lentipes concolor	**X**		**X**	**X**		**X**		**X**	
Fishes	F	*Sicyopterus stimpsoni*	ʻOʻopu nōpili	ʻōʻopu nōpili	Sicyopterus	**X**		**X**	**X**		**X**		**X**	
Fishes	F	*Stenogobius hawaiiensis*	ʻOʻopu naniha	ʻōʻopu naniha	Stenogobius	**X**		**X**	**X**		**X**		**X**	
Crustaceans	F	*Atyoida bisulcata*	Mountain ʻōpae	ʻōpae kalaʻole	Mountain Shrimp	**X**		**X**	**X**		**X**		**X**	
Crustaceans	F	*Macrobrachium grandimanus*	Hawaiian prawn	ʻōpae ʻoehaʻa	HI Prawn	**X**		**X**	**X**		**X**		**X**	
Molluscs	F	*Clithon cariosus*	none	pipiwai	Clithon Neritilia	**X**		**X**	**X**		**X**		**X**	
Molluscs	F	*Clithon neglectus*	none	hihiwai, pipipi, pipipi kai, pipipi wai	Clithon Neritilia	**X**		**X**	**X**		**X**		**X**	
Molluscs	F	*Erinna aulacospira*	none	none	Erinna Lymnaea	**X**			**X**		**X**		**X**	
Molluscs	F	*Erinna newcombi*	Newcomb's snail	none	Newcomb's Snail	**X**								
Molluscs	F	*Ferrissia sharpi*	none	none	Ferressia	**X**		**X**						

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Molluscs	F	*Lymnaea producta*	none	none	Erinna Lymnaea	**?**		**?**	**?**		**?**		**?**	
Molluscs	F	*Lymnaea rubella*	none	none	Erinna Lymnaea	**?**		**?**	**?**		**?**		**?**	
Molluscs	F	*Neritina granosa*	none	hīhīwai or wi	Neritina Snails	**X**		**X**	**X**		**X**		**X**	
Molluscs	F	*Neritina vespertina*	none	hapawai or Hapakai	Neritina Snails	**X**		**X**	**X**		**X**		**X**	
Flatworm	F	*Oahuhawaiiana kazukolinda*	none	none	Worms			**X**						
Crustaceans	A	*Calliasmata pholidota*	none	none	Anchialine Shrimp						**X**		**X**	
Crustaceans	A	*Carnarimelita janstocki*	none	none	Anchialine Amphipod								**X**	
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	*Holocaridina rubra*	none	ʻōpae ʻula, ʻōpae hiki	Anchialine Shrimp			**X**	**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	*Nuuanu amikai*	none	none	Anchialine Amphipod							**X**		
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**	

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Crustaceans	A	*Procaris hawaiana*	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*	Anchialine pond snail	none	Clithon Neritilia	?		?	?		X		X	
Mammals	M	*Balaenoptera acutorostrata*	Minke whale	none	Baleen Whales									
Mammals	M	*Balaenoptera borealis*	Sei whale	none	Baleen Whales									
Mammals	M	*Balaenoptera edeni*	Bryde's whale	none	Baleen Whales									
Mammals	M	*Balaenoptera musculus*	Blue Whale	none	Baleen Whales									
Mammals	M	*Balaenoptera physalus*	Fin whale	none	Baleen Whales									
Mammals	M	*Eubaleana japonica*	Northern right whale	none	Baleen Whales									
Mammals	M	*Feresa attenuata*	Pygmy killer whale	none	Toothed Whales									
Mammals	M	*Globicephala macrorhynchus*	Short-finned pilot whale	none	Pilot Whale									
Mammals	M	*Grampus griseus*	Risso's dolphin	none	Toothed Whales									
Mammals	M	*Indopacetus pacificus*	Longman's beaked whale	none	Toothed Whales									
Mammals	M	*Kogia breviceps*	Pygmy sperm whale	none	Toothed Whales									
Mammals	M	*Kogia sima*	Dwarf sperm whale	none	Toothed Whales									
Mammals	M	*Lagenodelphis hosei*	Fraser's dolphin	none	Toothed Whales									
Mammals	M	*Megaptera novaeangliae*	Humpback whale	koholā	Humpback Whale									
Mammals	M	*Mesoplodon densirostris*	Blainesville's beaked whale or densebeaked whale	none	Toothed Whales									
Mammals	M	*Monachus schauinslandi*	Hawaiian monk seal	'īlio-holo-i-ka-uaua	Monk Seal									
Mammals	M	*Orcinus orca*	Killer whale	none	Toothed Whales									

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Mammals	M	*Peponocephala electra*	Melon-headed whale	none	Toothed Whales									
Mammals	M	*Physeter macrocephalus*	Sperm whale	none	Toothed Whales									
Mammals	M	*Pseudorca crassidens*	False killer whale	none	False Killer Whale									
Mammals	M	*Stenella attenuata*	Spotted dolphin	nai'a	Spotted Dolphin									
Mammals	M	*Stenella coeruleoalba*	Striped dolphin	none	Toothed Whales									
Mammals	M	*Stenella longirostris*	Spinner dolphin	nai'a	Spinner Dolphin									
Mammals	M	*Steno bredanensis*	Rough-toothed dolphin	nai'a	Toothed Whales									
Mammals	M	*Tursiops truncatus*	Pacific bottlenose dolphin	nai'a	Bottlenose Dolphin									
Mammals	M	*Ziphius cavirostris*	Cuvier's beaked whale	none	Toothed Whales									
Reptiles	M	*Caretta caretta*	Loggerhead sea turtle	none	Loggerhead turtle									
Reptiles	M	*Chelonia mydas*	Green sea turtle	honu	Green sea turtle									
Reptiles	M	*Dermochelys coriacea*	Leatherback sea turtle	none	Leatherback turtle									
Reptiles	M	*Eretmochelys imbricata*	Hawksbill sea turtle	none	Hawksbill turtle									
Reptiles	M	*Lepidochelys olivacea*	Olive Ridley Sea Turtle	none	Olive Ridley Turtle									
Reptiles	M	*Pelamis platurus*	Yellow-bellied sea snake	none	Sea snake									
Sharks	M	*Rhincodon typus*	Whale shark	lele wa'a	Sharks and Rays									
Sharks	M	*Carcharodon carcharias*	Great white shark	niuhi	Sharks and Rays									
Rays	M	*Manta alfredi or birostris*	Manta Ray	none	Sharks and Rays									
Fishes	M	*Acromycter alcocki*	none	none	Eels									
Fishes	M	*Ammodytoides pylei*	Pyle's sand lance	none	Active Reef Fishes									
Fishes	M	*Ammolabrus dicrus*	Sand wrasse	none	Sex Changers									
Fishes	M	*Anampses chrysocephalus*	Psychedelic wrasse	none	Sex Changers									
Fishes	M	*Antennarius commersoni*	Commerson's frogfish	none	Cryptic Reef Fishes									
Fishes	M	*Aphareus rutlians*	Lehi	none	Bottomfishes									
Fishes	M	*Apogon maculiferus*	Spotted cardinalfish	'upāpalu	Cryptic Reef Fishes									
Fishes	M	*Apolemichthys arcuatus*	Bandit angelfish	none	Active Reef Fishes									
Fishes	M	*Aprion virescens*	Green jobfish	uku	Bottomfishes									

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Fishes	M	*Araiophos gracilis*	none	none	Deep Fishes									
Fishes	M	*Argyripnus brocki*	none	none	Deep Fishes									
Fishes	M	*Aseraggodes borehami*	Boreham's sole	none	Flatfishes									
Fishes	M	*Aseraggodes holcomi*	none	none	Flatfishes									
Fishes	M	*Aseraggodes therese*	Therese's sole	none	Flatfishes									
Fishes	M	*Atherinomorus insularum*	Hawaiian silverside (FAO; Randall, 1996a), Togoro (DLNR)	'iao	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									
Fishes	M	*Callechelys lutea*	Yellowspotted snake eel	pūhi	Eels									
Fishes	M	*Callionymus caeruleonotatus*	Bluespotted dragonet	none	Cryptic Reef Fishes									
Fishes	M	*Callionymus comptus*	Ornamented dragonet	none	Cryptic Reef Fishes									
Fishes	M	*Callionymus decoratus*	Decorated dragonet	none	Cryptic Reef Fishes									
Fishes	M	*Calotomus zonarchus*	Yellowbar parrotfish	uhu	Parrotfishes									
Fishes	M	*Cantherhines verecundus*	Shy filefish	'o'ili	Active Reef Fishes									
Fishes	M	*Caracanthus typicus*	Hawaiian orbicular velvetfish	none	Cryptic Reef Fishes									
Fishes	M	*Caranx ignobilis*	Giant Ulua or Trevally	ulua aukea	Bottomfishes									
Fishes	M	*Caranx lugubrius*	Black ulua	gunkan	Bottomfishes									
Fishes	M	*Cataetyx hawaiiensis*	none	none	Deep Fishes									

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Fishes	M	*Centropyge fisheri*	Orange angelfish (AFS), Fisher's angelfish (Hoover, 1993; Randall, 1996a)	none	Active Reef Fishes									
Fishes	M	*Centropyge loricula*	Hawaiian flame angelfish	none	Active Reef Fishes									
Fishes	M	*Chaetodon fremblii*	Bluestriped butterflyfish	kīkākapu	Active Reef Fishes									
Fishes	M	*Chaetodon tinkeri*	Tinker's butterflyfish	none	Active Reef Fishes									
Fishes	M	*Champsodon fimbriatus*	none	none	Deep Fishes									
Fishes	M	*Cheilodactylus vittatus*	Hawaiian morwong	kīkākapu	Active Reef Fishes									
Fishes	M	*Chlorurus perspicilatus*	Spectacled parrtofish	uhu	Parrotfishes									
Fishes	M	*Chromis hanui*	Chocolate-dip chromis	none	Active Reef Fishes									
Fishes	M	*Chromis ovalis*	Oval chromis	none	Active Reef Fishes									
Fishes	M	*Chromis struhsakeri*	Struhsaker's chromis	none	Active Reef Fishes									
Fishes	M	*Cirripectes obscurus*	Gargantuan blenny	pāo'o	Cryptic Reef Fishes									
Fishes	M	*Coris flavovittata*	Yellowstripe coris	hilu	Sex Changers									
Fishes	M	*Coris venusta*	Elegant coris	none	Sex Changers									
Fishes	M	*Cosmocampus balli*	Ball's pipefish	none	Syngnathiformes									
Fishes	M	*Cymolutes lecluse*	Slender razorfish, Hawaiian knifefish (Randall, 1996a; Hoover, 2003), Slender sand wrasse (Hoover, 1993, 2003)	none	Sex Changers									
Fishes	M	*Doryrhamphus baldwini*	Redstripe pipefish	none	Syngnathiformes									
Fishes	M	*Draculo pogognathus*	none	none	Cryptic Reef Fishes									
Fishes	M	*Elops hawaiensis*	Hawaiian ladyfish	awa 'aua	HI Ladyfish									
Fishes	M	*Enchelycore pardalis*	Dragon eel	pūhi-kauila	Eels									
Fishes	M	*Enchelyurus brunneolus*	none	none	Cryptic Reef Fishes									

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Species						Island Distribution (Current (bold) and historic (unbold))								
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Fishes	M	*Encrasicholina purpurea*	Hawaiian anchovy	nehu	Baitfishes									
Fishes	M	*Engyprosopon hawaiiensis*	none	none	Flatfishes									
Fishes	M	*Engyprosopon xenandrus*	none	none	Flatfishes									
Fishes	M	*Enneapterygius atriceps*	Hawaiian triplefin	none	Cryptic Reef Fishes									
Fishes	M	*Entomacrodus marmoratus*	Marbled blenny	pāo'o	Cryptic Reef Fishes									
Fishes	M	*Entomacrodus strasburgi*	Strasburg's blenny	none	Cryptic Reef Fishes									
Fishes	M	*Epigonus devaneyi*	none	none	Deep Fishes									
Fishes	M	*Epigonus glossodontus*	none	none	Deep Fishes									
Fishes	M	*Epinephelus lanceolatus*	Giant grouper	none	Bottomfishes									
Fishes	M	*Epinephelus quernus*	Hawaiian grouper	hāpu'u	Bottomfishes									
Fishes	M	*Etelis carbunculus*	Ehu	ula'ula	Bottomfishes									
Fishes	M	*Etelis coruscans*	Onaga	ula'ula koa'e	Bottomfishes									
Fishes	M	*Etmopterus villosus*	Hawaiian lanternshark	none	Deep Fishes									
Fishes	M	*Eurypegasus papilio*	Hawaiian sea moth	none	Syngnathiformes									
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	*Gadella molokaiensis*	none	none	Deep Fishes									
Fishes	M	*Genicanthus personatus*	Masked angelfish	none	Active Reef Fishes									
Fishes	M	*Glossanodon struhsakeri*	none	none	Deep Fishes									
Fishes	M	*Gonorynchus moseleyi*	salmon (AFS), Beaked sandfish (FAO)	none	Deep Fishes									
Fishes	M	*Gorgasia hawaiiensis*	Hawaiian garden eel	pūhi	Eels									
Fishes	M	*Grammonus waikiki*	none	none	Deep Fishes									
Fishes	M	*Gymnothorax nuttingi*	Nutting's moray	none	Eels									
Fishes	M	*Gymnothorax polyspondylus*	Manyvertebrae moray	none	Eels									
Fishes	M	*Gymnothorax steindachneri*	Steindachner's moray	pūhi	Eels									
Fishes	M	*Halicampus edmondsoni*	Edmondson's pipefish	none	Syngnathiformes									

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Species						Island Distribution (Current (bold) and historic (unbold))								
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Fishes	M	*Halieutaea retifera*	none	none	Deep Fishes									
Fishes	M	*Hippocampus fisheri*	Fisher's seahorse	none	Syngnathiformes									
Fishes	M	*Hippocampus histrix*	Spiny seahorse	none	Syngnathiformes									
Fishes	M	*Hippocampus kuda*	Yellow seahorse	none	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*	Blackside razorfish (Hoover, 1993, 2003; Randall, 1996a), Nabeta (DLNR)	lae-nihi	Sex Changers									
Fishes	M	*Iso hawaiiensis*	Hawaiian surf sardine	none	Baitfishes									
Fishes	M	*Istiblennius zebra*	Zebra blenny	pāo'o	Cryptic Reef Fishes									
Fishes	M	*Kuhlia xenura*	Hawaiian flagtail (Hoover, 1993, 2003; Randall, 1996a), Mountain bass (DLNR)	āholehole	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*	Sunset bass (Hoover, 1994)	none	Sex Changers									
Fishes	M	*Lophiodes bruchius*	none	none	Deep Fishes									
Fishes	M	*Luciobrotula lineata*	none	none	Deep Fishes									
Fishes	M	*Malacocephalus hawaiiensis*	Hawaiian softhead grenadier	none	Deep Fishes									
Fishes	M	*Microbrotula rubra*	none	none	Deep Fishes									
Fishes	M	*Nezumia ectenes*	none	none	Deep Fishes									

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Fishes	M	*Nezumia holocentra*	none	none	Deep Fishes									
Fishes	M	*Ophichthus fowleri*	Fowler's snake eel	none	Eels									
Fishes	M	*Ophichthus kunaloa*	none	none	Eels									
Fishes	M	*Osopsaron incisum*	none	none	Deep Fishes									
Fishes	M	*Ostracion whitleyi*	Whitley''s boxfish	none	Active Reef Fishes									
Fishes	M	*Oxyurichthys heisei*	Ribbon goby	none	Cryptic Reef Fishes									
Fishes	M	*Oxyurichthys lonchotus*	none	none	Cryptic Reef Fishes									
Fishes	M	*Parabothus chlorospilus*	none	none	Flatfishes									
Fishes	M	*Parupeneus porphyreus*	Whitesaddle goatfish (AFS; Hoover, 1993, 2003; Randall, 1996a), Red goat fish (DLNR)	kūmū	Kumu									
Fishes	M	*Physiculus sterops*	none	none	Deep Fishes									
Fishes	M	*Plagiotremus ewaensis*	Ewa blenny	none	Cryptic Reef Fishes									
Fishes	M	*Plagiotremus goslinei*	Scale-eating blenny	none	Cryptic Reef Fishes									
Fishes	M	*Plectroglyphidodon sindonis*	Hawaiian rock damselfish	none	Active Reef Fishes									
Fishes	M	*Pleurosicya larsonae*	none	none	Cryptic Reef Fishes									
Fishes	M	*Poecilopsetta hawaiiensis*	none	none	Flatfishes									
Fishes	M	*Priacanthus meeki*	Hawaiian bigeye	ʻāweoweo	Active Reef Fishes									
Fishes	M	*Pristipomoides auricillia*	Glodflag jobfish	kali kali	Bottomfishes									
Fishes	M	*Pristipomoides filamentosus*	ʻŌpakapaka	none	Bottomfishes									
Fishes	M	*Pristipomoides sieboldi*	Kalekale	none	Bottomfishes									
Fishes	M	*Pristipomoides zonatus*	Gindai	ukikiki	Bottomfishes									
Fishes	M	*Pseudanthias thompsoni*	Hawaiian anthias	none	Sex Changers									
Fishes	M	*Pseudocaranx dentex*	Thick or Pig Ulua	butaguchi	Bottomfishes									
Fishes	M	*Pseudogramma polyacanthum hawaiiensis*	Palespotted podge	none	Sex Changers									
Fishes	M	*Psilogobius mainlandi*	Mainland's goby	none	Cryptic Reef Fishes									

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Species						Island Distribution (Current (bold) and historic (unbold))								
Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	Ni'ihau	O'ahu	Moloka'i	Lāna'i	Maui	Kaho'olawe	Hawai'i	NWHI
Fishes	M	*Pterois sphex*	Hawaiian turkeyfish (AFS; Randall, 1996a; Hoover, 2003), Hawaiian lionfish (Hoover, 1993, 2003)	nohu pinao	Cryptic Reef Fishes									
Fishes	M	*Pycnocraspedum armatum*	none	none	Deep Fishes									
Fishes	M	*Saccogaster hawaii*	none	none	Deep Fishes									
Fishes	M	*Samariscus corallinus*	Coralline-red flounder	none	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*	Bigmouth scorpionfish (FAO), Shortnose scorpionfish (Randall, 1996a)	none	Cryptic Reef Fishes									
Fishes	M	*Scorpaenopsis cacopsis*	Titan scorpionfish (Hoover, 1993, 2003; Randall, 1996a), Hogo (DLNR)	nohu	Cryptic Reef Fishes									
Fishes	M	*Scorpaenopsis pluralis*	none	none	Cryptic Reef Fishes									
Fishes	M	*Seriola dumerili*	Amberjack	kahala	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									

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Fishes	M	*Torquigener randalli*	Randall's puffer	none	Active Reef Fishes									
Fishes	M	Undescribed *Anarchias* species	none	none	Eels									
Fishes	M	Undescribed *Bodianus* species	Hawaiian Pigfish	none	Sex Changers									
Fishes	M	Undescribed *Prognathodes* species	Orange-margin butterflyfish	none	Active Reef Fishes									
Fishes	M	*Ventrifossa ctenomelas*	Hawaiian grenadier	none	Deep Fishes									
Ascideans	M	*Aplidium crateriferum*	Cratered Aplidium	none	Misc Filter Feeders									
Ascideans	M	*Aplidium sp.*	Gold Ring Aplidium	none	Misc Filter Feeders									
Brachiopoda	M	*Lingula reevii*	Brachiopod	none	Misc Filter Feeders									
Bryozoa	M	*Parasmittina sp.*	none	none	Misc Filter Feeders									
Cephalopods	M	*Euprymna scolopes*	Hawaiian Bobtail Squid	mūhe'e	Cephalopods									
Cephalopods	M	*Octopus hawaiiensis*	Hawaiian Octopus	he'e	Cephalopods									
Crustaceans	M	*Aethra edentata*	Flat elbow crab	none	Other Crustaceans									
Crustaceans	M	*Aniculus hopperae*	Hopper's hermit crab	unauna	Other Crustaceans									
Crustaceans	M	*Calcinus hazletti*	Hazlett's hermit crab	unauna	Other Crustaceans									
Crustaceans	M	*Calcinus laurentae*	Laurent's hermit crab	unauna	Other Crustaceans									
Crustaceans	M	*Carpilius maculatus*	7-11 crab	'alakuma	Other Crustaceans									
Crustaceans	M	*Cinetorhynchus hawaiiensis*	Hawaiian hinge-beak shrimp	none	Other Crustaceans									
Crustaceans	M	*Cinetorhynchus hendersoni*	Henderson's hinge-beak shrimp	none	Other Crustaceans									
Crustaceans	M	*Dromia dormia*	Sponge crab	makua-o-ka-lipoa	Other Crustaceans									
Crustaceans	M	*Gnathophyllum precipuum*	Hawaiian cave shrimp	none	Other Crustaceans									
Crustaceans	M	*Hymenocera picta*	Harlequin shrimp	none	Other Crustaceans									
Crustaceans	M	*Levicaris mammilata*	Red Pencil urchin shrimp	none	Other Crustaceans									
Crustaceans	M	*Ligia hawaiensis*	none	none	Other Crustaceans									
Crustaceans	M	*Liomera supernodosa*	Knotted liomera	none	Other Crustaceans									
Crustaceans	M	*Lybia edmondsoni*	Hawaiian pom-pom crab	kū mimi pua	Other Crustaceans									

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Species						*Island Distribution (Current (bold) and historic (unbold))*								
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Crustaceans	M	*Metapenaeopsis sp.*	Bicolor sand shrimp	none	Other Crustaceans									
Crustaceans	M	*Panulirus marginatus*	black leg spiny lobster	ula poni, ula hiwa	Black Spiny Lobster									
Crustaceans	M	*Pseudopalicus oahuensis*	Button crab	none	Other Crustaceans									
Crustaceans	M	*Rhynchocinetes rathbunae*	Rathbun's hinge beaked shrimp	none	Other Crustaceans									
Crustaceans	M	*Stenopus earlei*	Earle's coral shrimp	none	Other Crustaceans									
Molluscs	M	*Acanthochiton viridis*	Green chiton	kuakulu	Chitons									
Molluscs	M	*Aldisa pikokai*	Pitted Nudibranch	none	Nudibranchs									
Molluscs	M	*Ardeadoris scottjohnsoni*	Scott Johnson's Nudibranch	none	Nudibranchs									
Molluscs	M	*Brachidontes crebristriarus*	Hawaiian mussel	nahawele li'ili'i	Bivalves									
Molluscs	M	*Cellana exarata*	Black foot limpet	'opihi makaiauli	Limpets									
Molluscs	M	*Cellana melanostoma*	Green -foot opihi	none	Limpets									
Molluscs	M	*Cellana sandwicensis*	Yellow foot limpet	'opihi 'ālinalina	Limpets									
Molluscs	M	*Cellana talcosa*	Yellow foot limpet	'opihi kō'ele	Limpets									
Molluscs	M	*Charonia tritonis*	Triton's trumpet	pū	Snails									
Molluscs	M	*Chicoreus insularum*	Burnt murex	none	Snails									
Molluscs	M	*Chromodoris vibrata*	Trembling Nudibranch	none	Nudibranchs									
Molluscs	M	*Conus abbreviatus*	Abbreviated cone	pū pū 'alā	Snails									
Molluscs	M	*Cypraea burgessi*	Burgess' cowry	none	Snails									
Molluscs	M	*Cypraea gaskoini*	Gaskoin's cowry	leho	Snails									
Molluscs	M	*Cypraea granulata*	Granulated cowry	leho	Snails									
Molluscs	M	*Cypraea mauiensis*	Maui cowry	leho	Snails									
Molluscs	M	*Cypraea ostergaardi*	none	leho	Snails									
Molluscs	M	*Cypraea rasleighana*	Rashleigh's cowry	leho	Snails									
Molluscs	M	*Cypraea semiplota*	"Half-swimmer" cowry	pū leholeho	Snails									
Molluscs	M	*Cypraea sulcidentata*	Groove-toothed cowry	leho	Snails									
Molluscs	M	*Cypraea tessallata*	Checkered cowry	leho	Snails									
Molluscs	M	*Cypraea tigris*	Tiger cowry	none	Snails									
Molluscs	M	*Duplicaria gouldi*	Gould's Auger	pūpū loloa, 'oi'oi	Snails									

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Molluscs	M	*Epitonium ulu*	Fungiid wentletrap	none	Snails									
Molluscs	M	*Glossodoris poliahu*	Snow-Goddess Nudibranch	none	Nudibranchs									
Molluscs	M	*Halgerda terramtuentis*	Gold Lace Nudibranch	none	Nudibranchs									
Molluscs	M	*Haumea juddi*	Judd's scallop	none	Bivalves									
Molluscs	M	*Hypselodoris andersoni*	Anderson's Nudibranch	none	Nudibranchs									
Molluscs	M	*Ischnochiton petaloides*	Flat chiton	pupu mo'o	Chitons									
Molluscs	M	*Isognomon californicum*	Black purse shells	nahawele	Bivalves									
Molluscs	M	*Melibe megaceras*	Dendronotid	none	Nudibranchs									
Molluscs	M	*Nerita picea*	Black Nerite	pipipi, pipipi kai	Snails									
Molluscs	M	*Nerita plicata*	none	none	Snails									
Molluscs	M	*Nerita polita*	Polished nerite	kūpe'e	Snails									
Molluscs	M	*Peltodoris fellowsi*	Fellow's nudibranch	none	Nudibranchs									
Molluscs	M	*Pinctada margaritifera*	Pearl oyster	pa	Bivalves									
Molluscs	M	*Pteria brunnea*	Winged pearl oyster	none	Bivalves									
Molluscs	M	*Sclerodoris paliensis*	Pali Nudibranch	none	Nudibranchs									
Molluscs	M	*Smaragdia bryannae*	HI sea grass snail	none	Snails									
Molluscs	M	*Strombus vomer hawaiiensis*	Hawaiian Stromb	none	Snails									
Molluscs	M	*Turbo sandwicensis*	Hawaiian Turban	'ailea	Snails									
Molluscs	M F	*Ostrea sandvicensis*	Hawaiian Oyster	none	HI Oyster									
Sponge	M	*Spongia oceania*	none	none	Sponge									
Echinoderm	M	*Actinocidaris thomasi*	Thomas's sea urchin	none	Echinoderms									
Echinoderm	M	*Lissodiadema purpureum*	Fine-spined urchin	none	Echinoderms									
Echinoderm	M	*Lovenia hawaiiensis*	Hawaiian lovenia	none	Echinoderms									
Echinoderm	M	*Mithrodia fisheri*	Fisher's star	none	Echinoderms									
Echinoderm	M	*Stichopus sp.1*	Hawaiian spiny sea cucumber	none	Echinoderms									
Echinoderm	M	*Stichopus sp.2*	Hawaiian yellow-tip sea cucumber	none	Echinoderms									

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Flatworm	M	*Pericelis hymanae Poulter*	Hyman's flatworm	none	Worms									
Flatworm	M	*Pseudobiceros sp. 2*	Hawaiian spotted flatworm	none	Worms									
Annelida	M	*Vermiliopsis torquata*	none	none	Worms									
Nemertea	M	*Baseodiscus cingulatus*	Banded Ribbon Worm	ko'ekai	Worms									
Cnidaria	M	*Acabaria bicolor*	Bicolor Gorgonian	none	Other Anthozoans									
Cnidaria	M	*Acropora cytherea*	Table coral	none	Stony Corals									
Cnidaria	M	*Acropora gemmifera*	none	none	Stony Corals									
Cnidaria	M	*Acropora humilis*	Finger staghorn coral	none	Stony Corals									
Cnidaria	M	*Acropora nasuta*	Branching staghorn coral	none	Stony Corals									
Cnidaria	M	*Acropora paniculata*	Fuzzy table coral	none	Stony Corals									
Cnidaria	M	*Acropora valida*	Bushy Staghorn coral	none	Stony Corals									
Cnidaria	M	*Anacropora sp.*	none	none	Stony Corals									
Cnidaria	M	*Anisopsammia ampheiliodes*	none	none	Stony Corals									
Cnidaria	M	*Anthelia edmondsoni*	Blue soft coral	'okole	Other Anthozoans									
Cnidaria	M	*Anthemiphyllia pacifica*	none	none	Stony Corals									
Cnidaria	M	*Antipathes dichotoma*	Branching Black coral	none	Black Corals									
Cnidaria	M	*Antipathes grandis*	Grand Black coral	'ekaha kū moana	Black Corals									
Cnidaria	M	*Antipathes intermedia*	Small feathery black coral	none	Black Corals									
Cnidaria	M	*Antipathes punctata*	none	none	Black Corals									
Cnidaria	M	*Antipathes subpinnata*	none	none	Black Corals									
Cnidaria	M	*Antipathes undulata*	none	none	Black Corals									
Cnidaria	M	*Balanophyllia desmophylloides*	none	none	Stony Corals									
Cnidaria	M	*Balanophyllia diomedeae*	none	none	Stony Corals									
Cnidaria	M	*Balanophyllia hawaiiensis*	none	none	Stony Corals									
Cnidaria	M	*Balanophyllia laysanensis*	none	none	Stony Corals									
Cnidaria	M	*Balanophyllia sp.*	Oval cup coral	none	Stony Corals									
Cnidaria	M	*Bathyactis hawaiiensis*	none	none	Stony Corals									

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Cnidaria	M	*Caryophyllia alcocki*	none	none	Stony Corals									
Cnidaria	M	*Caryophyllia octopalli*	none	none	Stony Corals									
Cnidaria	M	*Ceratotrochus laxus*	none	none	Stony Corals									
Cnidaria	M	*Cirrhipathes anguina*	Common wire coral	none	Black Corals									
Cnidaria	M	*Cladactella manni*	Mann's Anemone	ʻokole, ʻokola	Other Anthozoans									
Cnidaria	M	*Coscinaraea wellsi*	Wells coral	none	Stony Corals									
Cnidaria	M	*Cyathoceras diomedae*	none	none	Stony Corals									
Cnidaria	M	*Cycloseris fragilis*	Fragile mushroom coral	none	Stony Corals									
Cnidaria	M	*Cycloseris hexagonalis*	Humpback Coral	none	Stony Corals									
Cnidaria	M	*Cyphastrea ocellina*	Ocellated coral	ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Deltocyathus andamanicus*	none	none	Stony Corals									
Cnidaria	M	*Dendrophyllia oahensis*	none	none	Stony Corals									
Cnidaria	M	*Dendrophyllia serpentina*	Serpentine cup coral	none	Stony Corals									
Cnidaria	M	*Desmophyllum cristagallis*	none	none	Stony Corals									
Cnidaria	M	*Diaseris distorta*	Distorted mushroom coral	none	Stony Corals									
Cnidaria	M	*Endopachys oahensis*	none	none	Stony Corals									
Cnidaria	M	*Flabellum deludens*	none	none	Stony Corals									
Cnidaria	M	*Flabellum pavoninum*	none	none	Stony Corals									
Cnidaria	M	*Fungia granulosa*	Granulated mushroom coral	none	Stony Corals									
Cnidaria	M	*Fungia scutaria*	Mushroom coral	ākoʻakoʻakohe	Stony Corals									
Cnidaria	M	*Fungia sp.*	none	none	Stony Corals									
Cnidaria	M	*Gardineria hawaiensis*	none	none	Stony Corals									
Cnidaria	M	*Gardineroseris planulata*	Honeycomb coral	none	Stony Corals									
Cnidaria	M	*Heteractis malu*	HI sand anemone	none	Other Anthozoans									
Cnidaria	M	*Leiopathes glaberrima*	none	none	Black Corals									
Cnidaria	M	*Leptastrea bewickensis*	Bewick coral	none	Stony Corals									
Cnidaria	M	*Leptastrea bottae*	none	ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Leptastrea pruinosa*	Spotted coral	none	Stony Corals									

APPENDIX A: WILDLIFE (FAUNA) SPECIES OF GREATEST CONSERVATION NEED

Species						Island Distribution (Current (bold) and historic (unbold))								
Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	Ni'ihau	O'ahu	Moloka'i	Lāna'i	Maui	Kaho'olawe	Hawai'i	NWHI
Cnidaria	M	*Leptastrea purpurea*	Crust coral	none	Stony Corals									
Cnidaria	M	*Leptastrea transversa*	Transverse coral	none	Stony Corals									
Cnidaria	M	*Leptoseris foliosa*	Foliose coral	none	Stony Corals									
Cnidaria	M	*Leptoseris hawaiiensis*	Hawaiian plate coral	none	Stony Corals									
Cnidaria	M	*Leptoseris incrustans*	Swelling coral	none	Stony Corals									
Cnidaria	M	*Leptoseris myctoseroides*	Ridge coral	none	Stony Corals									
Cnidaria	M	*Leptoseris papyracea*	Papyrus coral	none	Stony Corals									
Cnidaria	M	*Leptoseris scabra*	Rough plate coral	none	Stony Corals									
Cnidaria	M	*Leptoseris tubulifera*	Tube coral	none	Stony Corals									
Cnidaria	M	*Madracis kauaiensis*	none	none	Stony Corals									
Cnidaria	M	*Madracis pharensis*	Hidden orange coral	none	Stony Corals									
Cnidaria	M	*Madrepora kauaiensis*	none	none	Stony Corals									
Cnidaria	M	*Montipora capitata*	Rice Coral	none	Stony Corals									
Cnidaria	M	*Montipora dilatata*	Irregular rice coral	none	Stony Corals									
Cnidaria	M	*Montipora flabellata*	Blue Rice Coral	none	Stony Corals									
Cnidaria	M	*Montipora patula*	Spreading Coral	none	Stony Corals									
Cnidaria	M	*Montipora studeri*	Branching rice coral	none	Stony Corals									
Cnidaria	M	*Montipora tuberculosa*	none	none	Stony Corals									
Cnidaria	M	*Montipora turgescens*	Lumpy rice coral	none	Stony Corals									
Cnidaria	M	*Montipora verrilli*	none	none	Stony Corals									
Cnidaria	M	*Myriopathes cf. japonica*	Dense feathery black coral	none	Black Corals									
Cnidaria	M	*Myriopathes ulex*	Feathery Black coral	none	Black Corals									
Cnidaria	M	*Palythoa psammophilia*	Toadstool Zoanthid	none	Other Anthozoans									
Cnidaria	M	*Palythoa toxica*	Toadstool Zoanthid	none	Other Anthozoans									
Cnidaria	M	*Paracyathus gardineri*	none	none	Stony Corals									
Cnidaria	M	*Paracyathus mauiensis*	none	none	Stony Corals									
Cnidaria	M	*Paracyathus molokensis*	none	none	Stony Corals									
Cnidaria	M	*Paracyathus tenuicalyz*	none	none	Stony Corals									
Cnidaria	M	*Parantipathes*	none	none	Black Corals									

*T=terrestrial, F=freshwater, A=anchialine, M=marine
Blue: ESA threatened/endangered; Yellow: ESA Candidate

APPENDIX A: WILDLIFE (FAUNA) SPECIES OF GREATEST CONSERVATION NEED

Species						Island Distribution (Current (bold) and historic (unbold))								
Group	Habitat*	Scientific Name	Common Name	Hawaiian Name	Fact sheet	Kaua'i	Ni'ihau	O'ahu	Moloka'i	Lāna'i	Maui	Kaho'olawe	Hawai'i	NWHI
Cnidaria	M	*Parazoanthus sp.*	none	none	Other Anthozoans									
Cnidaria	M	*Pavona duerdeni*	Flat lobe coral	none	Stony Corals									
Cnidaria	M	*Pavona pollicata*	none	none	Stony Corals									
Cnidaria	M	*Pavona varians*	Corrugated coral	ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Placotrochus fuscus*	none	none	Stony Corals									
Cnidaria	M	*Pocillopora damicornis*	Lace coral	ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Pocillopora eydouxi*	Antler coral	none	Stony Corals									
Cnidaria	M	*Pocillopora ligulata*	Thin cauliflower coral	none	Stony Corals									
Cnidaria	M	*Pocillopora meandrina*	Cauliflower coral	none	Stony Corals									
Cnidaria	M	*Pocillopora molokensis*	Molokai cauliflower coral	none	Stony Corals									
Cnidaria	M	*Porites annae*	Nodule coral	none	Stony Corals									
Cnidaria	M	*Porites bernardi*	False lichen coral	none	Stony Corals									
Cnidaria	M	*Porites brighami*	Brighams coral	none	Stony Corals									
Cnidaria	M	*Porites compressa*	Finger coral	pō haku puna, ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Porites convexa*	Plate and knob coral	none	Stony Corals									
Cnidaria	M	*Porites duerdeni*	Thick finger coral	none	Stony Corals									
Cnidaria	M	*Porites evermanni*	Evermann's coral	pō haku puna, ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Porites lichen*	Lichen coral	none	Stony Corals									
Cnidaria	M	*Porites lobata*	Lobe coral	pō haku puna, ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Porites pukoensis*	none	none	Stony Corals									
Cnidaria	M	*Porites rus*	Plate and Pillar Coral	none	Stony Corals									
Cnidaria	M	*Porites solida*	Solid coral	none	Stony Corals									
Cnidaria	M	*Porites studeri*	Deep lobe coral	none	Stony Corals									
Cnidaria	M	*Psammocora explanulata*	Flat coral	none	Stony Corals									
Cnidaria	M	*Psammocora haimeana*	Haime's lump coral	none	Stony Corals									
Cnidaria	M	*Psammocora nierstraszi*	Nierstrasz''s coral	none	Stony Corals									

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Blue: ESA threatened/endangered; Yellow: ESA Candidate

APPENDIX A: WILDLIFE (FAUNA) SPECIES OF GREATEST CONSERVATION NEED

Species						*Island Distribution (Current (bold) and historic (unbold))*								
Group	**Habitat***	**Scientific Name**	**Common Name**	**Hawaiian Name**	**Fact sheet**	***Kaua'i***	***Ni'ihau***	***O'ahu***	***Moloka'i***	***Lāna'i***	***Maui***	***Kaho'olawe***	***Hawai'i***	***NWHI***
Cnidaria	M	*Psammocora stellata*	Stellar coral	ʻākoʻakoʻa	Stony Corals									
Cnidaria	M	*Psammocora superficialis*	Superficial coral	none	Stony Corals									
Cnidaria	M	*Psammocora verrilli*	Verril's lump coral	none	Stony Corals									
Cnidaria	M	*Rhizopsammia verrilli*	Verrill's lump coral	none	Stony Corals									
Cnidaria	M	*Schizopathes conferta*	none	none	Black Corals									
Cnidaria	M	*Sinularia molokaiensis*	Hawaiian Leather Coral	none	Other Anthozoans									
Cnidaria	M	*Stephanophyllia formosissima*	none	none	Stony Corals									
Cnidaria	M	*Stichopathes cf. echinulata*	Red wire coral	none	Black Corals									
Cnidaria	M	*Tethocyathus minor*	Tiny cup coral	none	Stony Corals									
Cnidaria	M	*Trochocyathus oahensis*	none	none	Stony Corals									
Cnidaria	M	*Tubastraea coccinea*	Colonial cup coral	none	Stony Corals									
Cnidaria	M	*Tubastraea diaphana*	Black cup coral	none	Stony Corals									
Cnidaria	M	*Zoanthus kealakekuaensis*	Green mat Zoanthid	none	Other Anthozoans									

Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Abutilon	*eremitopetalum*				X	X	
Abutilon	*menziesii*				X		
Abutilon	*sandwicense*				X		
Acacia	*koa*			koa			X
Acacia	*koaia*			koaia; koa oha			X
Acaena	*exigua*				X		
Achyranthes	*mutica*				X		
Achyranthes	*splendens*	var.	*rotundata*		X		
Adenophorus	*periens*				X		
Alectryon	*macrococcus*	var.	*auwahiensis*	mahoe	X	X	
Alectryon	*macrococcus*	var.	*macrococcus*		X		
Alphitonia	*ponderosa*			kauila			X
Alyxia	*oliviformis*			maile			X
Amaranthus	*brownii*				X	X	
Antidesma	*platyphyllum*			hame			X
Argyroxiphium	*kauense*				X		
Argyroxiphium	*sandwicense*	subsp.	*sandwicense*	'ahinahina	X		X
Argyroxiphium	*sandwicense*	subsp.	*macrocephalum*	'ahinahina	X		X
Asplenium	*peruvianum*	var.	*insulare*		X		
Astelia	*menziesiana*			pa'iniu			X
Astelia	*waialealae*			pa'iniu	X	X	
Athyrium	*microphyllum*			'akolea			X
Bidens	*campylotheca*	subsp.	*waihoiensis*		X		
Bidens	*hillebrandiana*	subsp.	*hillebrandiana*	ko'oko'olau		X	
Bidens	*micrantha*	subsp.	*ctenophylla*		X		
Bidens	*micrantha*	subsp.	*kalealaha*		X		
Bidens	*spp.*			kokolau, ko'oko'olau			X
Bidens	*wiebkei*				X		
Bobea	*elatio*			ahakea			X
Bobea	*mannii*			ahakea			X
Boehmeria	*grandis*						X
Bolboschoenus	*maritimus*	subsp.	*paludosus*				X
Bonamia	*menziesii*				X		
Brighamia	*insignis*			'olulu	X	X	
Brighamia	*rockii*				X		
Broussaisia	*arguta*			kanawao			X
Caesalpinia	*kavaiensis*			uhiuhi	X		X
Canavalia	*molokaiensis*				X		

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Canavalia	*pubescens*				X		
Canthium	*odoratum*			alahe'e			X
Capparis	*sandwichiana*			maiapilo			X
Carex	*alligata*						X
Carex	*spp.*			sedge			X
Cenchrus	*agrimonioides*	var.	*agrimonioides*		X		
Centaurium	*sebaeoides*				X		
Chamaesyce	*celastroides*	var.	*kaenana*	'akoko	X		X
Chamaesyce	*deppeana*				X		
Chamaesyce	*eleanoriae*					X	
Chamaesyce	*halemanui*				X		
Chamaesyce	*herbstii*				X		
Chamaesyce	*kuwaleana*				X		
Chamaesyce	*olowaluana*			akoko			X
Chamaesyce	*rockii*				X		
Chamaesyce	*skottsbergii*	var.	*skottsbergii*		X		
Charpentiera	*obovata*			papala			X
Charpentiera	*spp.*			papala			X
Cheirodendron	*platyphyllum*			lapalapa			X
Cheirodendron	*trigynum*			'olapa			X
Chenopodium	*oahuense*			'aweoweo			X
Cibotium	*chamissoi*			hapu'u			X
Cibotium	*glaucum*			hapu'u			X
Cibotium	*spp.*			hapu'u			X
Cladium	*jamaicense*			'uki			X
Claoxylon	*sandwicense*			pooloa			X
Clermontia	*clermontioides*			ohawai			X
Clermontia	*drepanomorpha*				X		
Clermontia	*fauriei*			haha'aiakamanu			X
Clermontia	*lindseyana*				X		
Clermontia	*oblongifolia*	subsp.	*brevipes*	'oha wai	X	X	
Clermontia	*oblongifolia*	subsp.	*mauiensis*	'oha wai	X	X	
Clermontia	*peleana*	subsp.	*peleana*	'oha wai	X	X	
Clermontia	*pyrularia*			'oha wai	X	X	
Clermontia	*samuelii*	subsp.	*hanaensis*		X		
Clermontia	*samuelii*	subsp.	*samuelii*		X		
Clermontia	*spp.*			oha, 'oha wai, haha, oha kepau			X
Colubrina	*oppositifolia*				X		

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Coprosma	*elliptica*			pilo			X
Coprosma	*ernodeoides*			kukainene			X
Coprosma	*kauensis*			pilo			X
Coprosma	*menziesii*			pilo			X
Coprosma	*montana*			pilo			X
Coprosma	*ochracea*			pilo			X
Coprosma	*pubens*			pilo			X
Coprosma	*rhynchocarpa*			pilo			X
Coprosma	*spp.*			pilo			X
Cryptocarya	*mannii*			holio			X
Ctenitis	*squamigera*				X		
Cyanea	*acuminata*				X		
Cyanea	*asarifolia*			haha	X	X	
Cyanea	*asplenifolia*				X		
Cyanea	*copelandii*	subsp.	*copelandii*		X		
Cyanea	*copelandii*	subsp.	*haleakalaensis*		X		
Cyanea	*crispa*				X	X	
Cyanea	*dunbariae*			haha	X	X	
Cyanea	*eleeleensis*			haha	X	X	
Cyanea	*gibsonii*			haha	X	X	
Cyanea	*glabra*			haha	X	X	
Cyanea	*grimesiana*	subsp.	*grimesiana*	haha	X	X	
Cyanea	*grimesiana*	subsp.	*obatae*	haha	X	X	
Cyanea	*hamatiflora*	subsp.	*carlsonii*	haha	X	X	
Cyanea	*hamatiflora*	subsp.	*hamatiflora*		X		
Cyanea	*horrida*			haha		X	
Cyanea	*humboldtiana*				X		
Cyanea	*koolauensis*				X		
Cyanea	*kuhihewa*			haha	X	X	
Cyanea	*lobata*	subsp.	*lobata*	haha	X	X	
Cyanea	*longiflora*				X		
Cyanea	*magnicalyx*			haha		X	
Cyanea	*mannii*				X		
Cyanea	*mceldowneyi*				X		
Cyanea	*munroi*			haha		X	
Cyanea	*obtusa*			haha	X	X	
Cyanea	*pinnatifida*			haha	X	X	
Cyanea	*platyphylla*			'aku'aku	X	X	

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Cyanea	*procera*			haha	X	X	
Cyanea	*profuga*			haha		X	
Cyanea	*purpurellifolia*			haha		X	
Cyanea	*recta*				X		
Cyanea	*remyi*				X		
Cyanea	*rivularis*				X		
Cyanea	*sessilifolia*				X		
Cyanea	*shipmanii*			haha	X	X	
Cyanea	*solanacea*			popolo, haha nui		X	
Cyanea	*spp.*						X
Cyanea	*st.-johnii*			haha	X	X	
Cyanea	*stictophylla*			haha	X	X	
Cyanea	*superba*	subsp.	*superba*	haha	X	X	
Cyanea	*superba*	subsp.	*regina*		X		
Cyanea	*tritomantha*			aku			X
Cyanea	*truncata*			haha	X	X	
Cyanea	*undulata*			haha	X	X	
Cyclosorus	*interruptus*			neke fern			X
Cyperus	*fauriei*				X		
Cyperus	*laevigatus*			makaloa			X
Cyperus	*odoratus*					X	
Cyperus	*pennatiformis*	var.	*bryanii*		X		
Cyperus	*pennatiformis*	var.	*pennatiformis*		X		
Cyperus	*trachysanthos*				X		
Cyrtandra	*crenata*				X		
Cyrtandra	*cyaneoides*				X		
Cyrtandra	*dentata*				X		
Cyrtandra	*filipes*				X		
Cyrtandra	*giffardii*				X		
Cyrtandra	*gracilis*			ha'iwale		X	
Cyrtandra	*halawensis*			ha'iwale		X	
Cyrtandra	*hematos*			ha'iwale		X	
Cyrtandra	*kaulantha*			ha'iwale		X	
Cyrtandra	*kealiae*	subsp.	*kealiae*		X		
Cyrtandra	*munroi*				X		
Cyrtandra	*oxybapha*				X		
Cyrtandra	*paliku*			ha'iwale		X	
Cyrtandra	*polyantha*				X		

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Cyrtandra	*sessilis*			ha'iwale	X	X	
Cyrtandra	*spp.*						X
Cyrtandra	*subumbellata*				X		
Cyrtandra	*tintinnabula*				X		
Cyrtandra	*viridiflora*				X		
Cyrtandra	*waiolani*			ha'iwale		X	
Delissea	*niihauensis*	subsp.	*kauaiensis*		X	X	
Delissea	*niihauensis*	subsp.	*niihauensis*		X		
Delissea	*rhytidosperma*				X	X	
Delissea	*rivularis*			haha		X	
Delissea	*subcordata*				X	X	
Delissea	*undulata*				X	X	X
Deschampsia	*nubigena*						X
Dianella	*odorata*			uki			X
Dicranopteris	*linearis*			'uluhe			X
Diellia	*erecta*				X		
Diellia	*falcata*				X		
Diellia	*mannii*					X	
Diellia	*pallida*				X	X	
Diellia	*unisora*				X		
Diospyros	*sandwicensis*			lama			X
Diplazium	*molokaiense*				X	X	
Diplazium	*sanwichiananum*			ho'i'o			X
Dodonaea	*viscosa*			'a'ali'I			X
Dracaena	*aurea*			halapepe			X
Dryopteris	*angelica*					X	
Dryopteris	*crinalis*	var.	*podosorus*			X	
Dryopteris	*spp.*						X
Dryopteris	*tetrapinnata*				X		
Dubautia	*arborea*			na'ena'e			X
Dubautia	*herbstobatae*				X		
Dubautia	*kenwoodii*			na'ena'e		X	
Dubautia	*latifolia*				X		
Dubautia	*paleata*			na'ena'e pua kea			X
Dubautia	*pauciflorula*			na'ena'e	X	X	
Dubautia	*plantaginea*	subsp.	*magnifolia*		X		X
Dubautia	*plantaginea*	subsp.	*humilis*		X		
Dubautia	*raillardioides*			na'ena'e 'ula			X

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Dubautia	*spp.*			naenae			X
Elaeocarpus	*bifidus*			kalia			X
Elaphoglossum	*spp.*			ekaha; laukahi nunui			X
Eragrostis	*fosbergii*				X		
Eragrostis	*monticola*						X
Eragrostis	*variabilis*			kawelu			X
Erythrina	*sandwicensis*			wiliwili			X
Eugenia	*koolauensis*				X		
Euphorbia	*haeleeleana*				X		
Euphorbia	*spp.*			koko or akoko			X
Exocarpos	*luteolus*				X		
Flueggea	*neowawraea*				X		
Freycinetia	*arborea*			ieie			X
Gahnia	*lanaiensis*				X	X	
Gardenia	*brighamii*			nanu	X	X	
Gardenia	*mannii*				X		
Geranium	*arboreum*			hinahina	X		X
Geranium	*kauaiense*				X		
Geranium	*multiflorum*				X		
Geranium	*tridens*			hinahina			X
Gossypium	*tomentosa*			ma'o			X
Gouania	*hillebrandii*				X		
Gouania	*meyenii*				X		
Gouania	*vitifolia*				X	X	
Haplostachys	*haplostachya*				X		
Hedyotis	*cookiana*			'awiwi	X	X	
Hedyotis	*coriacea*				X		
Hedyotis	*degeneri*	var.	*coprosmifolia*		X		
Hedyotis	*degeneri*	var.	*degeneri*		X		
Hedyotis	*haupuensis*			pilo		X	
Hedyotis	*mannii*			pilo	X	X	
Hedyotis	*parvula*				X		
Hedyotis	*schlechtendahliana*	var.	*remyi*	kopa	X	X	
Hedyotis	*st.-johnii*				X	X	
Hedyotis	*terminalis*			manono			X
Hedyotis	*terminalis*			manono			X
Heliotropium	*anomalum*			hina hina			X
Heliotropium	*curassavicum*			kipukai			X

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Hesperomannia	*arborescens*				X		
Hesperomannia	*arbuscula*				X	X	
Hesperomannia	*lydgatei*				X		
Heteropogon	*contortus*			pili grass			X
Hibiscadelphus	*distans*			hau kuahiwi	X	X	
Hibiscadelphus	*giffardianus*			hau kuahiwi	X	X	
Hibiscadelphus	*hualalaiensis*			hau kuahiwi	X	X	
Hibiscadelphus	*woodii*			hau kuahiwi	X	X	
Hibiscus	*arnottianus*			hauhele, hau	X		X
Hibiscus	*brackenridgei*	subsp.	*mokuleianus*	ma'o hau hele	X	X	
Hibiscus	*brackenridgei*	subsp.	*brackenridgei*		X		
Hibiscus	*brackenridgei*	subsp.	*molokaiana*	ma'o hau hele		X	
Hibiscus	*clayi*			koki'o 'ula 'ula; aloalo	X	X	
Hibiscus	*kokio*						X
Hibiscus	*tiliaceus*			hau			X
Hibiscus	*waimeae*	subsp.	*hannerae*		X		
Huperzia	*mannii*				X		
Huperzia	*nutans*			wawae'iole	X	X	
Huperzia	*stemmermanniae*			wawae'iole	X	X	
Ilex	*anomala*			kawa'u			X
Ipomoea	*spp.*						X
Isachne	*distichophylla*			ohe			X
Ischaemum	*byrone*				X		
Isodendrion	*hosakae*				X		
Isodendrion	*laurifolium*				X		
Isodendrion	*longifolium*				X		
Isodendrion	*pyrifolium*			aupaka; wahine noho kula	X	X	
Jacquemontia	*ovalifolia*	subsp.	*sandwicensis*				X
Joinvillea	*adscendens*						X
Kanaloa	*kahoolawensis*				X	X	
Kokia	*cookei*			koki'o	X	X	
Kokia	*drynarioides*			hau hele 'ula; koki'o	X	X	
Kokia	*kauaiensis*				X		
Labordia	*cyrtandrae*			kamakahala	X	X	
Labordia	*lydgatei*				X	X	
Labordia	*sp. nov.*					X	
Labordia	*tinifolia*	var.	*wahiawaensis*	kamakahala	X	X	
Labordia	*tinifolia*	var.	*lanaiensis*		X		

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Labordia	*triflora*			kamakahala	X	X	
Labordia	*waialaeale*			kamakahala lau li'I			X
Lepidium	*arbuscula*				X		
Lepturus	*repens*						X
Lipochaeta	*lobata*	subsp.	*leptophylla*		X		
Lipochaeta	*spp.*						X
Lobelia	*gaudichaudii*	subsp.	*koolauensis*		X		
Lobelia	*monostachya*				X	X	
Lobelia	*niihauensis*				X		
Lobelia	*oahuensis*				X		
Lobelia	*spp.*						X
Lysimachia	*filifolia*				X		
Lysimachia	*iniki*					X	
Lysimachia	*lydgatei*				X	X	
Lysimachia	*maxima*				X	X	
Lysimachia	*pendens*					X	
Lysimachia	*scopulensis*					X	
Lysimachia	*spp.*						X
Lysimachia	*venosa*				X		
Machaerina	*angustifolia*			'uki			X
Marsilea	*villosa*			'ihi'ihilauakea	X		X
Melanthera	*fauriei*				X		
Melanthera	*kamolensis*				X		
Melanthera	*micrantha*	subsp.	*exigua*		X		
Melanthera	*micrantha*	subsp.	*micrantha*		X		
Melanthera	*tenuifolia*				X		
Melanthera	*venosa*				X		
Melanthera	*waimeaensis*				X		
Melicope	*adscendens*			alani	X	X	
Melicope	*anisata*			mokihana			X
Melicope	*balloui*			alani	X	X	
Melicope	*clusiifolia*			kukaemoa			X
Melicope	*cruciata*			pilo 'ula		X	
Melicope	*degeneri*			alani	X	X	
Melicope	*haupuensis*			alani	X	X	
Melicope	*hiiakae*			alani	X	X	
Melicope	*knudsenii*			alani	X	X	
Melicope	*lydgatei*			alani	X	X	

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Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Melicope	*macropus*				X		
Melicope	*makahae*				X		
Melicope	*mucronulata*			alani	X	X	
Melicope	*munroi*				X		
Melicope	*ovalis*				X		
Melicope	*pallida*				X		
Melicope	*paniculata*				X		
Melicope	*quadrangularis*				X		
Melicope	*reflexa*				X		
Melicope	*saint-johnii*				X		
Melicope	*zahlbruckneri*			alani	X	X	
Metrosideros	*polymorpha*			'ohi'a			X
Microlepia	*strigosa*	var.	*mauiensis*		X		
Munroidendron	*racemosum*				X		
Myoporum	*sandwicense*			naio			X
Myrsine	*juddii*				X		
Myrsine	*knudsenii*			kolea		X	
Myrsine	*lessertiana*			kolea			X
Myrsine	*linearifolia*				X		
Myrsine	*mezii*			kolea	X	X	
Myrsine	*sandwichensis*			kolea lauli'I			X
Myrsine	*sp.*			kolea			X
Nama	*sandwicensis*						X
Neowawraea	*phyllanthoides*			mehamehame			X
Neraudia	*angulata*	var.	*dentata*		X		
Neraudia	*angulata*	var.	*angulata*		X		
Neraudia	*ovata*				X	X	
Neraudia	*sericea*				X		
Nestegis	*sandwicensis*			olopua			X
Nothocestrum	*breviflorum*			'aiea	X		X
Nothocestrum	*latifolium*			'aiea			X
Nothocestrum	*longifolium*			'aiea			X
Nothocestrum	*peltatum*			'aiea	X	X	
Nothocestrum	*spp.*						X
Nototrichium	*humile*				X		
Ochrosia	*haleakalae*				X		
Ochrosia	*kilaueaensis*				X		
Oreobolus	*furcatus*						X

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Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Osmanthus (Olea)	*sandwicensis*						X
Osteomeles	*anthyllidifolia*			uulei			X
Pandanus	*odoratissiumu*			hala; lauhala			X
Pandanus	*tectorius*			hala			X
Panicum	*fauriei*	var.	*carteri*		X		
Panicum	*niihauense*			lau'ehu	X	X	
Panicum	*spp.*						X
Pelea	*spp.*			alani			X
Peperomia	*subpetiolata*			'ala 'ala wai nui	X	X	
Perrottetia	*sandwicensis*			olomea			X
Peucedanum	*sandwicense*				X		
Phyllostegia	*bracteata*				X		
Phyllostegia	*brevidens*					X	
Phyllostegia	*glabra*	var.	*lanaiensis*		X		
Phyllostegia	*haleakalae*				X	X	
Phyllostegia	*helleri*				X		
Phyllostegia	*hirsuta*				X		
Phyllostegia	*hispida*				X	X	
Phyllostegia	*kaalaensis*				X	X	
Phyllostegia	*knudsenii*				X	X	
Phyllostegia	*mannii*				X	X	
Phyllostegia	*mollis*				X		
Phyllostegia	*parviflora*	var.	*parviflora*		X		
Phyllostegia	*parviflora*	var.	*lydgatei*		X	X	
Phyllostegia	*parviflora*	var.	*glabriuscula*			X	
Phyllostegia	*pilosa*				X	X	
Phyllostegia	*racemosa*			kiponapona	X	X	
Phyllostegia	*renovans*					X	
Phyllostegia	*stachyoides*					X	
Phyllostegia	*velutina*				X		
Phyllostegia	*waimeae*				X	X	
Phyllostegia	*warshaueri*				X	X	
Phyllostegia	*wawrana*				X	X	
Pipturus	*spp.*			mamaki			X
Pisonia	*sandwicensis*			aulu			X
Pisonia	*spp.*			papala kepau			X
Pisonia	*umbellifera*			papala kepau			X
Pittosporum	*halophyllum*			ho'awa		X	

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Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Pittosporum	*hawaiiense*			hoawa			X
Pittosporum	*hosmeri*			hoawa			X
Pittosporum	*spp.*			hoawa			X
Pittosporum	*terminalioides*			hoawa			X
Plantago	*hawaiensis*				X		
Plantago	*princeps*	var.	*anomala*		X		
Plantago	*princeps*	var.	*laxifolia*		X		
Plantago	*princeps*	var.	*longibracteata*		X		
Plantago	*princeps*	var.	*princeps*		X		
Platanthera	*holochila*				X	X	
Platydesma	*campanulata*			pilo kea			X
Platydesma	*remyi*				X		
Pleomele	*forbesii*				X		
Pleomele	*hawaiiensis*				X		
Poa	*mannii*				X		
Poa	*sandvicensis*				X		
Poa	*siphonoglossa*				X		
Portulaca	*sclerocarpa*				X		
Portulaca	*sp. A*					X	
Pritchardia	*affinis*			loulu	X	X	
Pritchardia	*aylmer-robinsonii*			loulu	X	X	
Pritchardia	*beccarriana*			loulu			X
Pritchardia	*glabrata*			loulu		X	
Pritchardia	*kaalae*				X		
Pritchardia	*munroi*			loulu	X	X	
Pritchardia	*napaliensis*				X		
Pritchardia	*remota*				X		
Pritchardia	*schattaueri*			loulu	X	X	
Pritchardia	*sp. 1*			loulu		X	
Pritchardia	*spp.*						X
Pritchardia	*viscosa*			loulu	X	X	
Pseudomorus	*sandwicensis*			aiai			X
Psychotria	*grandiflora*			kopiko	X	X	
Psychotria	*hexandra*	var.	*oahuensis*	kopiko	X	X	
Psychotria	*hobdyi*				X		
Psychotria	*sp.*			kopiko			X
Psydrax	*odorata*			alahe'e			X
Pteralyxia	*kauaiensis*				X		

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Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Pteralyxia	*macrocarpa*			kaulu			X
Pteris	*lidgatei*				X		
Pyschotria	*hawaiiensis*			kopiko			X
Racomitrium	*lanuginosum*						X
Ranunculus	*mauiensis*				X		
Raowolfia	*sandwicensis*			hao			X
Remya	*kauaiensis*				X		
Remya	*mauiensis*				X	X	
Remya	*montgomeryi*				X	X	
Reynoldsia	*sandwicensis*			ohe, ohe makai			X
Rhynchospora	*chinensis*	subsp.	*spiciformis*	kuolohia			X
Rubus	*hawaiensis*			'akala			X
Sadleria	*cyatheoides*			amaumau			X
Sanicula	*mariversa*				X		
Sanicula	*purpurea*				X		
Santalum	*ellipticum*			'iliahialo'e			X
Santalum	*freycinetianum*	var.	*lanaiense*		X		
Santalum	*freycinetianum*			'iliahi			X
Sapindus	*oahuensis*			kaulu			X
Sapindus	*saponaria*			a'e			X
Scaevola	*coriacea*				X		
Scaevola	*glabra*			'ohe naupaka			X
Scaevola	*procera*			naupaka kuahiwi			X
Scaevola	*sericea*			naupaka kahakai			X
Scaevola	*sp.*			naupaka			X
Schiedea	*adamantis*				X	X	
Schiedea	*apokremnos*				X		
Schiedea	*attenuata*				X	X	
Schiedea	*haleakalensis*				X		
Schiedea	*hawaiiensis*					X	
Schiedea	*helleri*				X	X	
Schiedea	*hookeri*				X		
Schiedea	*jacobii*					X	
Schiedea	*kaalae*				X	X	
Schiedea	*kauaiensis*				X	X	
Schiedea	*kealiae*				X		
Schiedea	*lauii*					X	
Schiedea	*lychnoides*				X		

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Fern, Fern Allies & Flowering Plants

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Schiedea	*lydgatei*				X		
Schiedea	*membranacea*				X		
Schiedea	*nuttallii*				X	X	
Schiedea	*obovata*				X	X	
Schiedea	*perlmanii*					X	
Schiedea	*pubescens*				X		
Schiedea	*salicaria*				X		
Schiedea	*sarmentosa*				X		
Schiedea	*spergulina*				X		
Schiedea	*spergulina*	var.	*leiopoda*			X	
Schiedea	*stellarioides*				X		
Schiedea	*trinervis*				X		
Schiedea	*verticillata*				X		
Schiedea	*viscosa*				X	X	
Schoenoplectus	*lacustris*	subsp.	*validus*	'aka'akai			X
Sesbania	*tomentosa*			'ohai	X		X
Sesuvium	*portulacastrum*			'akulikuli			X
Sicyos	*alba*			'anunu	X	X	
Sicyos	*lanceoloidea*			'anunu		X	
Sida	*fallax*			'ilima			X
Sideroxylon	*sandwicense*			aulu, kaulu			X
Silene	*alexandri*				X	X	
Silene	*hawaiiensis*				X		
Silene	*lanceolata*				X		
Silene	*perlmanii*				X		
Smilax	*melastomifolia*			pi'oi			X
Solanum	*americanum*			popolo			X
Solanum	*incompletum*			popolo ku mai	X	X	
Solanum	*sandwicense*			popolo 'aiakeakua	X	X	
Solanum	*nelsonii*			popolo			X
Sophora	*chrysophylla*			mamane			X
Spermolepis	*hawaiiensis*				X		
Sporobolus	*virginicus*			'aki'aki			X
Stenogyne	*angustifolia*				X		
Stenogyne	*bifida*				X	X	
Stenogyne	*campanulata*				X	X	
Stenogyne	*cranwelliae*				X		
Stenogyne	*kaalae*	subsp.	*sherffii*			X	

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Stenogyne	*kanehoana*				X	X	
Stenogyne	*kealiae*				X		
Stenogyne	*macrantha*			ma'ohiohi			X
Stenogyne	*purpurea*						X
Stenogyne	*rugosa*			ma'ohiohi			X
Stenogyne	*scrophularioides*			ma'ohiohi			X
Styphelia	*tameiameiae*			pukiawe			X
Syzygium	*sandwicensis*			'ohi'a ha			X
Tetramolopium	*arenarium*	subsp.	*arenarium*		X		
Tetramolopium	*capillare*				X		
Tetramolopium	*diersingii*					X	
Tetramolopium	*filiforme*	var.	*filiforme*		X		
Tetramolopium	*filiforme*	var.	*polyphyllum*		X		
Tetramolopium	*lepidotum*	subsp.	*lepidotum*		X	X	
Tetramolopium	*remyi*				X	X	
Tetramolopium	*rockii*	var.	*calcisabulorum*		X		
Tetramolopium	*rockii*	var.	*rockii*		X		
Tetraplasandra	*bisattenuata*			'ohe mauka		X	
Tetraplasandra	*flynnii*			'ohe'ohe		X	
Tetraplasandra	*gymnocarpa*				X		
Tetraplasandra	*hawaiensis*			ohe'ohe			X
Tetraplasandra	*sp.*			ohe			X
Touchardia	*latifolia*			olona			X
Trematolobelia	*singularis*				X		
Urera	*kaalae*			opuhe	X	X	
Urera	*sandvicensis*			opuhe			X
Vaccinium	*calycinum*			'ohelo; 'ohelo kau la'au			X
Vaccinium	*reticulatum*			'ohelo			X
Vaccinium	*spp.*						X
Vicia	*menziesii*				X	X	
Vigna	*o-wahuensis*				X		
Viola	*chamissoniana*	subsp.	*chamissoniana*		X		
Viola	*helenae*				X	X	
Viola	*kauaensis*	var.	*wahiawaensis*	nani wai'ale'ale	X	X	
Viola	*lanaiensis*				X	X	
Viola	*oahuensis*				X		
Wikstroemia	*monticola*			'akia			X
Wikstroemia	*oahuensis*			'akia			X

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Fern, Fern Allies & Flowering Plants

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Wikstroemia	*oahuensis*			'akia			X
Wikstroemia	*phillyreifolia*			'akia			X
Wikstroemia	*sanwicensis*			'akia			X
Wikstroemia	*skottsbergiana*			'akia		X	
Wilkesia	*gymnoxiphium*			iliau			X
Wilkesia	*hobdyi*				X		
Wilkesia	*spp.*			iliau			X
Xylosma	*crenatum*				X	X	
Xylosma	*hawaiiense*			maua			X
Zanthoxylum	*dipetalum*	var.	*tomentosum*	kawa'u	X	X	
Zanthoxylum	*hawaiiense*				X		
Zanthoxylum	*oahuense*				X		
Zanthoxylum	*spp.*			a'e or hea'e			X
Aquatic Plants							
Halophila	*hawaiiana*			seagrass			X
Ruppia	*maritima*			widgeon grass			X
Endemic Terrestrial Algae							
Bjornbergiella	*hawaiiensis*						X
Diprora	*haenaensis*						X
Navicula	*contenta*						X
Navicula	*hawaiiensis*						X
Navicula	*thurstonensis*						X
Scytonema	*javanicum*	var.	*hawaiiense*				X
Scytonema	*pulvinatum*						X
Endemic Freshwater Algae							
Batrachospermum	*spermatiophorum*						X
Cladophora	*longiarticulata*	var.	*valida*				X
Conferva	*sandvicensis*						X
Cosmarium	*depauperatum*						X
Eunotia	*abbottiae*						X
Eunotia	*smithiae*						X
Frustulia	*creuzburgensis*						X
Haematococcus	*thermalis*						X
Lophopodium	*sandvicense*						X
Lyngbya	*cladophorae*						X
Micrasterias	*adscendens*						X
Navicula	*genustriata*						X
Navicula	*oahuensis*						X
Navicula	*testata*						X

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Endemic Freshwater Algae

Genus	Species	var./subsp.	Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Pithophora	*affinis*						X
Pithophora	*macrospora*						X
Staurastrum	*monticulosum*	var.	*duplex*				X
Staurastrum	*subtile*						X
Stauroneus	*maunakeäensis*						X
Stigonema	*aerugineum*						X
Tolypothrix	*musicola*	var.	*havaiensis*				X
Trentepohlia	*cucculata*	var.	*sandvicensis*				X
Trentepohlia	*diffracta*	var.	*sandvicensis*				X
Xanthidium	*octocorne*	var.	*majus f. havaiensis*				X
Endemic Marine Algae							
Acrochaetium	*dotyi*						X
Alsidium	*cymatophilum*						X
Antithamnion	*erucacladellum*						X
Boodleopsis	*hawaiiensis*						X
Callidictyon	*abyssorum*						X
Callithamniella	*pacifica*						X
Centroceras	*corallophilloides*						X
Ceramium	*cingulum*						X
Ceramium	*dumosertum*						X
Ceramium	*hanaense*						X
Ceramium	*tranquillum*						X
Ceramium	*womersleyi*						X
Chrysymenia	*glebosa*						X
Codium	*cicatrix*						X
Codium	*extricatum*						X
Corallophila	*ptilocladioides*						X
Crouania	*sp.*						X
Dasya	*iridescens*						X
Dasya	*kriseniae*						X
Dasya	*muurayana*						X
Ditria	*reptans*						X
Dotyella	*hawaiiensis*						X
Dotyella	*irregularis*						X
Dotyophycus	*pacificum*						X
Dudresnaya	*littleri*						X
Euptilocladia	*magruderi*						X
Fernandosiphonia	*ecorticata*						X
Gelidiella	*womersleyana*						X

*X=Endangered, Threatened, Candidate, Proposed Endangered
**X=fewer than 50 individuals in the wild
***X=important habitat or dominant plant in community

Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Endemic Marine Algae

Genus	Species	var./subsp. Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Gelidium	*pluma*					X
Gelidium	*reediae*					X
Gracilaria	*abbottiana*					X
Gracilaria	*coronopifolia*					X
Gracilaria	*dawsonii*					X
Gracilaria	*dotyi*					X
Gracilaria	*epihippisora*					X
Grateloupia	*hawaiiana*					X
Halymenia	*chiangiana*					X
Halymenia	*cromwellii*					X
Halymenia	*stipitata*					X
Hawaiia	*trichia*					X
Helminthocladia	*rhizoidea*					X
Helminthocladia	*simplex*					X
Herposiphonia	*dubia*					X
Hypoglossum	*wynnei*					X
Janczewskia	*hawaiiana*					X
Laurencia	*crustiformans*					X
Laurencia	*mcdermidae*					X
Liagora	*perennis*					X
Lophocladia	*kipukaia*					X
Micropeuce	*setosus*					X
Naccaria	*hawaiiana*					X
Padina	*melemele*					X
Padina	*thivyae*					X
Peleophycus	*multiprocarpium*					X
Phaeocolax	*kajimurai*					X
Platoma	*ardreanum*					X
Pleonosporium	*intricatum*					X
Plocamium	*sp.*					X
Polyopes	*hakalauensis*					X
Polysiphonia	*profunda*					X
Polysiphonia	*rubrorhiza*					X
Polysiphonia	*tuberosa*					X
Prionitis	*corymbifera*					X
Pseudochlorodesmis	*hawaiiensis*					X
Pterocladiella	*bulbosa*					X
Reticulocaulis	*mucosissimus*					X
Sargassum	*echinocarpum*					X

*X=Endangered, Threatened, Candidate, Proposed Endangered
**X=fewer than 50 individuals in the wild
***X=important habitat or dominant plant in community

Appendix B: Wildlife (Flora) Species of Greatest Conservation Need

Endemic Marine Algae

Genus	Species	var./subsp. Subspecies	Common/Hawaiian name	Federal status*	GSN?**	Important interaction***
Sargassum	*obtusifolium*					X
Sargassum	*polyphyllum*					X
Scinaia	*furcata*					X
Scinaia	*hormoides*					X
Spirocladia	*hodgsoniae*					X
Sporochnus	*dotyi*					X
Trichogloeopsis	*hawaiiana*					X
Ululania	*stellata*					X
Valonia	*trabeculata*					X
Womersleyella	*pacifica*					X
Wrangelia	*elegantissima*					X

*X=Endangered, Threatened, Candidate, Proposed Endangered
**X=fewer than 50 individuals in the wild
***X=important habitat or dominant plant in community

APPENDIX C: OVERVIEW OF MANAGEMENT PROGRAMS AND EXISTING REGULATIONS

A variety of land and water management programs and existing regulations protect Hawaii's native species and their habitats. This appendix provides an overview of these protections, first outlining the land and water management by Federal, State, county, and private entities, then describing existing regulations in order from international, Federal, State, and local protections.

LAND AND WATER MANAGEMENT PROGRAMS

National Parks

The National Park System, operated by the National Park Service of the U.S. Department of Interior, was established to preserve natural areas (including scenery, natural and historic features, and wildlife) in the United States so that they can be enjoyed by current generations and preserved for future generations. The protection, management, and administration of these areas are to be conducted in light of the high public value and integrity of the National Park System. There are eight national park units in Hawai‘i: Haleakalā National Park (Maui); Kalaupapa National Historical Park (Moloka‘i); Hawai‘i Volcanoes National Park (Hawai‘i); Kaloko-Honokōhau National Historical Park (Hawai‘i); Pu‘uhonua O Hōnaunau National Historical Park (Hawai‘i); Ala Kahakai National Historic Trail (Hawai‘i); Pu‘ukoholā Heiau National Historic Site (Hawai‘i), and the U.S.S. Arizona Memorial (O‘ahu).

National Wildlife Refuges

Over 500 National Wildlife Refuges (NWRs) across the United States form a system of habitats managed by the U.S. Fish and Wildlife Service of the U.S. Department of Interior. Hawaii's Refuges were established to protect the Islands' unique native plants and animals and their habitats. There are ten wildlife refuges in Hawai‘i: Hawaiian Islands NWR (Northwestern Hawaiian Islands, including marine waters), Hanalei NWR (Kaua‘i), Hulē‘ia NWR (Kaua‘i), Kīlauea Point NWR (Kaua‘i), O‘ahu Forest NWR (O‘ahu), James Campbell NWR (O‘ahu), Pearl Harbor NWR (O‘ahu), Keālia Pond NWR (Maui), Kakahai‘a NWR (Moloka‘i), and Hakalau Forest NWR (Hawai‘i).

U.S. Military Installations – Integrated Natural Resources Management Plans

The Sikes Act Improvements Act of 1997 required every military installation containing land and water suitable for the conservation and management of natural resources to complete an Integrated Natural Resources Management Plan (INRMP). The purpose of these INRMPs is to integrate the mission of the military installation with stewardship of the natural resources found there. There are several INRMPs covering military installations in Hawai‘i, including:

- Oahu INRMP (covers U.S. Army installations at Dillingham Military Reservation, Kahuku Training Area, Kawailoa Training Area, Mākua Military Reservation, Schofield Barracks East Range, Schofield Barracks Military Reservation);

- Pōhakuloa Training Area INRMP (covers U.S. Army installation at Pōhakuloa Training Area, Hawai‘i);
- Marine Corps Base Hawai‘i INRMP (covers Marine Corps installations on O‘ahu, including Mōkapu Peninsula (Kāne‘ohe Marine Base), Waikāne Valley, and Marine Corps Training Area – Bellows);
- Pearl Harbor Naval Complex INRMP (covers U.S. Navy installations at Pearl Harbor, O‘ahu);
- Naval Magazine Pearl Harbor INRMP (covers U.S. Navy installation at Lualualei, O‘ahu);
- Naval Computer and Telecommunications Area Master Station Pacific INRMP (covers U.S. Navy installation at Wahiawā and Lualualei, O‘ahu); and
- Pacific Missile Range Facility INRMP (covers U.S. Navy installation at Barking Sands, Kaua‘i).

National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) is responsible for managing fisheries in Federal waters and protecting species under the Endangered Species Act, the Marine Mammal Protection Act, and other Federal legislation.

Western Pacific Fisheries Management Council

The Western Pacific Fisheries Management Council (WPFMC) is responsible for recommending fisheries management actions in Federal waters in the region including Hawai‘i, and works in concert with the National Marine Fisheries Service. WPFMC develops Fisheries Management Plans (FMPs) under the Magnuson-Stevens Fishery Conservation and Management Act for commercially harvested species. These plans must identify Essential Fish Habitat (EFH) that is necessary for “spawning, breeding, feeding, or growth to maturity” and enact actions to minimize threats to and conserve EFH. These plans also identify more limited Habitat Areas of Particular Concern that are key habitats for managed species. FMPs are developed for bottomfishes, coral reef ecosystems, crustaceans, pelagic fishes, and precious corals.

Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve

The Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve was established in 2000 by Executive Order. The Reserve protects the species in the marine waters and submerged lands of the Northwestern Hawaiian Islands, as well as the Hawaiian Islands NWR outside of State waters. It is managed by the National Ocean Service of the National Oceanic and Atmospheric Administration (NOAA-NOS). Only limited fishing that occurred before the Executive Order is allowed, and then only in areas not designated for complete protection from fishing and other consumptive uses. The Reserve is currently undergoing the public process to become a National Marine Sanctuary.

Hawaiian Islands Humpback Whale National Marine Sanctuary

Jointly managed by NOAA-NOS and Hawai‘i Department of Land and Natural Resources, Division of Aquatic Resources (DAR) to protect humpback whales in Federal and State waters. The sanctuary's goal is to promote comprehensive and coordinated management, research, education, and long-term monitoring for the endangered

humpback whale and its habitat. The Sanctuary includes waters around portions of all the Main Hawaiian Islands, centering on the key habitat of Maui County. Protections for the whales include increased fines for violations of the Endangered Species Act and Marine Mammal Protection Act and 100 yard approach rule to limit harassment of whales in the water. Funding and personnel for research, education, and enforcement also increase these actions in the State.

State Natural Area Reserves

The State Natural Area Reserve system (NARS) was established to preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawai‘i (Hawai‘i Revised Statutes (HRS) Chapter 195). The NARS are managed by the State Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW). Each Natural Area Reserve was established based on the concept of protecting ecosystems rather than individual species, with the goal of preserving and protecting representative samples of Hawaiian biological ecosystems and geological formations. There are 19 NARS in Hawai‘i covering more than 109,000 acres. Hono o Na Pali (Kaua‘i), Ku‘ia (Kaua‘i), Ka‘ena Point (O‘ahu), Pahole (O‘ahu), Mt. Ka‘ala (O‘ahu), West Maui (Maui), Hanawī (Maui), ‘Āhihi-Kīna‘u (Maui) (contains both terrestrial and marine acreage), Kanaio (Maui), Oloku‘i (Moloka‘i), Pu‘u Ali‘i (Moloka‘i), Manukā (Hawai‘i), Kīpāhoehoe (Hawai‘i), Mauna Kea Ice Age (Hawai‘i), Waiākea 1942 Flow (Hawai‘i), Kahauale‘a (Hawai‘i), Pu‘u Maka‘ala (Hawai‘i), Laupāhoehoe (Hawai‘i), Pu‘u o ‘Umi (Hawai‘i).

State Forest Reserves

The State Forest Reserves were first established in Hawai‘i over a century ago to protect the water supply that was being threatened due to the destruction of the forest by cattle (HRS Chapter 183). The Forest Reserves are managed by DOFAW. Limited collecting for personal use (e.g., *ti* leaves and bamboo) and limited (no more than $3,000 value per year) commercial harvesting of timber, seedlings, greenery, and tree ferns is allowed by permit. There are 49 forest reserves on the five major islands (Kaua‘i, O‘ahu, Maui, Moloka‘i, and Hawai‘i), totaling over 640,000 acres; most of the State land in the Conservation District is within a forest reserve.

State Restricted Watersheds

The purpose of a State Restricted Watershed is to regulate human use in areas where water supplies are vulnerable to contamination by public access (Hawai‘i Administrative Rules (HAR) §§ 13-105-1 et seq.). Six restricted watersheds on O‘ahu (3) and Hawai‘i (3) have been established and are managed by DOFAW.

State Wilderness Preserves

The purpose of a State Wilderness Preserve is to preserve and protect “all manner of flora and fauna” (HAR §§ 13-3-1 et seq.). The only wilderness preserve in the State is the Alaka‘i Wilderness Preserve on Kaua‘i, covering just over 9,000 acres on the summit plateau of Mt. Wai‘ale‘ale, and is managed by DOFAW.

State Wildlife Sanctuaries
Wildlife Sanctuaries are established by the State to conserve, manage, and protect indigenous wildlife (HAR §§ 13-125-1 et seq.). The Wildlife Sanctuaries are managed by DOFAW. There are four wildlife sanctuaries in the State: Paikō Lagoon Wildlife Sanctuary (Oʻahu), Kanahā Pond Wildlife Sanctuary (Maui), Kīpuka ʻĀinahou Nēnē Sanctuary (Hawaiʻi), and the Hawaiʻi State Seabird Sanctuary (multiple islands offshore of the Main Hawaiian Islands and two islands of Kure Atoll in the Northwestern Hawaiian Islands).

State Parks
There are 52 state parks encompassing nearly 25,000 acres on all the Main Hawaiian Islands. These parks are managed for outdoor recreation and heritage opportunities and range from landscaped grounds with developed facilities to wildland areas with trails and primitive facilities (HRS Chapter 183).

Leased and Unencumbered Lands
The State Department of Land and Natural Resources, Division of Land Management manages State lands not set aside to agencies or otherwise encumbered or designated for a specific land use. Some of these lands are leased by auction to private landowners, while lands that are not under lease are called "unencumbered lands." Unencumbered lands are often beach or coastal areas in the Conservation District (see below – State Land Use Districting) but do not include parks, harbors, or forest reserves.

Hawaiian Home Lands
The Department of Hawaiian Home Lands manages approximately 200,000 acres in trust for Native Hawaiians. The mission of the Department of Hawaiian Home Lands is to manage the Hawaiian Home Lands trust effectively and to develop and deliver land to Native Hawaiians. The Department will partner with others towards developing self-sufficient and healthy communities.

Commission on Water Resources Management
The Commission on Water Resources Management within the Department of Land and Natural Resources is mandated by Chapter 174C of the Hawaiʻi Revised Statutes to set policies, protect resources, defines uses, establish priorities while assuring rights and uses, and establish regulatory procedures for inland surface water and ground water resources. The Commission designates and manages water management areas and is responsible for protecting instream uses of water, including maintaining the biological integrity of aquatic wildlife.

State Marine Waters
DAR manages marine and freshwater areas throughout the State under general management authority from Hawaiʻi Revised Statutes Chapters 188 and 190. These areas include 11 Marine Life Conservation Districts (MLCD), 19 Fish Management Areas (FMA), three Public Fishing Areas (PFA), two Wildlife Sanctuaries, and the South Kona ʻōpelu Fishing Area.

Eight MLCDs include areas that are set aside as No Take Marine Protected Areas to protect sensitive species and habitats and other areas that allow a variety of forms of take but were set up to manage user conflicts or address other management issues. Some limitations on access (e.g., boats) also occur. FMAs were mostly set up to manage user conflicts. They have restrictions on gear, size of fish, access, season, etc., that differ from general fishing regulations. Only the Waikiki Shoreline FMA is completely No Take. Many FMAs are in harbors, bays, or canals. PFAs are managed areas with regulations to protect introduced freshwater gamefish and other fishes. Access, take, size, gear, and season limits are used. The Sanctuaries are limited access and take areas set up for conducting scientific research (Coconut Island) and conservation (Paikō Lagoon).

Bottomfish Restricted Areas

Bottomfish Restricted Areas (BRAs) are managed by DAR and were established in 1998 after encouragement by the Western Pacific Fisheries Management Council and consultation with an ad hoc committee and extensive public comment. Their goal is to protect stocks of bottomfish in the Main Hawaiian Islands. No fishing for state-defined bottomfish species is allowed in these areas. There are 18 BRAs.

Fish Replenishment Areas

Fish Replenishment Areas (FRAs) are managed by DAR and were established in 2000 in order to protect the stocks of marine aquarium fishes on the island of Hawai‘i and to mange conflicts among commercial aquarium fishers and other resource users. No commercial or recreational aquarium fish collecting or fish feeding is allowed. There are nine FRAs in West Hawai‘i.

Kaho‘olawe Island Reserve

In late 1990, the U.S. Department of Defense stopped using Kaho‘olawe for bombing and target practice and shortly thereafter began a Congressionally-funded clean-up of the island. In 1993, the Hawai‘i State Legislature established the Kaho‘olawe Island Reserve to protect the entire island and surrounding coastal waters extending two miles seaward and established the Kaho‘olawe Island Reserve Commission (KIRC) to manage the island. The U.S. Navy clean-up resulted in approximately ten percent subsurface clearance of the island and 69 percent surface clearance of unexploded ordnance from the island. In 2003, management and ownership of the island was officially transferred from the U.S. Navy to KIRC, a state agency administratively attached to DLNR. Kaho‘olawe Island Reserve is to be used solely and exclusively, in perpetuity, for: (1) the preservation and practice of all rights customarily and traditionally exercised by Native Hawaiians for cultural, spiritual, and subsistence purposes; (2) the preservation and protection of the Reserve’s archaeological, historical, and environmental resources; (3) rehabilitation, revegetation, habitat restoration, and preservation; and (4) education. Commercial uses are strictly prohibited in the Reserve (HRS Chapter 6K). Marine take is restricted to non-commercial catch for Kaho‘olawe visitors and open trolling for the general public in restricted areas and dates.

Division of Boating and Ocean Recreation

The aim of the Department of Land and Natural Resources, Division of Boating and Ocean Recreation (DOBOR) is to preserve Hawaii's natural and cultural resources while ensuring public access to State waters and enhancing the ocean experience. DOBOR manages 30 boat harbors and boat launching facilities as well as designated offshore mooring areas. DOBOR regulates commercial operations, events, placement of sinking vessels, pollution, anchoring, and user conflicts, all of which can affect wildlife conservation efforts.

Office of Conservation and Coastal Lands

The Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) has a mission to protect and conserve Conservation District lands and beaches within the State of Hawai‘i (including submerged lands) for the benefit of present and future generations, pursuant to Article XI, Section 1, of the Hawai‘i State Constitution. OCCL plays an important role in determining shoreline boundaries for public access, shoreline encroachments, administers application for ocean aquaculture, and enacts beach restoration projects.

State Department of Agriculture

The State Department of Agriculture, Agricultural Resource Management Division operates the State's Agricultural Park program. This program makes land available to small farmers at reasonable cost with long-term tenure and provides irrigation water. There are ten agricultural parks: four on Hawai‘i, four on O‘ahu, one on Kaua‘i, and one on Moloka‘i. The lessees are all engaged in diversified agricultural crops or aquaculture and are small farming enterprises (under 20 acres). The Division also manages five irrigation systems, two on O‘ahu, two on Hawai‘i, and one on Moloka‘i.

Board of Water Supply

The Boards of Water Supply in each county own and manage land in their island watersheds, typically in mountainous areas, in order to protect the county's supply of water.

Cooperative Efforts

Invasive Species Committees

Over the past decade, partnerships and groups have organized to address gaps in Hawaii's biosecurity system. These include the Hawai‘i Invasive Species Council (HISC), to provide cabinet-level leadership, the Coordinating Group on Alien Pest Species (CGAPS), for interagency and non-governmental organization communications and collaborative projects, and the Invasive Species Committees (ISCs) for island-based rapid response.

HISC was created in 2003 to advise the Governor on issues regarding invasive species, create and implement an invasive species plan, review State agency mandates and commercial interests, and suggest appropriate legislation to improve the State's administration of invasive species programs and policies. HISC, under the co-leadership of the State Department of Agriculture and the Department of Land and Natural Resources, is comprised of the leaders of the

University of Hawai‘i, the State Department of Business, Economic Development and Tourism, State Department of Health, and State Department of Transportation, with an invitation to participate issued to the county mayors, State Department of Defense, State Department of Commerce and Consumer Affairs, State Department of Hawaiian Home Lands, Federal agency representatives and non-profit agency representatives. Hawai‘i is the sixth state in the nation to create this type of council.

CGAPS was formed in 1995 and is comprised of primarily management-level participants from every major agency and organization involved in invasive species work including Federal, State, county, and private entities. Members meet quarterly to discuss how to influence policy and funding decisions, improve communications, increase collaborations, and promote public awareness.

The first ISC was formed on Maui in 1997 in response to the need for an early detection and rapid on-the-ground response to an array of incipient invasive species, and one is now on every major Hawaiian island (Kaua‘i, O‘ahu, Maui, Moloka‘i, and Hawai‘i). The ISCs are voluntary partnerships of private, government, non-profit organizations, and individuals working together to address invasive species issues particular to the island. The overall goal of the ISCs is to prevent, eradicate, or control priority incipient plant and animal species that threaten Hawaii’s most intact Federal, State, and private conservation lands.

In addition, there are working groups specific to high-priority potential invasive species. Two examples include the West Nile Virus Prevention Group and the Brown Tree Snake Rapid Response Team. The West Nile Virus Prevention Group is composed of a broad coalition of government agencies and non-governmental organizations, including the State Department of Agriculture, Department of Land and Natural Resources, and Department of Health, the Federal Department of Agriculture, and the Department of Interior's Fish and Wildlife Service and U.S. Geological Survey Biological Resources Division, the U.S. Postal Service; the University of Hawai‘i, the Hawaiian Humane Society, the Honolulu Zoo, Ducks Unlimited, and the Nature Conservancy of Hawai‘i. The West Nile Virus Prevention Group has developed a plan to respond to, track, and limit the spread of West Nile virus in Hawai‘i. A multi-agency Brown Tree Snake Rapid Response Team has been formed to address potential brown tree snake sightings in Hawai‘i. Members travel to Guam for regular training in how to search for and capture brown tree snakes, as one method to prevent the establishment of this animal.

Watershed Partnerships

The first Watershed Partnership was established in East Maui in 1991 by the State Department of Land and Natural Resources, the National Park Service, the county of Maui, the East Maui Irrigation Company, the Nature Conservancy, Keola Hana Maui, and Haleakalā Ranch Company in recognition that active management was needed to sustain a healthy forested watershed and that effective management is

best achieved through coordinated actions of all major landowners in the watershed. Since that time, Watershed Partnerships have now been established on six islands: Kauaʻi Watershed Alliance (Kauaʻi, 2003), Koʻolau Mountains Watershed Partnership (Oʻahu, 1999), West Maui Mountains Watershed Partnership (Maui, 1998), Leeward Haleakalā Watershed Restoration Partnership (Maui, 2003), East Molokaʻi Watershed Partnership (Molokaʻi, 1999), Lānaʻi Forest and Watershed Partnership (Lānaʻi, 2001), ʻŌlaʻa-Kīlauea Partnership (Hawaiʻi, 1994), and the Kohala Mountains Watershed Partnership (Hawaiʻi, 2004). Overall, these partnerships cover over 344,000 hectares (850,000 acres) of forested watershed, involving more than 50 public and private partners. The amount of land under active management varies between partnerships. In 2003, the individual watershed partnerships jointly formed the Hawaiʻi Association of Watershed Partnerships, to support the statewide needs of watershed partnerships.

Endangered Forest Bird Conservation

The State has established a partnership of non-profit conservation organizations, private landowners, and government agencies including DLNR and the U.S. Fish and Wildlife Service to work cooperatively for the conservation of endangered birds. The Maui Forest Bird Recovery Project and the Kauaʻi Endangered Bird Recovery Team are two ongoing efforts. The goal of these cooperative efforts is to recover native Hawaiian ecosystems at the landscape level and to establish self-sustaining bird populations in the wild, using management programs that include captive propagation and reintroduction. Their efforts employ an integrated conservation strategy of research, habitat management, and public education, with a focus on ecosystem health and protection as a prerequisite to reintroduction. On Maui, the focus of the program is on conservation efforts in Hanawī NAR for the endangered poʻouli, while on Kauaʻi, the focus of the program is on conservation efforts in the Alaka'i Swamp for the endangered puaiohi.

Offshore Island Restoration Committee

The Offshore Island Restoration Committee (OIRC) is a cooperative effort made up of the U.S. Fish and Wildlife Service, State Division of Forestry and Wildlife, Bishop Museum, the University of Hawaiʻi at Mānoa, The Nature Conservancy, and the National Park Service to inventory and restore high priority offshore islands and islets throughout the Main Hawaiian Islands. OIRC is currently in the process of inventorying, identifying, and prioritizing offshore islands and islets for restoration, management, and conservation activities.

Hawaiʻi and Pacific Plants Recovery Coordinating Committee

The Hawaiʻi and Pacific Plants Recovery Coordinating Committee (HPPRCC) was established by the U.S. Fish and Wildlife Service in 1993 to provide the Service with information and advice on the biology, current status, and management needs to recover the many listed endangered or threatened Hawaiian plant taxa. Current members of the HPPRCC include representatives from the U.S. Fish and Wildlife Service, DOFAW, The Nature Conservancy, U.S. Geological Survey, U.S. Army, Hawaiʻi Biodiversity and Mapping program,

University of Hawai‘i, and the Hawai‘i Silversword Foundation. HPPRCC is currently developing a strategy for rare plant conservation and has identified “Genetic Safety Net” plants – plants for which there are less than 50 known individuals in the wild. The goal of the developing strategy is to coordinate and integrate existing plant conservation efforts.

Natural Area Partnership Preserves

Under the Natural Area Partnership (NAP) program, the State provides two-thirds of the management costs for private landowners who agree to permanently protect intact native ecosystems, essential habitat for threatened and endangered species, or areas with other significant biological resources (HRS Chapter 195). The NAP program can support a full range of management activities to protect, restore, or enhance significant native resources or geological features. There are seven NAP-funded preserves in Hawai‘i: Pu‘u Kukui (Maui), Kapunakea (Maui), Waikamoi (Maui), Mo‘omomi (Moloka‘i), Kamakou (Moloka‘i), Pelekunu (Moloka‘i), and Kanepu‘u (Lāna‘i). In addition, there is an application pending for an eighth NAP preserve in Ka‘ū (Hawai‘i).

The Nature Conservancy Preserves

The Nature Conservancy of Hawai‘i (TNC) is a private, non-profit affiliate of the national organization, with a mission to protect eight remaining, large native-dominated landscapes from further fragmentation and to sustain these areas as natural systems through coordinated, multi-partner conservation strategies. In addition to managing six of the seven NAP preserves, TNC also manages other protected areas: Honouliuli Preserve (O‘ahu), ‘Ihi‘ihilauakea Preserve (O‘ahu), Kona Hema Preserve (Hawai‘i), and Ka‘u Preserve (Hawai‘i). Additional conservation management is conducted through cooperation with private landowners on Kaua‘i.

National Tropical Botanical Gardens

The National Tropical Botanical Garden (NTBG) is dedicated to the conservation of tropical plant diversity, particularly rare and endangered species. The NTBG, which is supported by private contributions, operates three gardens on Kaua‘i: Limahuli Garden and Preserve (1,000+ acres), McBryde Garden (252 acres), and Allerton Garden (100+ acres).

Land Trusts

The State has several private non-profit organizations whose mission is to acquire lands for long-term protection and preservation for the enjoyment of current and future generations. Examples include the Trust for Public Land, the Maui Coastal Land Trust, and the Kaua‘i Public Land Trust. The Maui Coastal Land Trust is currently managing the Waihe‘e Coastal Dunes and Wetlands Reserve on Maui.

General Conservation Management on Private Land

Unlike the continental United States, most of the private land in Hawai‘i is owned by a few major landowners. Though nearly half of Hawaii’s lands are owned by either State or Federal agencies, the participation and involvement of private landowners, many of whose lands are adjacent to government managed areas, is critical for the conservation of

native species and habitats. Hawai‘i has several programs that provide financial and technical support for assisting private landowners interested in conservation on their lands. Examples include Federal programs offered through the U.S. Fish and Wildlife Service and the Natural Resources Conservation Service (within the U.S. Department of Agriculture), State programs through DOFAW (e.g., Landowner Incentive Program, Forest Stewardship program), and county tax incentives (e.g., island of Hawai‘i native forest tax exemption).

EXISTING REGULATIONS

Convention on International Trade in Endangered Species

The Convention on International Trade in Endangered Species (CITES) establishes import and export restrictions and regulations to protect living and dead animals and plants and their parts from excessive extractive use and international trade.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act is the domestic law that implements the United States' commitment to four international conventions (with Canada, Japan, Mexico, and Russia) for the protection of migratory birds. Each of the conventions protect selected species of birds that are common to the U.S. and the other country (i.e., they occur in both countries at some point during their annual life cycle).

Federal Endangered Species Act

The Endangered Species Act was passed in 1973, to prevent the extinction of species. The current purpose of the Endangered Species Act (ESA) is to conserve the ecosystems on which threatened and endangered species depend and to conserve and recover listed species. A species may be listed as threatened if it is likely to become endangered within the foreseeable future, and a species may be listed as endangered if it is in danger of extinction throughout all or a significant portion of its range. In addition, listed species receive regulatory protection, as taking (which includes injuring or killing) a listed species is prohibited under the ESA. In addition, the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service or National Marine Fisheries Service in order to ensure that activities they fund, authorize, permit, or carry out are not likely to jeopardize the continued existence of the species or result in destruction or adverse modification of critical habitat. The ESA allows the U.S. Fish and Wildlife Service (terrestrial and some aquatic species) or the National Marine Fisheries Service (marine species) to allow takes that would otherwise be prohibited, provided that such taking is incidental to, and not the purpose of, carrying out an otherwise lawful activity (“incidental take”), by permit and an accompanying habitat conservation plan (USFWS only). In addition to the protection offered by listing, many species in Hawai‘i have designated critical habitat, including most of the listed plants, the Blackburn’s sphinx moth, the Kaua‘i cave wolf spider, the Kaua‘i cave amphipod, the palila, Hawaiian monk seal, and the O‘ahu ‘elepaio. Subspecies and other populations may be listed separately if they are sufficiently distinct from their conspecific relatives. In Hawai‘i, such protections extend to bats, some birds, and many plants. Candidate species are those species which are under consideration for listing as threatened or endangered by the

USFWS. NMFS calls these "species of concern" when there is not enough information available to decide on a listing or they are not actively being considered. A number of species are candidates or species of concern in Hawai'i. The ESA also authorizes U. S. implementation of CITES.

Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 protects marine mammals by prohibiting the take, harassment, and importation of marine mammals in the United States and by prohibiting the take of marine mammals by U. S. citizens anywhere in the world. Exceptions can be granted for scientific research, education, native subsistence, and take incidental to commercial fisheries. The Act also requires establishing stock assessments and research. Species which fall below their "optimal sustainable population" size are listed as "depleted". Depleted populations must have a conservation plan to guide research and management actions to restore the health of the species.

The Clean Water Act

The Clean Water Act of 1977 established the basic structure for regulating discharges of pollutants into the waters of the United States. Its goal is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The Clean Water Act gives the Environmental Protection Agency the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act also contains requirements to set water quality standards for all contaminants in surface waters. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of sewage treatment plants and recognized the need for planning to address the critical problems posed by non-point source pollution.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet this requirement, federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS). The Environmental Protection Agency reviews and comments on EISs prepared by other federal agencies, maintains a national filing system for all EISs, and assures that its own actions comply with NEPA.

State Species Protection

The State has established various laws and administrative rules to protect indigenous wildlife and plants. Hawai'i Revised Statutes § 195-1 recognize that "[a]ll indigenous species of aquatic life, wildlife, and land plants are integral parts of Hawaii's native ecosystems and comprise the living heritage of Hawaii, for they represent a natural resource of scientific, cultural, educational, environmental, and economic value to future generations of Hawaii's people" and that "it is necessary that the State take positive actions to enhance their prospects for survival." Administrative rules designed to conserve, manage, protect and enhance indigenous wildlife, endangered and threatened wildlife, and introduced wild birds contain a long list of prohibited activities, with

additional protections afforded threatened and endangered species (HAR Chapter 13-124). Similarly, administrative rules designed to conserve, manage, protect and enhance native threatened and endangered plants contain a list of prohibited activities, including a ban on the take of threatened or endangered plants (HAR Chapter 13-107). The State list of threatened and endangered species includes by reference species on the Federal list, as well as a few additional species, such as the ʻiʻiwi on Oʻahu. "Incidental takes" of threatened or endangered species (plant and animals) are allowed subject to approved habitat conservation plans and Safe Harbor Agreements (HRS Chapter 195D).

State Protection for Caves

In 2002, special laws were enacted to protect the irreplaceable resources of cultural, spiritual, aesthetic, and scientific value contained in Hawaii's network of underground caves (HRS Chapter 6D). A cave is defined as any naturally occurring void, cavity, recess, or system of interconnected passages large enough for human entry beneath the surface of the earth. Hawaiʻi State law prohibits destruction of a cave or any part of the interior of a cave without the owner's written consent, prohibits removing, killing, or harming any native organisms within a cave, prohibits burning any material within a cave that may produce smoke that is harmful to naturally occurring organisms, and prohibits storage or disposal of garbage, dead animals, sewage, litter, or other toxic substances in any cave. However, State law does not prohibit these activities if they occur during permitted construction activities, provided that cave protection mitigation measures disclosed through the environmental review process and land-use permitting processes are adhered to. In addition, State law does not prohibit or constrain surface activities on the land above a cave.

State Land Use Districting

All lands in Hawaiʻi are allocated by the State into one of four districts: Conservation, Agricultural, Urban, or Rural. The State, through its Department of Land and Natural Resources (DLNR) and its Board of Land and Natural Resources (the Board), has primary land-management responsibility for activities and development in the Conservation District, while the counties have primary responsibility in the Urban, Rural, and Agricultural Districts. The purpose of the Conservation District is to conserve, protect, and preserve the State's important natural resources through appropriate management in order to promote the long-term sustainability of these natural resources, and to promote public health, safety, and welfare (HRS Chapter 183C). To this end, only limited development is allowed in the Conservation District. "Important natural resources" include the watersheds that supply potable water and water for agriculture; natural ecosystems and sanctuaries of native flora and fauna, particularly those which are endangered; forest areas; scenic areas; significant historical, cultural, archaeological, geological, mineral, and volcanological features and sites; and other designated unique areas. Permits are required for most activities in the Conservation District (HAR § 13-5-1 et seq.). As an additional measure of protection, all land in the Conservation District has been assigned to one of five subzones that reflect a hierarchy of uses from the most restrictive to the most permissive. These subzones are the Protective Subzone (the most restrictive), Limited, Resource, General, and Special. Except for the Special Subzone, all

uses and activities allowed in a more restrictive subzone in the hierarchy are allowed in the less restrictive subzones.

Introduction of Non-native Species

The Hawai‘i Department of Agriculture is primarily responsible for regulating the introduction of non-native species. The Department's Plant Industry Division is responsible for protecting Hawaii's agricultural industries, natural resources, and the public from the entry and establishment of detrimental plants, animals, insects, weeds, and other pests and to assure the safe and efficient use of pesticides in Hawai‘i (HRS Chapters 150A, 152, and 149A; HAR Title 4, Subtitle 6). The Department's Division of Animal Industry is responsible for controlling and preventing the entry and spread of pests and disease that may affect the poultry and livestock industries, operating the rabies quarantine program and the airport holding facility, conducting investigations into violations of animal quarantine/importations statutes, and providing veterinary laboratory support for diagnosing animal diseases (HRS Chapter 142).

State Water Quality

The State Department of Health is responsible for administering the Clean Water Act in Hawai‘i. The Department administers the National Pollutant Discharge Elimination System (NPDES) permit program, issues Clean Water Act Section 401 Water Quality Certifications for federal permits for construction in nearshore and inland waters, and partners to develop best management practices for non-point source pollution control. The Department promotes community-based watershed management through education and voluntary compliance with environmental management standards.

State Environmental Review Requirements

Hawai‘i State law establishes a system of environmental review to ensure that environmental concerns are given appropriate consideration in decision-making (HRS Chapter 343). Similar to the Federal National Environmental Policy Act (NEPA), Hawai‘i law requires environmental assessments or environmental impact statements (depending on the impacts of the project) to be prepared for any project occurring in the Conservation District, as well as any project using State or county lands or funds. There are six other triggers for environmental review that more rarely operate to benefit native species (e.g., construction within the Waikīkī Special District).

Enforcement of Conservation Regulations

The Department of Land and Natural Resources Division of Conservation and Resource Enforcement (DOCARE), the U. S. Coast Guard, the NOAA Office of Law Enforcement, the U. S. Navy, the U.S. Marine Corps Base Hawai‘i, and the county police departments all play a role in enforcing the conservation regulations of the State.

Coastal Zone Management

The Federal Coastal Zone Management (CZM) Program was created through passage of the Coastal Zone Management Act of 1972. The program for Hawai‘i was approved in 1977 (HRS Chapter 205A), and is administered through the Department of Business, Economic Development and Tourism Coastal Zone Management Program (CZM

Hawai‘i). Within a framework of cooperation among Federal, State, and local levels, CZM Hawai‘i employs a wide variety of regulatory and non-regulatory techniques to address coastal issues and uphold environmental law. Among them are stewardship, planning, permitting, education and outreach, technical assistance to local governments and permit applicants, policy development and implementation, and identification of emerging issues and exploration of solutions. CZM Hawai‘i is leading the preparation of a framework for updating the Ocean Resources Management Plan. CZM Hawai‘i is mandated to develop and implement a Coastal Nonpoint Pollution Control Program which is to be approved by NOAA and the Environmental Protection Agency.

Special Management Areas

As mandated by the Hawai‘i Coastal Zone Management program, counties are responsible for administering permits for development in Special Management Areas (SMAs) located along the shoreline. The intent of this permitting process is to avoid the permanent loss of valuable resources and to ensure adequate access to beaches, recreation areas and natural reserves (HRS Chapter 205A). Although SMAs are defined to include all lands extending not fewer than 100 yards inland from the shoreline, counties can amend their boundaries to achieve certain Costal Zone Management objectives. Amendments removing areas from an SMA are subject to State review for compliance with the coastal law.

County Zoning

Counties are responsible for reviewing development in the Agricultural, Rural, and Urban Districts. The Agricultural District includes both “good” farm land and “junk” land that is unsuitable for farming or ranching. “Junk” land includes gulches, steep hillsides, rocky land, and on Maui and the Big Island, even relatively recent lava flows having little or no topsoil. Crops, livestock, and grazing are permitted in the Agricultural District, as are accessory structures and farmhouses. Although land in the Agricultural District is not meant to be urbanized, it has, in practice, been used for large-lot subdivisions. These subdivisions can be designed for “residential” development (i.e., housing units targeted at Hawai‘i residents) or high-end “resort/residential” development (i.e., housing units targeted at non-Hawai‘i residents and associated with resorts). The Urban and Rural Districts in each county are subject to county land use and development (commercial, industrial, residential, etc.) regulations, including county community plans, zoning, and building code regulations.

APPENDIX D: SUMMARY OF PUBLIC COMMENTS RECEIVED

This appendix summarizes the public comments received during development of Hawaii's Comprehensive Wildlife Conservation Strategy (CWCS). It does not include specific biological information (such as new data on a species' distribution or abundance). Further, the public comments have been summarized and aggregated for better understanding and explanation on the incorporation of major themes provided.

PUBLIC COMMENT RECEIVED THROUGHOUT THE PROCESS – FROM SCOPING THROUGH THE SECOND REVISED DRAFT CWCS

Terrestrial

- Species of Greatest Conservation Need
    - Include IUCN ranking as status reference
    - Helpful to link threatened habitats with species as well as high priority areas on each island for recovery
    - Question on whether to include possible extinct species on the list
    - Question as to why the Canadian goose is not listed
    - Recommended additions of the Bristle-thighed Curlew and Short-tailed Albatross
    - Question on why the green-winged teal is listed
- Habitat
    - Offshore islands should be linked with each island section
    - Recognize Lā'au Point on Moloka'i as a critical area for monk seals
    - A wildlife area should not be judged solely on the native species composition
- Threats
    - Recognize game animals and game birds as threats to native wildlife and habitats and that hunting opportunities need to be provided, but with minimal impact to native species. Currently, hunting does not produce this result
    - Disagree that collection is a large pressure on Blackburn's sphinx moth
    - Strengthen avian malaria as a threat
    - Add wildfires as threat to native habitat
    - Add Axis deer on Maui
    - Add alien dominated vegetation as single largest impediment to restoring native ecosystems
    - Add introduced coqui or veiled chameleons as threats since they not only prey on native invertebrates, but also provide food for other introduced species (e.g., lizards, centipedes, etc.) thereby increasing their populations
    - Mongooses are just as big a threat to terrestrial animals as rats and feral cats
    - Feral pigs are known to destroy nēnē nests and take goslings
    - To loss and degradation of habitats, add pesticide and herbicide use, electrical towers, and possibly wind farms

    - There is as of yet no firm evidence that introduced birds are effective carriers and spreaders for avian diseases to native birds
    - IACUC as an impediment to effective invasive species control
- Conservation Actions
    - Consider captive propagation of koloa maoli to enhance wild populations
    - Actions need to be considered at the landscape level
    - Need to recognize the importance of enhanced and secure sources of management funding for State and public private partnership activities
    - Support Cats Indoors Programs statewide
    - Early detection and response key to managing threats to native wildlife
    - In addition to building fencing, emphasis needs to be placed on maintaining fences as well
    - Increase awareness of endangered species and preservation on Molokaʻi
    - To protect the pueo on Molokaʻi, feral animals must be controlled
    - Priority habitats on Kauaʻi should include wetlands for nēnē
- General Comments
    - Concern that the Strategy will lead to increased taxes as more funds will be required to hire staff and carry out the Strategy
    - Concern over using showcase or umbrella species to protect other species and habitats. An alternative recommendation is to use a suite of different species associated with a habitat to monitor both species and habitats
    - Not all introduced species are detrimental to native species as some are used by native species as food and habitat
    - The Strategy should also protect introduced endangered species
    - Native Hawaiian access rights as they relate to conservation-based restrictions should be recognized
    - Add that a West Nile Virus working group has been established to address WNV issues
    - Strategy should include maps of important landscape areas on each of the islands which encompass areas important for conservation of SGCN
    - The Strategy should list specific goals such as the following: urgent need for ungulate free areas on islands where there are currently none; long term goal to represent all ecosystem types of sufficient size in ungulate free status; stepped up and better coordinated effort at keeping the worst habitat modifying weeds out of pristine areas; establish a resilient network of marine managed areas which should include a minimum of 20% no take
    - Need to further prioritize objectives and actions to increase efficacy of the Strategy
    - Clarification on how the Strategy will be implemented post October 1st should be made as well as timeline for all the actions
    - The Strategy could provide more specifics on how the objectives will be achieved (e.g., setting goals and outlining specific actions)
- Fact Sheets
    - Most comments received were corrections and additions to species information concerning habitat use, biology, threats, distribution, conservation actions

Aquatic

- Species of Greatest Conservation Need
  - Include marine algae
  - Include only anchialine species and Newcomb's snail
  - Game fish – should include because are already managed
  - Game fish – should not include because should not allow fishing of them if truly of conservation need
  - Game fish – should include because if listed as overfished, might have to stop fishing, so should take proactive steps to ensure continued fishing opportunities
  - Game fish – if plan to exclude, need a standardized and scientific approach on which will be excluded
  - Game fish – difficult to say if actually being overfished, or what the cause for low numbers is
- Habitat
  - Include discussion of impact on stream habitat (and on other wildlife, such as native birds) by Army Corps of Engineer manipulations
- Threats
  - Include discussion of harvesting of rare shells for sale on Ebay or other Internet auctions
  - Include discussion of extractions for research purposes – currently does not require a permit, and is an area of potential abuse
  - Include discussion of bio-prospecting
  - Impact of two additional cruise ships – trickle-down impact of additional 'spin-off' recreational activities, resulting in increased impacts to marine environment
  - Inefficient use of funding
  - Concern over rechannelization of streams for native stream species
  - Manta ray populations in other parts of the world are threatened by their fishing. Potential threat of fishing to manta rays in Hawai'i
  - Take of rare species supposedly for cultural purpose, but in reality for commercial sale (e.g., polished nerite or kūpe'e)
- Conservation Actions
  - Amending import/export regulations to be more conservative – switch from a ban on identified species to a ban of all except for identified species
  - Establish collection limits on any indigenous species (at a genus or higher taxonomic level – not species specific) to prevent future commercial or recreational take expansion from decimating populations before effective response can be made
  - Require permits for research if involve extraction of organisms
- General Comments
  - Concern about public distribution of sensitive information (e.g., habitat location), especially for species not currently under protection
  - How can species be added over time?

- Incorporate the *ahupua‘a* concept into the CWCS
- Try to use knowledge from *kupuna* (elders) about species and habitats

Comments specific to CWCS Drafts

- Similar to the republic of Fiji, airport arrivals to Hawai‘i should be treated to a video explaining the dangers of invasive species to Hawai‘i and how they can be transported in recreational gear; and increase posters at airports that relate to invasive species as well as endangered species export/import regulations and restrictions, including required permits
- Programmatic Safe Harbor Agreements for Hawaiian waterbirds should be included as a management tool
- Broaden handbook recommendation from just post-wildfire treatment to other subjects
- Greater emphasis on traditional Hawaiian resource management systems, such as the *ahupua‘a* system, should be made
- Newell’s shearwaters utilize primarily inaccessible nest sites on sheer cliffs or uluhe covered habitats, white-tailed tropicbirds nest primarily in MHI
- Statewide Chapters
  - Habitats - add lakes and anchialine pond descriptions
  - Threats - for ‘alalā, habitat degradation and fragmentation are critical challenges for ‘alalā recovery
  - Threats - under invasive species, add a category called “genetic pollution” which would include GMOs and the problem of hybridization between introduced and native species
  - Threats - avian botulism, most prevalent disease threat for native waterbirds, should be added
  - Threats - feral mallards are a statewide problem for koloa maoli, not a local one. They are a threat not only to the koloa maoli, but to other native waterbirds and eventual relocation of Laysan Duck
  - Threats - add to climate change, increased drought periods which impact wildlife and habitat
  - Threats - add relationship between feral pigs spreading mosquito borne avian disease
  - Threats - for coastal dune ecosystems, off-road vehicles are a major threat
  - Threats - add rats as seed predators on native plant species
  - Objectives - summary of action should be outlined to specifically address how to eradicate feral goats, sheep, and mouflon from palila critical habitat, particularly on Mauna Kea. This should include an assessment of progress and outline of future actions
  - Objectives - add a bullet for need to increase research on management tools for controlling introduced vertebrates
  - Objectives - add a recommendation to increasing outreach and developing partnerships with the agricultural industries and research facilities
  - Objectives - add a recommendation of organizing an interagency and stakeholder task force to examine and conduct pilot studies on how to

make endangered species on private lands economically viable for landowners
    - Objectives - add recommendation identifying the need to promote emergency priority biological control development and release
    - Objectives - identify most serious alien threats to assist interdiction prioritization
    - Objectives - identify specific steps to prevent inter-island spread of invasives
- Island-sections
    - Kauaʻi: add Limahuli preserve as managed by National Tropical Botanical Garden as well as an area that requires enhanced management
    - Kauaʻi: add Haʻena Sate Park wetlands and *loʻi* systems for native wetland birds; Limahuli stream, one of the state's top five pristine streams and utilized by koloa maoli
    - Niʻihau: include language about the significance of ephemeral playa lakes and removal of feral mallards
    - Maui: major streams should include Honokōhau stream, which is impacted by diversions by Honolua ditch; Kanahā pond should be accurately described to reflect current state of water resources to the pond (artificially pumped); instead add 57 diverted streams, USGS maps show 70 diverted streams in east Maui, while west Maui has over one dozen; intact freshwater systems are also found in undiverted streams of Kīpahulu and Kaupō areas (Alelele, Kālepa streams) and Makamakaʻole streams
    - Maui: Kanahā pond is threatened by airport expansion; add threats through importation of invasive plant, seeds, and pathogens as a result of insufficient inspection at airports and harbors; stream restoration language should outline a timeframe
    - Maui: promote funding to support preservation of East Maui wiliwili forest, including actions to treat forest for *Erythrina* gall wasp and seed collection and storage; expand marine protect areas or marine management areas
    - Maui: Fleming Arboretum has a new electronic database with 170 native dryland forest species on its 17 acre site
    - Maui: add to potential areas for enhanced conservation management wiliwili forests, particularly in areas of leeward Haleakalā volcano; dryland forests of southern Maui (Auwahi, Kahikinui, Kaupō, Manawainui); south eastern Maui coastline (Keoneʻoʻio Bay to Kanaloa point) which have anchialine ponds
    - Kahoʻolawe: separate plants and animals for reintroductions and highlight Laysan Duck as one species specifically planned for reintroduction per the recovery plan
    - Hawaiʻi: mouflon sheep should be highlighted as a threat for the entire Mauna Kea area; axis deer
    - Hawaiʻi: draft a Safe Harbor Agreement for endangered waterbirds; secure stable funding for sea turtle work and understanding of adjacent nearshore

marine habitats to better evaluate NPS impacts; suggestions on adding specific inventories for specific taxa which have already been conducted

- Appendices
    - Comments made included edits to distribution information

PUBLIC COMMENT RECEIVED ON DRAFT CWCS AT TECHNICAL WORKSHOPS JUNE-JULY 2005

Species of Greatest Conservation Need

- Include plants on the list of species of greatest conservation need; do not omit them from the CWCS. Recommendations include: including all threatened and endangered plants; including all identified genetic safety net plants (those species with less than 50 individuals); including species with documented animal interactions (food, host, habitat); including species identified as a dominant or co-dominant species in a natural community by Wagner's *Manual of the Flowering Plants of Hawai'i*; including all native plant species; and no plant species should be added at this time but identifying the need to comprehensively plan for the conservation of native plants
- Instead of trying to identify a subset of species found on a particular island (e.g., those endemic to Kaua'i or those for which Kaua'i is important habitat), take a broader approach – either include all known from the island or focus on key species that typify a habitat. Otherwise, lists between islands appear inconsistent (especially where limited by information gaps). Alternatively, take a broad approach so as to be an information source and provide protection to a larger range of native species
- Clarify that SGCN includes non-threatened and non-endangered species – the prevalence of listed species leads to confusion about other species
- Recommend tiering SGCN (e.g., vulnerable, endangered) to reflect that certain species require special, species-specific management. Others disagreed, stating that critically endangered species already receive attention and tiering could detract attention from species that are historically ignored
- Support the inclusion of all native invertebrates – because while a few are listed, there are hundreds with the potential for listing, but there just is not enough information available yet (e.g., drosophila). In addition, new species are collected on nearly every survey

Threats

- Highlight threat of smallmouth bass to native freshwater species; other non-native stream species as threat to terrestrial invertebrates
- Development as a threat – particularly the increase of formerly open lands being fenced/gated and of former agricultural land being converted to residential development
- Fire, especially due to arson and especially in low elevation dry areas, needs to be emphasized as a threat
- Existing regulations are sufficient; the real problem is a lack of enforcement
- Poaching, particularly of marine species, is perceived as a major problem

- Sedimentation of streams and run-off to nearshore reefs is a threat to all islands, as is stream diversions
- Add or highlight threat of ants, feral cats and dogs, rodents, rabbits on Saddle Road, feral chickens, rats, parasitoid wasps and flies, avian disease, feral ungulates (cattle, pigs, goats, mouflon), loss of seed dispersal and changes in habitat, real estate development, light pollution, barn owls, introduction of snakes on island of Hawai‘i
- Highlight threat of pigs, goats, kāhili ginger, strawberry guava as additional threats on Kaua‘i
- Highlight threat of ungulates in general (not just axis deer), feral dogs, feral cats and cat colonies, parrots, *Euglandia rosea* (carnivorous snail), hybridization of koloa maoli, competition from alien species as additional threats on Maui
- Information gaps are a serious threat for invertebrates – surveys are needed as is compilation of unpublished information. Other invertebrate threats include alien invasions, habitat loss, loss of native plants, parasitism, biocontrol, and coqui frogs (and other predators)
- Stress the threat posed by invasive species – key threat facing species in Hawai‘i today. Threat of disease to important dominant plants – especially ‘ōhi‘a and koa – is particularly of concern and would be devastating to a full range of native wildlife in the State
- Add global climate change as a threat
- Add ballast water and hull fouling as potential vectors for invasive species
- Major threat relating to invasive species is that there is no funding for prevention, just eradication, but the best money is spent on prevention

Conservation Actions

- Highlight that restoration is part of conservation
- Need for post-fire restoration needs to be included
- Need to state more clearly that restoration for biological integrity is needed
- Suggest a conservation goal of no net loss of streams
- Suggest adding stream corridors to the Conservation District as a means of increasing protection
- Suggest streamlining Conservation District rules for beneficial conservation projects (such as fencing)
- With invasive species, need a strong statement about the need to control established plants (or animals) and preventing their establishment in still-pristine areas
- Clarify that implementation of existing management plans or continuing existing management programs is a priority
- Existing management needs consistent dedicated funding; current funding is not adequate
- Develop a strategy for post-fire response, as well as for improved interagency fire prevention and fighting
- CWCS should reflect that game hunting and conservation are compatible
- CWCS should reflect that game hunting and conservation are incompatible

- Add eradication of cats from Kahoʻolawe
- Highlight need to continue proactive prevention of invasive species introduction
- Add need to develop standardized information gathering protocols for project types – so information can be compared across years and funding agencies
- Need partnerships to keep light-free areas dark, and to reduce light pollution in areas where light exists
- Actions to respond to invasive species should emphasize the need to erect and maintain ungulate-proof fences, the need for control of established invasives, and the need for early action and rapid response
- CWCS should recognize need to increase inspections of cargo with known potential pests (such as Guam) and monitoring around airports, emphasize the need to establish inter-island quarantine, and identify proactive measures to combat invasive species introduction (such as concrete fences around airports, other ports of entry)
- Emphasize Safe Harbor Agreements and habitat conservation plans and the need to provide technical assistance or funding to support their preparation
- Improve collaboration at the field level (e.g., multi-disciplinary surveys) to increase understanding of interactions between species (plants, invertebrates, and birds)
- Emphasize need to develop information collection and information sharing protocols – require information distribution to an identified repository as condition of funding. Consider incentives to encourage release of survey information on private lands
- Include recommendation to explore ways to mitigate the effects of channelization
- Emphasize need for better communication between agencies with regulatory responsibilities so that actions can be more coordinated and impacts of regulatory action in the larger context are recognized
- Community involvement and community-based management needs to be emphasized
- Include incentives for water diverters/water users to take actions to mitigate impacts of diversions on stream life
- Encourage interagency collaboration – especially between terrestrial and aquatic managers/regulators
- Recognize the important role the military plays (and can play) as partners in native wildlife protection – from active management of areas for conservation, to creation of de facto refuges by secure zones, to ability to partner regarding enforcement
- Explore the importance of demonstration projects as a way for increased community involvement
- Recognize that some non-native species provide good habitat or food for native wildlife (especially in wetland and coastal environments) – e.g., not all non-natives are invasive or 'bad.' Also, recognize the difficulty of restoring native communities and the need to *transition* from non-native to native to prevent negative impacts to native wildlife (e.g., avoid clear-cutting non-natives and replanting, because native plants may not survive the first planting)

- Recognize the importance of community action – including the community effort to get Kawai Nui recognized as a Ramsar Wetland of Importance
- Support research to determine where 'excess' birds go when protected areas have reached capacity – to identify appropriate actions to prevent protected areas from becoming a source for a sink
- Increase actions regarding land use changes and opportunities these present
- Recognize the island of Hawai'i is big – especially in comparison to the other islands and so conservation needs to occur at a landscape level
- Incorporate cultural aspects of wildlife conservation, an example is seabirds (petrels were cultivated and harvested)
- Include more specificity in the document – make it easier to implement and to monitor
- Review the current State list of injurious wildlife for additions
- Support Hawaii's participation in a national initiative by the National Science Foundation called National Ecological Observatory Network (NEON) that will have a 30 year time frame and deploy sensors to monitor different habitats and their interactions
- Support mechanisms to allow interagency pooling of funding (e.g., PCSU, CESU)
- Clearly recognize need for more funding as a major constraint on current management and current invasive species response
- Encourage habitat conservation, rather than species-specific actions
- Build on existing plans
- Think creatively in using existing sources of funding or finding new partners
- Explicitly include the need to conduct hands-on actions like captive propagation for critically rare species
- Work with DOE to develop curriculum for local schools to teach about Hawaii's natural resources and conservation; develop internship programs with local universities to better connect students with agencies/organizations needing assistance
- Streamline permitting process for conservation actions
- Update the list of noxious weeds; better yet, change policy so the default is nothing gets in unless on the 'approved list' rather than letting in anything not on the 'bad list'
- Expand invasive species control beyond the ISCs; need better coordination and discussion of priority species and how to control. Replicate Maui 'drive-by weed assessment' on other islands to better understand what is present and what the appropriate response is
- Recognize that some hunting units should not be managed for recreational opportunities but for conservation (game removal)

Priority Areas

- Expand draft priority areas for potential conservation management: too limited in scope. Should reflect areas identified as recovery habitat, areas identified as critical habitat, areas that are facing immediate threats, areas that are actually in use by species of greatest conservation need

- Clarify how priority areas were selected – maps may unintentionally omit areas
- Maps do not illustrate well important areas such as offshore islets, coastal areas, anchialine ponds, wetlands, lava tube systems, riparian corridors
- Priority areas miss some areas that would provide important habitat if there were restoration actions or more active management
- Identify priority areas using a watershed/*ahupua‘a* perspective – recognize the difficulty of protecting wetlands and bays without protecting the areas above (mountains and stream corridors)
- Suggest noting which areas are highly managed, which areas are managed but underfunded for management needs, and which areas are not managed at all
- Existing managed areas should be priority areas, must continue to stay managed in the future
- Suggestion that once HI-GAP analysis complete, revisit the issue of priority areas to ensure no areas missed or use to help identify priorities
- Priority areas should include both freshwater streams that are relatively pristine (so that they can be protected) and areas (particularly in middle reaches) that are less pristine but are threatened and still of biological importance. Existing water quality maps could be used to begin process to designate priority streams

Marine systems

- Integrate the marine with the terrestrial to reflect the *ahupua‘a* model and the impact of shoreline actions on marine environment (development, coastal alterations, sedimentation)
- Emphasize information on the issues specifically facing aquatic systems
- Include discussion of Marine Managed Areas in each individual island discussion
- Include areas for black coral habitat as priority areas
- Include ship groundings as well as ship strikes as a threat
- Include discussion on light pollution
- Highlight potential harm caused by oil spills and existence of oil response team
- Emphasize threat of water quality
- Consider reinstating *kapu* system rather than creating new managed areas
- Include reference to development of new Marine Managed Areas
- Include reference to marine invasive species plan
- Include threat of recreational use, encouraged by guidebooks promoting sensitive habitats for recreation
- Recommend that State impose a license for all fishing. Others opposed imposition of a fishing license
- Identify need to research areas used by seabirds at sea to evaluate possible protections or management actions
- Fisheries bycatch should also mention dolphins as well
- Additional marine threats to highlight include bleaching and disease, hull fouling and ballast, ship grounding should be added to ship strike, lighting on coasts, recreational overuse should be supplemented with “commercial” overuse, e.g. fish trade for aquarium, what about whale watching industry?

- Include consideration of overharvesting of non-fish species and include policies to address this threat

General Comments

- Aquatic systems (i.e., freshwater streams) need to be better integrated with the terrestrial elements of the CWCS as they are linked and affect one another. Focusing on stream corridors might be a useful way to link upland to the coast and to better protect the whole resource
- Incorporate success stories into the CWCS (e.g., nēnē)
- Encourage taking an *ahupua'a* approach to conservation
- Emphasize habitat and protection at a habitat level more
- How will the CWCS actually be implemented and what does the CWCS really mean for partners and for the public? Will it determine future funding priorities?
- How will the SGCN list be maintained?
- How will information collected through implementation of the CWCS be maintained? Concerns were expressed regarding disclosure of sensitive information to the public (e.g., concerns that collectors may trespass onto private lands if a particular species is present)
- How will activities be prioritized? Suggestion to prioritize based on protecting areas falling outside of currently managed areas. Suggestion to not prioritize, because conservation success will depend on factors beyond biological need (community support, landowner interest, funding availability, etc.)
- How can the State DLNR, with perceived conflicting mandates, lead a CWCS without addressing and resolving some of their internal conflicts – such as the incompatibility of game hunting and conservation? Encouraged better internal communication and a need to update internal policies
- How strongly will the State DLNR be acting to implement the CWCS, now that important actions are identified as needed on State lands? How will implementation fit in relation to other management mandates?
- Will the review process occur more often than ten years? How will there be accountability of the implementation?

PUBLIC COMMENT RECEIVED ON DRAFT CWCS AT PUBLIC MEETINGS JUNE-JULY 2005

Kaua'i

- Plants should be included in the CWCS if it truly is to be a comprehensive document, in light of the huge number of endangered plants and the important role of many natives (specifically koa, 'ōhi'a, hala, and lama) in the ecosystem
- The CWCS should include discussion/acknowledgement of GMOs (genetically modified organisms) - the impact of GMOs on wildlife is not fully researched but is possible considering documentation (by this member of the public) of nēnē eating GMO corn. The CWCS should explore the need to review use of State lands for GMO research
- Development is a significant threat - to native wildlife and to open space. Specific comments included: need to hurry and protect areas such as the Salt Pond

Area (considered by the speaker as a priority area for both wildlife and for cultural significance) before the landowner tries to develop it fully
- Urbanization is a problem – there needs to be more restrictions to ensure development does not result in sedimentation/runoff (non-point source pollution) to adjacent properties and the ocean
- Additional threats important to Kauaʻi include: feral pigs and goats - impacting landscape all over the island, creating wallows for breeding mosquitoes, causing siltation and sedimentation of freshwater and marine resources - impacting the ʻoʻopu and hihiwai as well as the fish in the coastal flats
- Need to clearly recognize that there should be areas for conservation where the goal is removal of all ungulates and other areas for hunting
- Feral chickens - what is their impact on threatened or endangered species, and if the Department doesn't know, it should consider this research and not treat chickens any more favorably than other introduced animals
- Support for the protection of threatened and endangered species
- It is likely that all the north shore reefs are of quality to warrant protection
- Marine threats are comprehensive, and the CWCS should develop objectives to parallel every identified threat
- Encourage collaboration with regional watershed councils as much as possible
- Is there a connection between military/Navy testing and whale beaching? CWCS should address this issue

Molokaʻi

- CWCS should address residential development (off-islanders cutting off traditional access as develop and build fences around homes)
- CWCS should address the need to conduct enforcement of existing rules (mentioned repeatedly)
- ʻIlio Point to Kalaupapa is important seabird habitat where there is a need to control cats and pigeons
- There is a need for more surveys on bat distribution on Molokaʻi
- Plants should be included in the CWCS, especially island endemics
- The East Molokaʻi watershed area east of Kapualei is a priority area
- Streams on the north coast of Molokaʻi - Waikolu, Wailau and Pelekunu - are of high importance with full array of native wildlife
- CWCS should consider the re-introduction of historic birds
- Marine debris a huge problem - disturbing limu production along some shorelines
- Sewage issues of east end homes along ocean may contribute to algal growth
- Utilize *ahupuaʻa* concept as a framework in planning; native rights must be preserved
- Additional 'no fishing' zones should be identified to improve seed stock
- There needs to be a policy developed to address expanding "eco-tourism" activities before they become a problem to the resources

Maui

- Emphasize prevention of introduction of new invasive species and the need to improve both prevention capacity and detection/response capacity for those that are introduced
- Recognize the connection between the land and the reefs (including the direct harm from runoff/pollution)
- Planning has been done. Instead, what is needed is to take action and address issues. Put actual resources into doing something
- Recognize the importance of water - and clean water - to Maui and Maui's species and the problem of politics relating to water use and policy
- Encourage reforestation
- Include opportunities for local communities to have a say in planning
- Expand enforcement capacity
- Consider an airport tax on visitors to help pay for invasive species prevention
- Incorporate accountability in the CWCS
- Expand MPAs (marine protected areas) to protect all the marine eco-types
- Consider closures of areas to all type of activities, not just a few (e.g., if close to fishing should also close to tourists snorkeling)
- Provide ways to educate both residents and tourists about natural resources and conservation actions

Lānaʻi

- Recognize need to prevent invasive species introduction from Maui, especially at Mānele Bay with the ferry from Maui
- Implement erosion control on windward side
- Ensure Lānai's natural resources receive attention and are not forgotten
- Conduct bird surveys to determine which native birds are still present on the island
- Recognize need for coastal protection – especially on the northeastern portion of island
- Include restoration as well as protection as needed conservation actions
- Recognize need to increase funding for enforcement

Hawaiʻi

- For data collection, consider talking with old-timers to gather information
- Existing surveys are woefully inadequate to determine status of species
- Overview of permitted animal rehabilitators is inadequate
- Hawaiʻi is the endangered species capital of the world, yet the agricultural inspection happens as people leave, not when they enter. There should be twice as stringent inspections for entry
- Commercial shipping, nursery plants, and Christmas trees should undergo thorough inspections or treatments. Unfortunately, feel little is being done currently. Also, there is no reason to import plants – should require nurseries to sell local stock only. Should focus on known problem importers (e.g., places that have sold or continue to sell invasive species)

- Consider instituting a tax on plant imports – regressive, so that the more is imported, the higher the tax. Would provide a disincentive to import and promote local supply
- Need a bigger emergency fund to deal with detected invasives – so early response can be effective
- Mosquitoes are a major vector – so CWCS should aim to eliminate mosquitoes since the technological capacity now exists
- Turtles are a threat to marine fish by eating all the algae, leaving nothing for the fish, and attracting sharks. Turtle season should be open again
- Most of the conservation problems stem from a lack of funding to address problems when they were small – is there any commitment for more money?
- What will the CWCS mean for private landowners? How can they be encouraged to participate? Many want to, but see hurdles – permitting problems, concern over later liability if species thrive, lack of information on options that would benefit the landowner and native species
- Cattle do not harm the dryland forest; it is the goats and sheep. Cattle can help reduce fountain grass through grazing and it is cheaper and more effective than herbicides
- Federal government has a history of regulating – State should avoid too much regulation
- Kepa Maly has a CD available summarizing the history of fishing in Hawai‘i – a great resource on the cultural background of this activity
- Hawai‘i is the only State without a recreational fishing license – this needs to change. The license would be a revenue source and a way to gather needed information
- Regarding gill nets, instead of a flat ban, manage, like the West Hawai‘i Fisheries model
- The State should encourage local management wherever possible, using the West Hawai‘i Fisheries Council as a model. WHFC has local support for needed actions – reducing enforcement problems
- How does the CWCS fit in with all the other planning initiatives ongoing – coastal zone management, ocean sustainability, etc.
- Aquarium fish collection is another area where the State loses money by not taxing or at least monitoring the collection
- Manta rays should be considered vulnerable species
- Marine protected areas are a great idea that the CWCS should explore
- Pollution in Hawai‘i is mainly too many nutrients – which can kill the coral reef
- Actions need to be proactive – it is harder to address problems late
- Hopefully the CWCS will spill over to encourage land use policies positively impacting the environment
- State laws should limit the importation of birds
- How much money is there to implement the CWCS?
- Who will set the priorities regarding implementation of the CWCS?

- Though update every ten years, there are things that will likely happen in the interim (e.g., a potential new invasive species) – how will the CWCS account for this possibility?
- All agree that early detection and rapid response is needed – this is not new. The problem is in doing
- How will the CWCS deal with overlapping authorities/inconsistent involvement? (e.g., government, academics, research, citizens all with their own reasons for being involved and different level of resources)
- Concerned about ʻopaeʻula and anchialine ponds – there are three primary threats: mosquitofish introduced by Department of Health, introduced mollies, and introduced Tahitian prawns. Government took the lead in taking the steps backwards, but now wants to be in control of conservation? Need to explore the idea of task forces for specific species – made up of government, academics, private sector – to improve communications and develop the best plan of action for that species
- Genetically modified organisms (GMOs) are of concern – just approved in Kona and likely to impact native species
- CWCS discusses threatened and endangered species – and clearly loss of habitat is important. For birds, there is government and private cooperation. What about anchialine ponds? Approximately 95 percent of the habitat has been lost. Need to encourage actions on private lands
- Feral ducks may be disease carriers that threaten the native duck
- Cattle have played a huge role in harming habitat. State Land division does not monitor the number of cattle on leased land – need to recognize the need to have a management plan/policy
- Feral dogs, cats, and now chickens are a problem
- Do not institute licensing for recreational fishing; will create more enforcement difficulties. Instead, encourage more education and voluntary catch reporting.
- CWCS should address cruise ship impacts, such as sewage and dropping anchor, and think proactively about addressing their impacts
- What's the status of gill nets, and will a final policy address Native Hawaiian issues?
- What is the practicality of enforcing anything in the Northwestern Hawaiian Islands, especially foreign vessels illegally poaching? How big a problem is this?
- Shoreline encroachments are a serious problem – people illegally irrigating to get more vegetation (and thus more land) when getting their shoreline certifications – harming wildlife by reducing available habitat for turtles, monk seals, seabirds. The law needs to be clarified
- Does the CWCS address the need for monitoring emerging open ocean aquaculture?
- CWCS should identify the need to increase resources for enforcement – to increase enforcement capacity. Not just additional bodies, but also tools – like satellite monitoring of the Northwestern Hawaiian Islands or air patrols
- Recognize that enforcement officers are doing education and outreach too – often the first contact for the public

- CWCS is a huge task, and there is very little money for implementation (in comparison to the State's needs). Support the effort and support the State not relinquishing any authority to the Federal government
- Turtle protection is a conservation success – ban on eating has resulted in greater populations. Education has been effective
- Aquarium fish collecting policy is another success – setting aside certain areas for replenishment areas (with no take). Both collectors and locals are not happy – so likely the policy is a good one
- State has a mandate to run a sustained yield hunting program, but also has a mandate to protect endangered species and outplant native plants. There can be co-existence between these two programs
- Are there areas where game birds are a problem? Do they predate on native species or compete with them?
- Is there a year or timeframe when the evolutionary process is determined to stop? (e.g., what about birds that find their way here naturally and begin to evolve)
- CWCS needs to recognize half of life is reality and other half is perception. Need to work on the perception side so that people voluntarily participate in conservation. When talk about enforcement, rules, many perceive as a negative. Instead need to transition discussion to positive. Example is the island's exceptional tree law – recognizing exceptional trees creates an incentive for people to value it and not want to cut it. Might want to create similar programs for native species. There are many examples of great stewardship in the private sector already, so a recognition program could be easy to establish. This would involve the community in conservation
- CWCS needs to focus on commonalities and not a 'divide and conquer' strategy. Aim for the middle, and then build on that support with education, propaganda, and recognition for good work
- CWCS should also include stiffening penalties on habitat degradation (such as discharge of untreated waste in Forest Reserves) – current law treats this as a petty misdemeanor and violators receive a slap on wrist. Not a large deterrent, especially if the profit outweighs the costs of getting caught
- Ecotourism facilitates greater public access into areas. Need to keep an eye on this trend so that resources are not damaged before anyone notices

O'ahu

- Include plants as species of greatest conservation need – plants are important component of ecosystem in which animals live and have value of their own as well (high levels of endemism)
- Plants were here first before animals
- Plants have unexplored medicinal uses – so CWCS should ensure their long-term protection too – for our future benefit
- Fire is a huge threat, particularly due to arson
- Aquatic threats include pollution, drought, and flooding, waste management policies (illegal dumping), uncontrolled development
- Direct take is a threat, particularly of many marine species

- Strategy should be proactive and positive, with a vision of where we see Hawai‘i in the future
- How will the CWCS really make a difference – general conservation objectives are great but not really new. How is this process and plan different from past efforts?
- Many invertebrates (e.g., *Drosophila* flies) are highly host-specific and this may assist in identifying specific plants to be covered in the CWCS
- Invasive species strategy should follow the New Zealand model, should include landing fees to fund needed improvements at airports
- Draft CWCS does a great job pulling together a lot of information, but determining actual/highest priorities from the array of strategies is difficult
- CWCS should identify need to connect folks currently working in isolation – encourage more collaboration and communication
- Real need in Hawai‘i is more money – without more funding, the CWCS will be like any other plan
- CWCS omits discussion of fishponds, which do host bird populations. Though many are privately owned, they are important for restoration of marine fish and birdlife
- Regarding the use of gill nets in the strategies section, the current wording supports the continued use of gill nets. Rather, the strategy should be to examine banning the use of gill nets altogether
- There are many resources available in Hawai‘i – the need is connecting different resources together
- Recognize the importance of proper management of the coastal dune ecosystem
- Emphasize the importance of preventing the introduction of new invasive species
- Nearshore nutrification is a threat; could be impacting nearshore fisheries and the nearshore limu (algae) community
- Recognize the concept of community-based management and their role in enhancing enforcement capacity
- Oil spills are a marine threat – and not limited to tankers but pertains to research vessels too
- The need to protect Ni‘ihau’s marine resources both for the species and for the local indigenous community should be recognized
- Commercial use continues to expand and can see initial negative impacts to species (reduced ‘ōpihi) – maybe should explore self-regulation of tourist activities (e.g., boat tours, hiking tours)

Incorporation of Feedback from Public Open Houses and Technical Workshops for Hawaii’s Comprehensive Wildlife Conservation Strategy

Ten major themes emerged during this series of public outreach and participation events held on the six islands. They were addressed and incorporated in the following ways:

The need to increase invasive species preventative measures

The concern over increased entry of invasive species into the State was heard on every island. People identified the need to increase preventative measures and improve the capabilities of rapid response to the arrival of new invasives. Strategies on how to support this were added in Chapter 4 as well as specific strategies on each island as identified during public open houses and workshops (Chapter 6, Island Conservation Needs).

The need to emphasize ongoing actions in currently managed areas
Currently managed areas for conservation such as National Parks, National Wildlife Refuges, National Marine Sanctuary, Natural Area Reserves, Wildlife Sanctuaries, Watershed Partnerships, Private Reserves, and others were always recognized in the CWCS as important areas for conservation of native wildlife and habitats. However, language in each of the island sections (Chapter 6) as well as in the statewide section (Chapter 4) was added to clarify this importance and further emphasize these areas as priority for continued management. Additionally, these chapters outline the future support needed for conservation actions that require additional funding to achieve goals and objectives.

The need to include plants as listed Species of Greatest Conservation Need
Native plants were always recognized in Hawaii's CWCS through its approach in emphasizing the need for habitat-level management and by recognizing plants as important hosts for native invertebrates, as food sources for native birds, and generally as habitat for native wildlife. However, as a result of the feedback garnered through public open houses and technical workshops, flora are now also listed specifically as Species of Greatest Conservation Need (SGCN). For terrestrial plants, specific species listed as SGCN include threatened and endangered plants, genetic safety net plants (plants with less than 50 individuals left), plants with identified animal interactions, and dominant and co-dominant plants in one of the recognized natural communities in the *Manual of Flowering Plants of Hawai'i*. In addition, endemic terrestrial algae were included. These species were selected based on recommendations made by the Hawaiian botanical community. For aquatic flora, all endemic plants and algae were included.

The need for increased compliance with existing conservation rules and regulations and increase enforcement
Many comments were raised on how Hawai'i was not in need of new rules or regulations for conservation, but in need of better compliance with enforcement of already existing rules and regulations. The issue of compliance was separated out as its own major threat and strategies were developed to increase enforcement and compliance in Chapter 4.

The need for more funding to support on-the-ground conservation actions
The lack of both consistent and long-term funding was identified as a major conservation challenge by many. Without funding to conduct research, implement conservation actions, hire staff, enforce laws, carry out monitoring, and conduct other priority conservation measures, protecting native wildlife and habitats is impossible. The lack of funding has been pulled out as its own identified major threat. Additionally, instead of being a strategy, enhancing funding has been added as a brand new objective with its own

strategies identifying potential new funding mechanisms and ways of leveraging existing funds in new ways (Chapter 4).

The need to continue to support involvement of communities in conservation efforts
The role of communities and involvement of citizens in conservation projects and activities is one of the reasons why Hawai‘i has several conservation success stories. To continue to support these initiatives, the important role of communities and community involvement in conservation is highlighted as strategies in both the statewide and island conservation needs sections (Chapters 4 and 6 respectively).

The need to highlight freshwater resources and better integrate them with terrestrial and marine sections
In Hawai‘i, the connection between issues affecting both land and sea are important. For example, habitat loss and degradation in the watersheds affect freshwater streams and water quality, which in turn affects marine habitats through sedimentation and pollution. To further emphasize these connections and integration of habitats and threats, additional information was provided for freshwater habitats and the threats facing these areas in the statewide overview (Chapters 3 and 4). Similarly, objectives and threats to freshwater habitats identified in the statewide and marine chapters were better integrated and repeated or added to in the island sections on freshwater resources (Chapter 6).

The need to highlight conservation threats such as development
The Strategy is required to identify and describe threats to Species of Greatest Conservation Need. Major threats are identified at the statewide level (Chapter 4) as well as at the marine (Chapter 5) and island levels (Chapter 6). However, one consistent threat heard at the public open houses and technical workshops was the concern over development, particularly of open spaces and along streams and shorelines. To address this, development and shoreline alterations have been pulled out as threats under “Loss and Degradation of Habitat.” Fire as well as sedimentation has also been similarly added. Other threats identified at the island level have been added in the island overviews (Chapter 6).

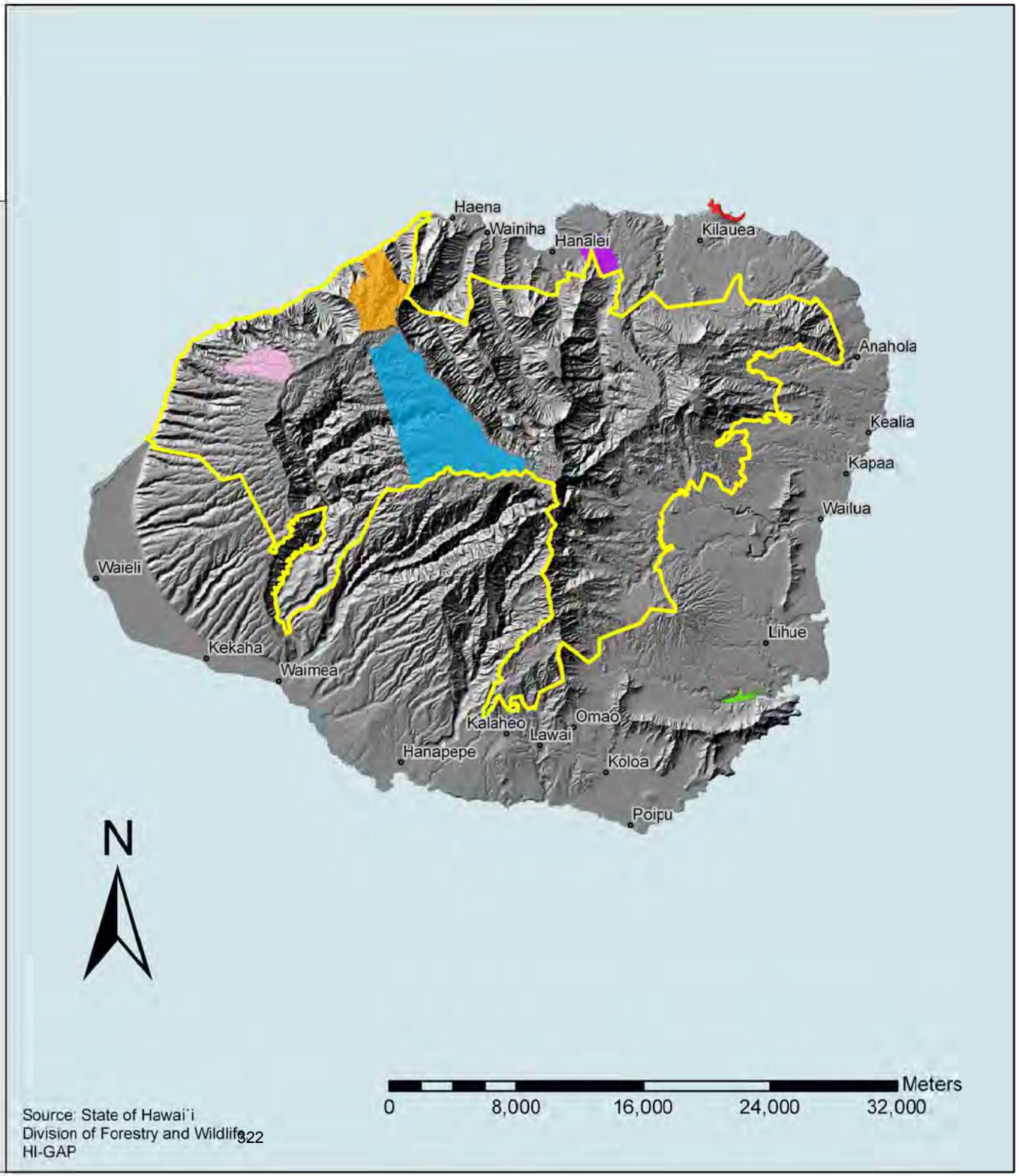
The need to prioritize actions
Given the great conservation needs and limited funding available to address these needs, people felt that further prioritization of actions was necessary in the Strategy than had already been done. As a result of this feedback, in Chapter 4 Statewide Conservation Needs, highest priority strategies were identified under each of the seven conservation objectives listed. These strategies were selected based on the degree to which they would contribute to conservation over the next ten years, strategies that need to occur first before other strategies can be implemented, and feedback during the technical workshops and public open houses held during the months of June and July.

The need to highlight additional areas that would benefit from future conservation management.
The public scoping draft recognized areas that could benefit from increased conservation management. Many individuals or groups highlighted additional areas for this section.

These additional areas were considered for addition, evaluation for future additions, or additions to include in on-going processes (e.g. marine managed areas re-evaluation).

Current Management of Species and Habitats on the Island of Kaua`i

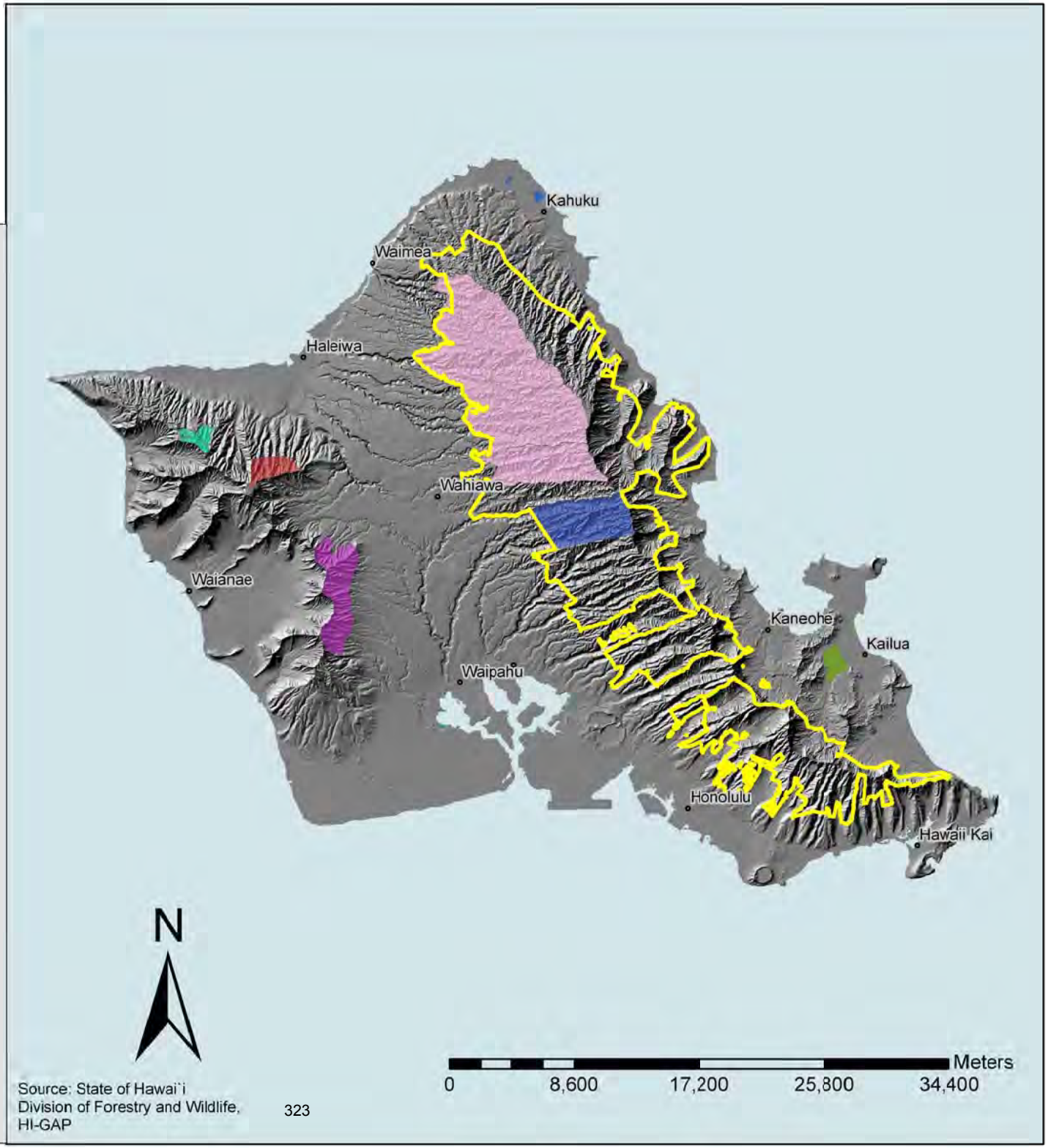
- Alakai Wilderness Preserve
- Hanalei National Wildlife Refuge
- Hono O Na Pali Natural Area Reserve
- Hule'ia National Wildlife Refuge
- Kilauea Point National Wildlife Refuge
- Ku'ia Natural Area Reserve
- Kaua`i Watershed Alliance



Source: State of Hawai`i
Division of Forestry and Wildlife
HI-GAP

Current Management of Species and Habitats on the Island of O`ahu

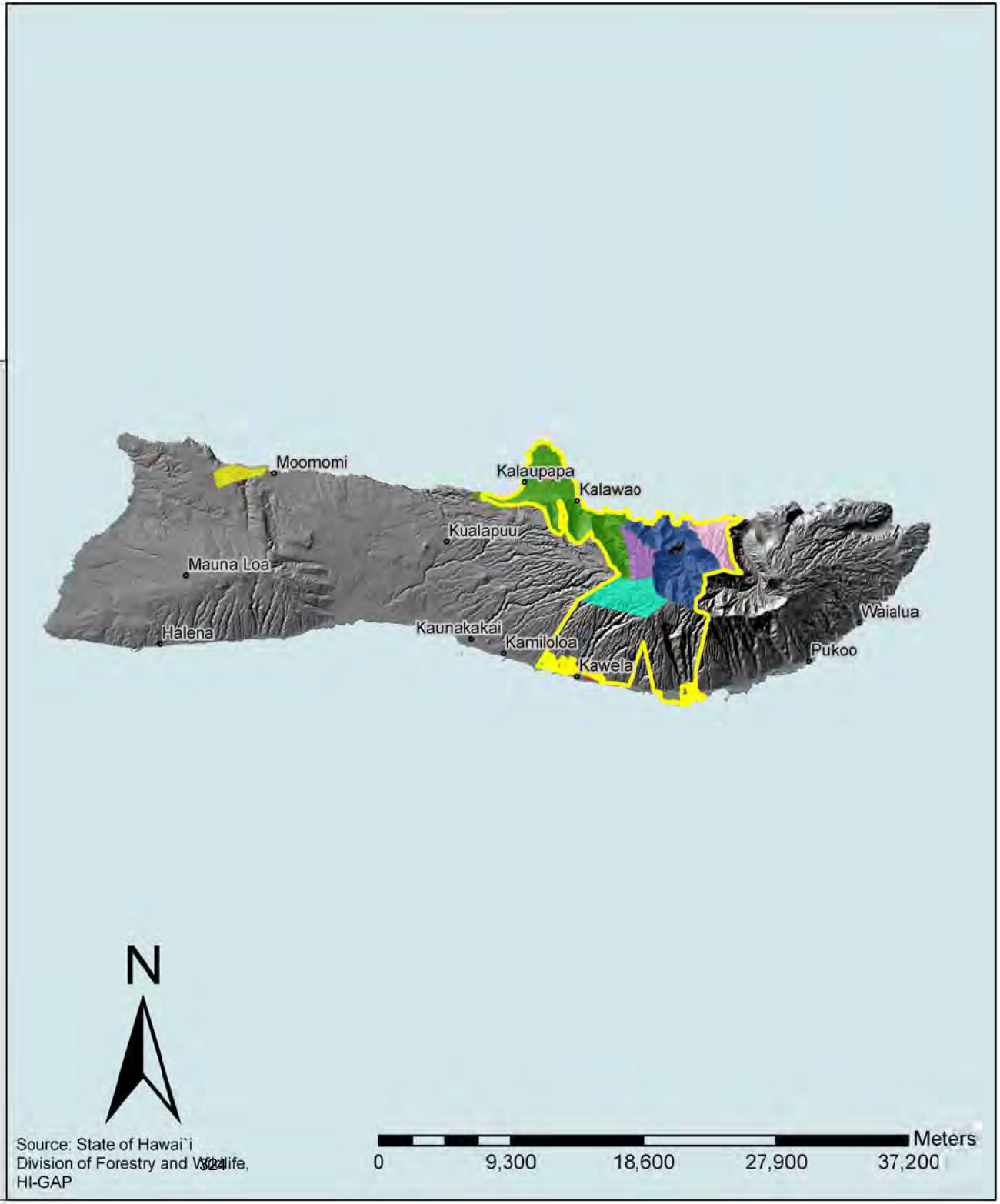
- Kawai Nui Marsh
- Kawailoa Training Area
- Honouliuli Preserve
- James Campbell National Wildlife Refuge
- Ka`ala Natural Area Reserve
- Ka`ena Point Natural Area Reserve
- O`ahu Forest National Wildlife Refuge
- Pahole Natural Area Reserve
- Paiko Lagoon Wildlife Sanctuary
- Pearl Harbor National Wildlife Refuge
- Ko`olau Mountains Watershed Partnership



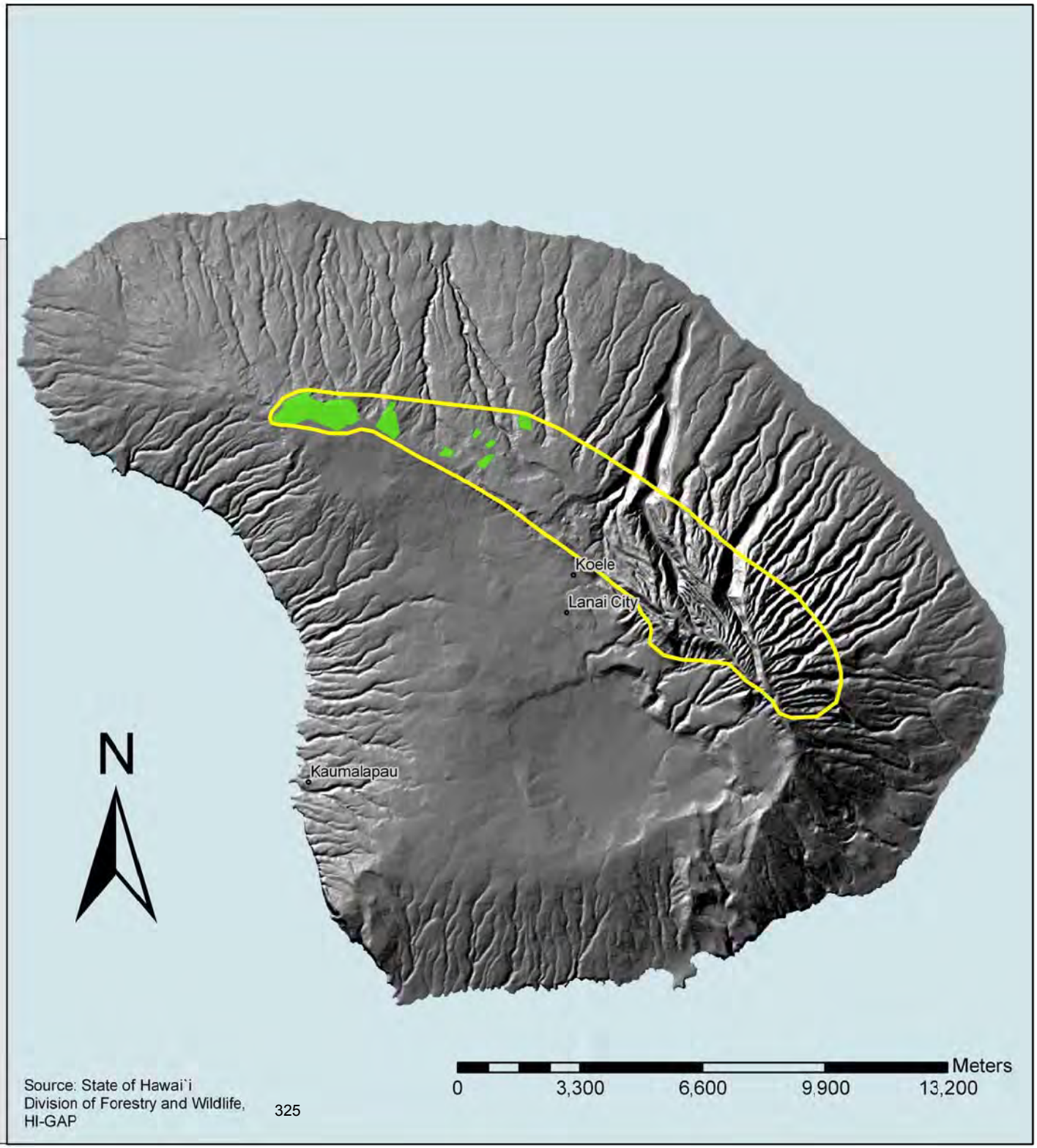
Source: State of Hawai`i Division of Forestry and Wildlife, HI-GAP

Current Management of Species and Habitats on the Island of Moloka`i

- Kakahai'a National Wildlife Refuge
- Kalaupapa National Historical Park
- Kamakou Preserve
- Mo'omomi Preserve
- Oloku'i Natural Area Reserve
- Pelekunu Preserve
- Pu'u Ali'i Natural Area Reserve
- East Moloka`i Watershed Partnership

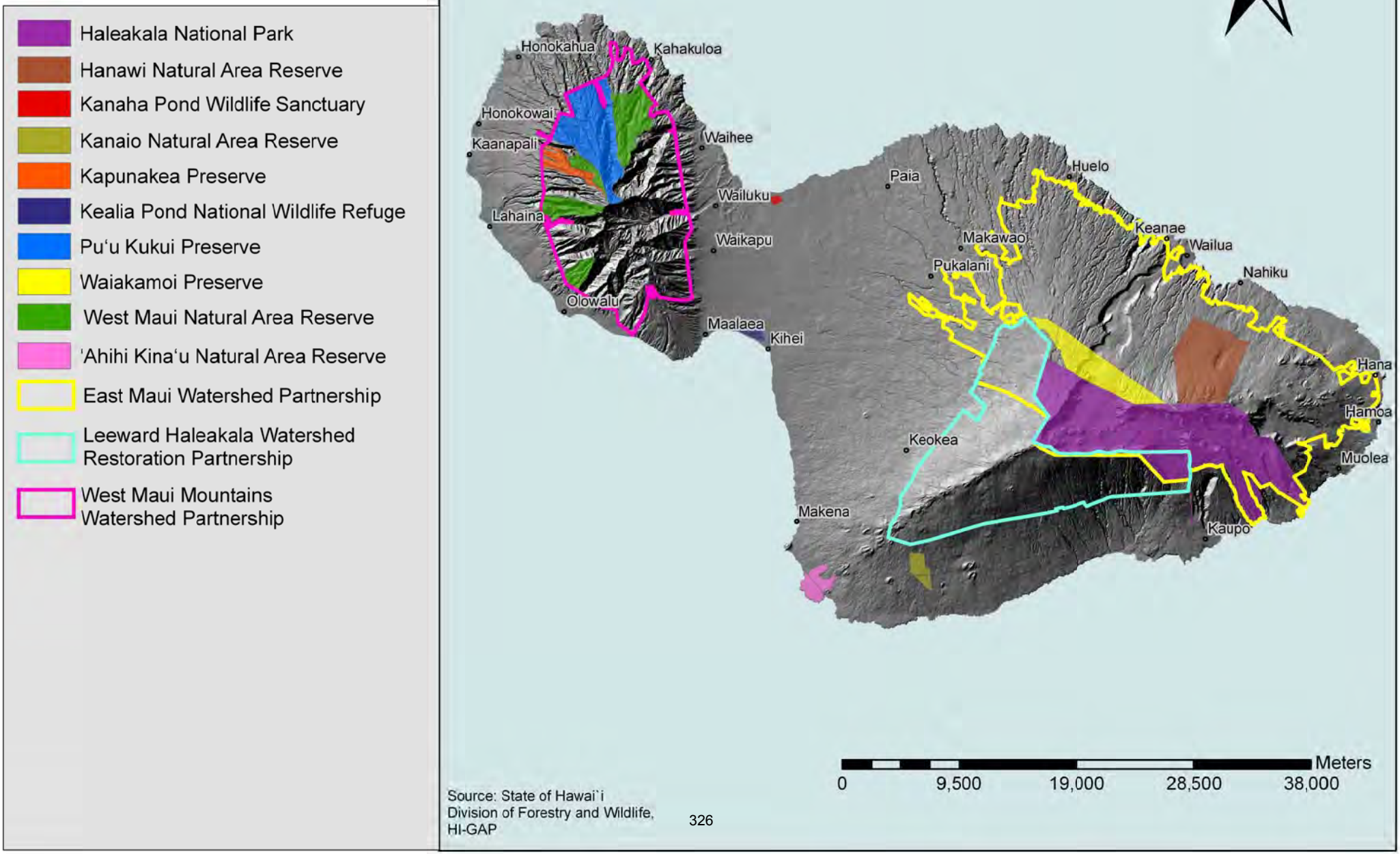


Current Management of Species and Habitats on the Island of Lana`i

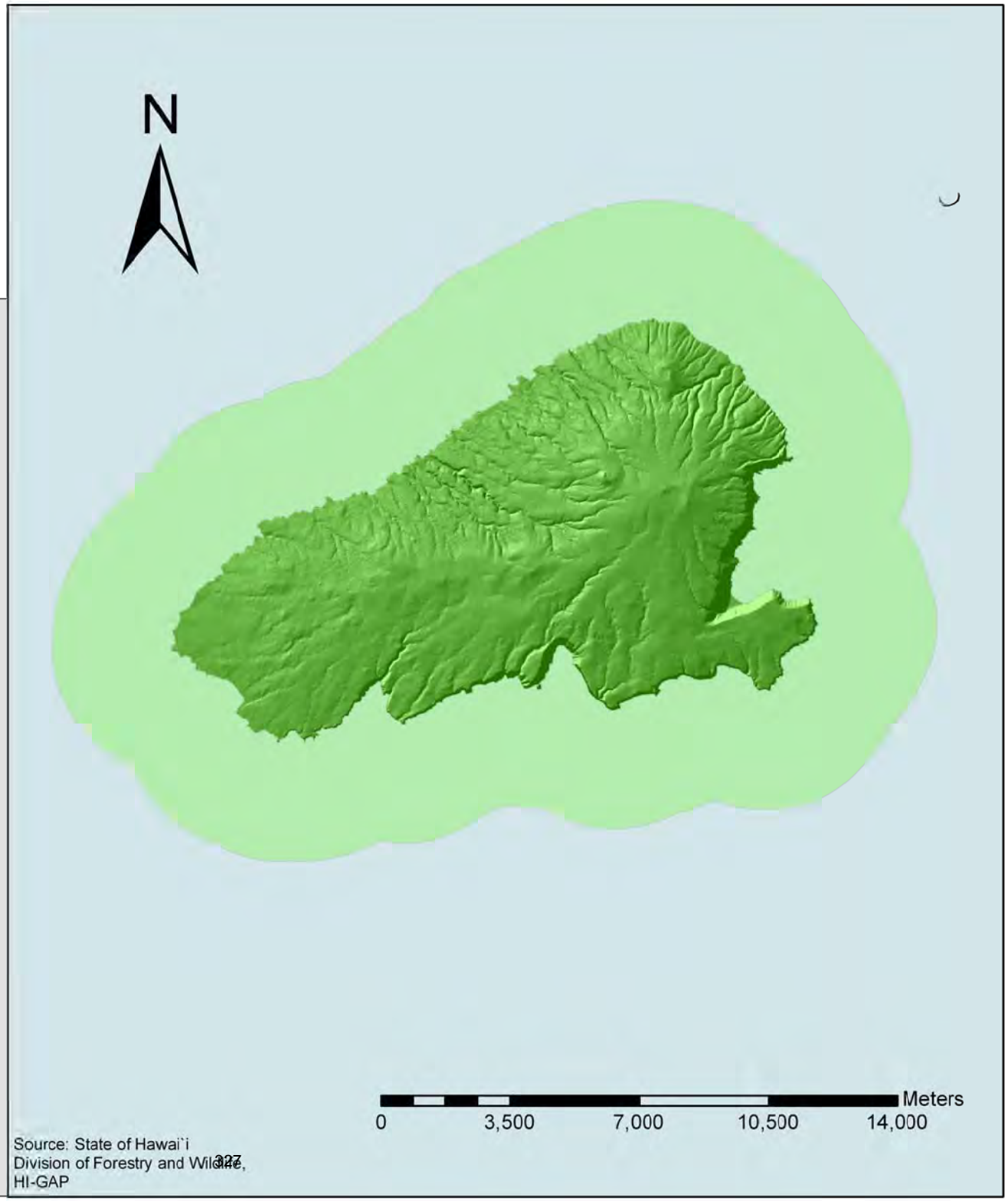


Source: State of Hawai`i Division of Forestry and Wildlife, HI-GAP

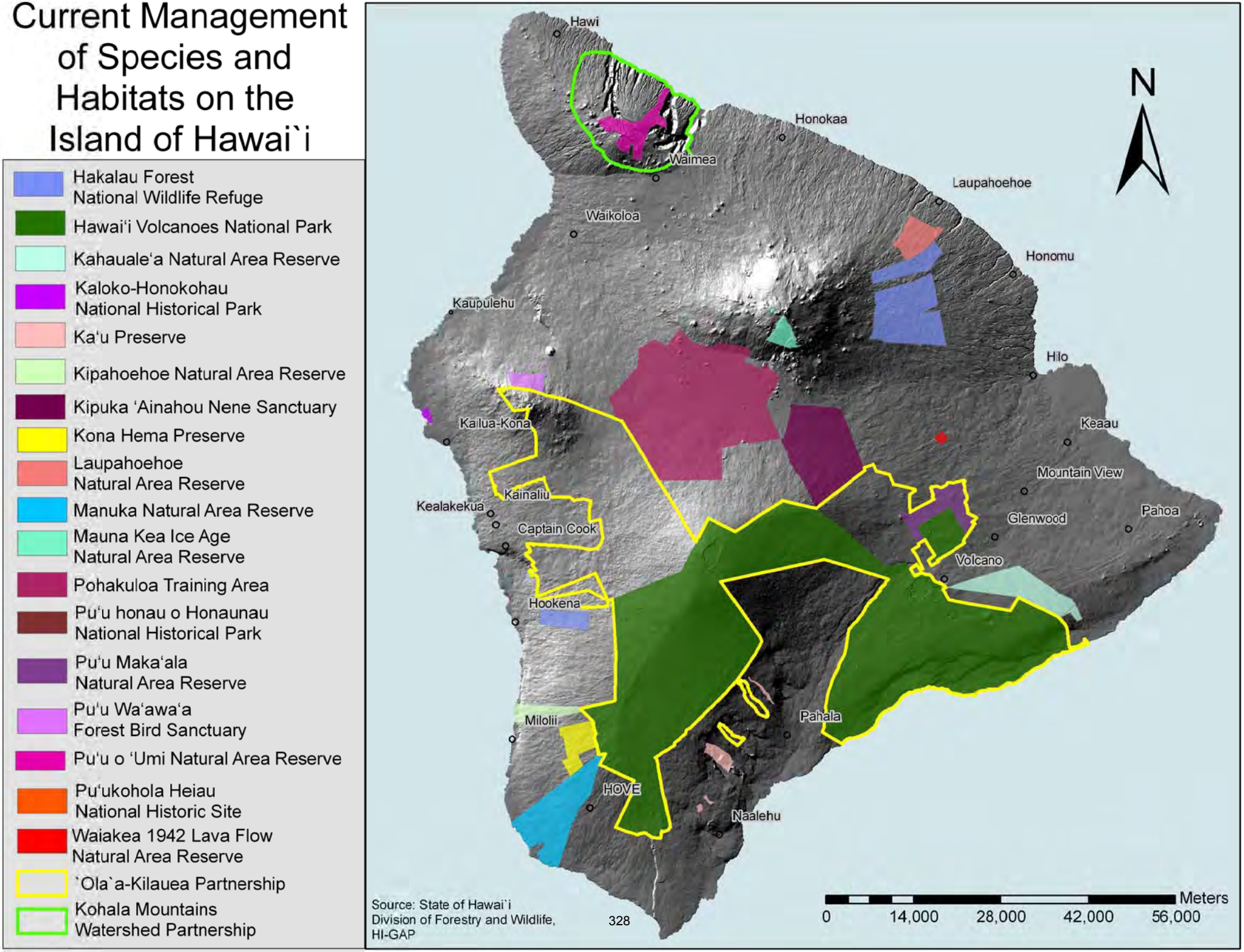
Current Management of Species and Habitats on the Island of Maui

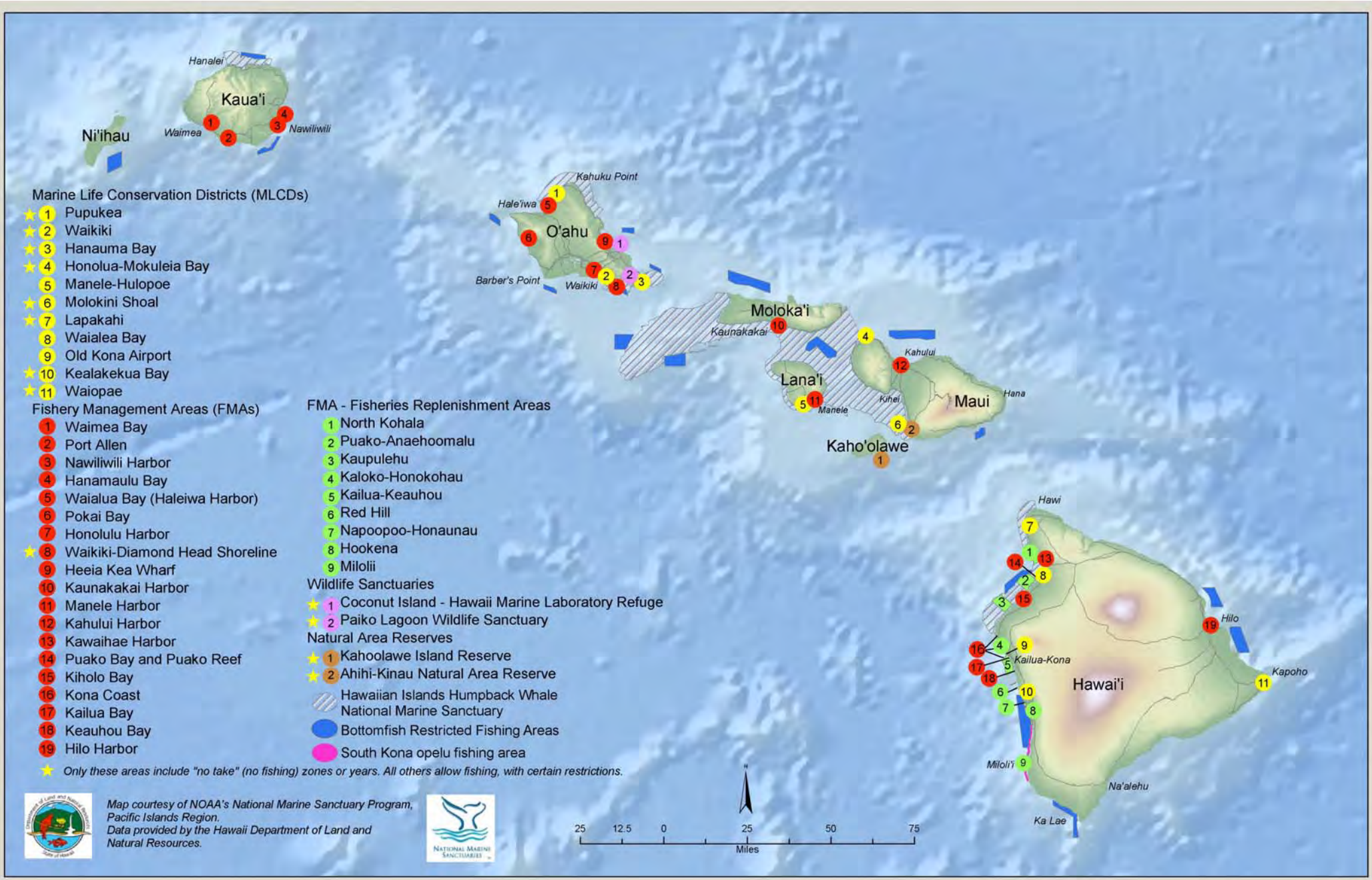


Current Management of Species and Habitats on the Island of Kaho`olawe



Current Management of Species and Habitats on the Island of Hawai`i




Hanalei
Kaua'i
Ni'ihau
Waimea
Nawiliwili
Kahuku Point
Hale'iwa
O'ahu
Barber's Point
Waikiki
Moloka'i
Kaunakakai
Kahului
Lana'i
Maui
Hana
Kihei
Manele
Kaho'olawe
Hawi
Hilo
Kailua-Kona
Hawai'i
Kapoho
Miloli'i
Na'alehu
Ka Lae
Marine Life Conservation Districts (MLCDs)
1 Pupukea
2 Waikiki
3 Hanauma Bay
4 Honolua-Mokuleia Bay
5 Manele-Hulopoe
6 Molokini Shoal
7 Lapakahi
8 Waialea Bay
9 Old Kona Airport
10 Kealakekua Bay
11 Waiopae
Fishery Management Areas (FMAs)
1 Waimea Bay
2 Port Allen
3 Nawiliwili Harbor
4 Hanamaulu Bay
5 Waialua Bay (Haleiwa Harbor)
6 Pokai Bay
7 Honolulu Harbor
8 Waikiki-Diamond Head Shoreline
9 Heeia Kea Wharf
10 Kaunakakai Harbor
11 Manele Harbor
12 Kahului Harbor
13 Kawaihae Harbor
14 Puako Bay and Puako Reef
15 Kiholo Bay
16 Kona Coast
17 Kailua Bay
18 Keauhou Bay
19 Hilo Harbor
FMA - Fisheries Replenishment Areas
1 North Kohala
2 Puako-Anaehoomalu
3 Kaupulehu
4 Kaloko-Honokohau
5 Kailua-Keauhou
6 Red Hill
7 Napoopoo-Honaunau
8 Hookena
9 Mililii
Wildlife Sanctuaries
1 Coconut Island - Hawaii Marine Laboratory Refuge
2 Paiko Lagoon Wildlife Sanctuary
Natural Area Reserves
1 Kahoolawe Island Reserve
2 Ahihi-Kinau Natural Area Reserve
Hawaiian Islands Humpback Whale National Marine Sanctuary
Bottomfish Restricted Fishing Areas
South Kona opelu fishing area
Only these areas include "no take" (no fishing) zones or years. All others allow fishing, with certain restrictions.
Map courtesy of NOAA's National Marine Sanctuary Program, Pacific Islands Region.
Data provided by the Hawaii Department of Land and Natural Resources.
25 12.5 0 25 50 75
Miles