U.S. Fish & Wildlife Service

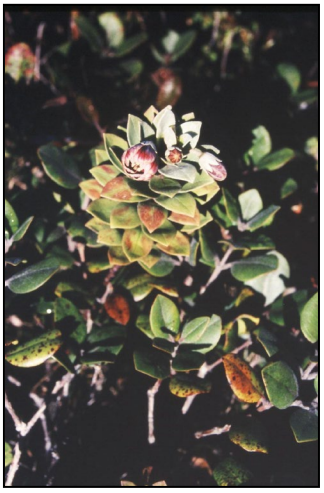
Draft Kauai Islandwide Recovery Plan

Akekee, photo by J. Denny

Dubautia waialealae, photo by M. Bruegmann/USFWS

Blackburn's sphinx moth, photo by Betsy Gagné.

Alae keokeo, photo by E. VanderWerf/USFWS



Lysimachia daphnoides and *Hibiscadelphus distans*, photos by M. Bruegmann/USFWS

Draft Kauai Islandwide Recovery Plan

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September 2019

U.S. Fish and Wildlife Service

Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXX
Regional Director
U.S. Fish and Wildlife Service
Date: XXXXXXXXXXXXXXXXXXXXXXXXXX

EXECUTIVE SUMMARY

Current Species Status and Distribution: This Draft Kauai Islandwide Recovery Plan addresses 175 species of listed plants and animals. The range and current status of each species is provided below. Of the 175 species in this recovery plan, 111 are endemic to Kauai (99 plants, 5 invertebrates, and 7 vertebrates) and are fully addressed in this recovery plan. Kauai-only actions are included for species known from multiple islands; the full recovery actions and recovery criteria for those multi-island species will be covered in a separate multi-island recovery plan.

Island distribution and status of the 175 species covered in this plan.

Scientific Name	Common Name	Listing Status	Island Distribution*	Known or estimated number of populations	Known or estimated number of individuals
PLANTS					
Acaena exigua	Lili wai	Endangered	KX, MX	0	0
Achyranthes mutica	No common name	Endangered	KX, H	4	38
Adenophorus periens	Fern, pendant kihi	Endangered	K, OX, LX, Mo, H	12	<123
Alectryon macrococcus	Mahoe	Endangered	K, O, Mo, M	~30	~337
Asplenium dielerectum	Diellia, asplenium-leaved	Endangered	KX, O, LX, Mo, M, H	5	~100
Asplenium dielmannii	No common name	Endangered	K	2	69
Asplenium dielpallidum	No common name	Endangered	K	6	12
Astelia waialealae	Painiu	Endangered	K	4	16
Bonamia menziesii	No common name	Endangered	K, O, L, MoX, M, H	31	~140
Brighamia insignis	Olulu	Endangered	K, NiiX	1	1
Canavalia napaliensis	Awikiwiki	Endangered	K	4+	<206
Canavalia pubescens	Awikiwiki	Endangered	KX, NiX, L, M	4	<200
Charpentiera densiflora	Papapa	Endangered	K	7	400
Ctenitis squamigera	Pauoa	Endangered	KX, O, L, Mo, M	10	~240
Cyanea asarifolia	Haha	Endangered	K	1	50
Cyanea dolichopoda	Haha	Endangered	K?	0	0
Cyanea eleeleensis	Haha	Endangered	K?	0	0
Cyanea kolekoleensis	Haha	Endangered	K	1	~1-3
Cyanea kuhihewa	Haiwale	Endangered	K	0	0
Cyanea recta	Haha	Threatened	K	8	~1,000
Cyanea remyi	Haha	Endangered	K	3	24
Cyanea undulata	No common name	Endangered	K	1	6
Cyperus pennatiformis	No common name	Endangered	KX, OX, M, La	0	0
Cyperus trachysanthos	Puukaa	Endangered	K, NiX, O, LX, MoX	7	691-1,000

Scientific Name	Common Name	Listing Status	Island Distribution*	Known or estimated number of populations	Known or estimated number of individuals
Cyrtandra cyaneoides	Mapele	Endangered	K	11	<800
Cyrtandra limahuliensis	Haiwale	Threatened	K	~10	several thousand
Cyrtandra oenobarba	Haiwale	Endangered	K	8	<450
Cyrtandra paliku	Haiwale	Endangered	K	1	10
Delissea rhytidosperma	No common name	Endangered	Ni, K	2	8
Delissea rivularis	Oha	Endangered	K	1	19
Diplazium molokaiense	No common name	Endangered	KX, OX, LX, MoX, M	3	~65
Doryopteris angelica	No common name	Endangered	K	5	14
Dryopteris crinalis var. *podosorus*	Palapalai aumakua	Endangered	K	3	~40
Dubautia imbricata subsp. *imbricata*	Naenae	Endangered	K	3	~1,400
Dubautia kalalauensis	Naenae	Endangered	K	1	26
Dubautia kenwoodii	Naenae	Endangered	K?	0	0
Dubautia latifolia	Naenae	Endangered	K	11	<200
Dubautia pauciflorula	Naenae	Endangered	K	5	~50
Dubautia plantaginea subsp. *magnifolia*	Naenae	Endangered	K	1	100
Dubautia waialealae	Naenae	Endangered	K	1	3,000
Euphorbia eleanoriae	Akoko	Endangered	K	3	<50
Euphorbia haeleeleana	Akoko	Endangered	K, O	16	445
Euphorbia halemanui	No common name	Endangered	K	4	<400
Euphorbia remyi var. *kauaiensis*	Akoko	Endangered	K	5	~1,000
Euphorbia remyi var. *remyi*	Akoko	Endangered	K	10	350
Exocarpos luteolus	Heau	Endangered	K	8	39
Flueggea neowawraea	Mehamehame	Endangered	K, O, MoX, M, H	15	~120
Gardenia remyi	Nanu	Endangered	K, Mo, M, H	19	~85
Geranium kauaiense	Nohoanu	Endangered	K	3	140
Gouania meyenii	No common name	Endangered	O, K	2	<63
Haplostachys haplostachya	Honohono	Endangered	KX, MX, H	2	>10,000
Hesperomannia lydgatei	No common name	Endangered	K	1	~100
Hibiscadelphus distans	Kauai hau kuahiwi	Endangered	K	2	~170
Hibiscadelphus woodii	Hau kuahiwi	Endangered	K	1	1
Hibiscus brackenridgei	Mao hau hele, (=native yellow hibiscus)	Endangered	KX, O, L, MoX, M, H	12	~245
Hibiscus clayi	Clay's hibiscus	Endangered	K	2	55
Hibiscus waimeae subsp. *hannerae*	Kokio keokeo	Endangered	K	3	~80

Scientific Name	Common Name	Listing Status	Island Distribution*	Known or estimated number of populations	Known or estimated number of individuals
Huperzia mannii	Wawaeiole	Endangered	KX, M, HX	9	~70
Huperzia nutans	Wawaeiole	Endangered	KX, O	5	11
Ischaemum byrone	Ischaemum, Hilo	Endangered	K, O, Mo, M, H	11	>500
Isodendrion laurifolium	Aupaka	Endangered	K, O	18	~170
Isodendrion longifolium	Aupaka	Threatened	K, O	7	103
Joinvillea ascendens spp. *ascendens*	Ohe	Endangered	K, O, Mo, M, H	43	<200
Kadua cookiana	Awiwi	Endangered	K, HX	2	~110
Kadua fluviatilis	Kamapuaa	Endangered	K, O	11	<900
Kadua st.-johnii	No common name	Endangered	K	3	<50
Kanaloa kahoolawensis	Ka palupalu o Kanaloa	Endangered	KX, OX, MX, Ka	1	1
Keysseria erici	No common name	Endangered	K	<4	>3,000
Keysseria helenae	No common name	Endangered	K	3	~300
Kokia kauaiensis	Kokio	Endangered	K	5	<50
Labordia helleri	Kamakahala	Endangered	K	10	<550
Labordia lydgatei	Kamakahala	Endangered	K	5	29
Labordia pumila	Kamakahala	Endangered	K	3	<900
Labordia tinifolia var. *wahiawaensis*	Kamakahala	Endangered	K	1	<30
Lipochaeta fauriei	Nehe	Endangered	K	10	<240
Lipochaeta micrantha	Nehe	Endangered	K	<6	<720
Lipochaeta waimeaensis	Nehe	Endangered	K	1	180
Lobelia niihauensis	No common name	Endangered	K, NiX, O	17	~1,600
Lysimachia daphnoides	Lehua makanoe	Endangered	K	3	<300
Lysimachia iniki	No common name	Endangered	K	1	40
Lysimachia pendens	No common name	Endangered	K	1	~10
Lysimachia scopulensis	No common name	Endangered	K	1	~30
Lysimachia venosa	No common name	Endangered	K?	0	0
Melicope degeneri	Alani	Endangered	K	1	~22
Melicope haupuensis	Alani	Endangered	K	3	30
Melicope knudsenii	Alani	Endangered	K, M	4	4
Melicope pallida	Alani	Endangered	K, OX	7	<296
Melicope paniculata	Alani	Endangered	K	6	<200
Melicope puberula	Alani	Endangered	K	3	~900
Melicope quadrangularis	Alani	Endangered	K?	0	0
Mezoneuron kavaiense	Uhiuhi	Endangered	KX, O, LX, MoX, MX, H	7	~80
Myrsine fosbergii	Kolea	Endangered	K, O	14	103
Myrsine knudsenii	Kolea	Endangered	K	3	30
Myrsine linearifolia	Kolea	Threatened	K	12	<197
Myrsine mezii	Kolea	Endangered	K	2	2
Nothocestrum latifolium	Aiea	Endangered	K, O, Mo, L, M	17	<1,200

Scientific Name	Common Name	Listing Status	Island Distribution*	Known or estimated number of populations	Known or estimated number of individuals
Nothocestrum peltatum	Aiea	Endangered	K	7	23
Panicum niihauense	Lau ehu	Endangered	K, NiX	1	~35
Peucedanum sandwicense	Makou	Threatened	K, O, Mo, M	16-18	<2,135
Phyllostegia knudsenii	No common name	Endangered	K?	0	0
Phyllostegia renovans	No common name	Endangered	K	5	36
Phyllostegia waimeae	No common name	Endangered	K	1	~6
Phyllostegia wawrana	No common name	Endangered	K	2	~50
Pittosporum napaliense	Hoawa	Endangered	K	3	<200
Plantago princeps	Kuahiwi laukahi	Endangered	K, O, Mo, M, H	22	several thousand
Platanthera holochila	No common name	Endangered	K, OX, Mo, MX	3	26
Platydesma rostrata	Pilo kea lau lii	Endangered	K	15-20	~100
Poa mannii	Mann's bluegrass	Endangered	K	13	>100
Poa sandvicensis	Hawaiian bluegrass	Endangered	K	9	~6,000
Poa siphonoglossa	No common name	Endangered	K	6	<70
Polyscias bisattenuata	No common name	Endangered	K	2	37
Polyscias flynnii	No common name	Endangered	K	2	5
Polyscias racemosa	No common name	Endangered	K	17	<99
Pritchardia hardyi	Loulu	Endangered	K	2	300
Pritchardia napaliensis	Loulu	Endangered	K	6	157
Pritchardia viscosa	Loulu	Endangered	K	1	4
Psyschotria grandiflora	Kopiko	Endangered	K	10	<700
Psyschotria hobdyi	Kopilo	Endangered	K	10	<30
Pteralyxia kauaiensis	Kaulu	Endangered	K	10	120
Ranunculus mauiensis	Makou	Endangered	K, O, Mo, M, H	14	198
Remya kauaiensis	No common name	Endangered	K	17	~110
Remya montgomeryi	No common name	Endangered	K	6	18
Scaevola coriacea	Naupaka, dwarf	Endangered	KX, NiX, OX, LX, Mo, M, HX	3	108
Schenkia sebaeoides	Awiwi	Endangered	K, O, L, Mo, M	17-18	~6,000
Schiedea apokremnos	Maolioli	Endangered	K	9	~800
Schiedea attenuata	No common name	Endangered	K	1	20
Schiedea helleri	No common name	Endangered	K	2	<101
Schiedea kauaiensis	No common name	Endangered	K	2	6
Schiedea lychnoides	Kuawawaenohu	Endangered	K	7	35
Schiedea membranacea	No common name	Endangered	K	5	90
Schiedea nuttalii	No common name	Endangered	K,O	2	<46
Schiedea spergulina var. *leiopoda*	No common name	Endangered	K	1	<325
Schiedea spergulina var. *spergulina*	No common name	Threatened	K	6	<585
Schiedea stellarioides	Laulihilihi	Endangered	K	3	<300
Schiedea viscosa	No common name	Endangered	K	5	30

Scientific Name	Common Name	Listing Status	Island Distribution*	Known or estimated number of populations	Known or estimated number of individuals
Sesbania tomentosa	Ohai	Endangered	K, NiX, O, Ka, L, Mo, M, H, Nh, Ne	20	<7,500
Silene lanceolata	No common name	Endangered	KX, O, LX, Mo, H	5	>20,000
Solanum incompletum	Popolo ku mai	Endangered	KX, LX, MoX, MX, H	2	83
Solanum nelsonii	Popolo	Endangered	KX, Ni, OX, Mo, MX, H, Mi, Nh, PH, La	8	<16,056
Solanum sandwicense	Popolo aiakeakua	Endangered	K,O	5	~20
Spermolepis hawaiiensis	No common name	Endangered	K, O, L, MoX, M, H	19	< 13,100
Stenogyne campanulata	No common name	Endangered	K	1	~50
Stenogyne kealiae	No common name	Endangered	K	5	<200
Viola helenae	No common name	Endangered	K	2	7
Viola kauaiensis var. *wahiawaensis*	Nani waialeale	Endangered	K	2	<50
Wilkesia hobdyi	Dwarf iliau	Endangered	K	10	<809
Xylosma crenatum	No common name	Endangered	K	4	20
Zanthoxylum hawaiiense	Ae	Endangered	K, LX, Mo, M, H	8	550
INVERTEBRATES					
Adelocosa anops	Kauai cave wolf spider	Endangered	K	1	unknown
Drosophila musaphilia	Hawaiian picture-winged fly	Endangered	K?	0	unknown
Drosophila sharpi	Hawaiian picture-winged fly	Endangered	K?	0	unknown
Erinna newcombi	Newcomb's snail	Endangered	K	10	<400
Manduca blackburni	Blackburn's sphinx moth	Endangered	KX, OX, MoX, LX, M, H	4	unknown
Megalagrion pacificum	Pacific Hawaiian damselfly	Endangered	KX, O, L, Mo, M, H	0	unknown
Megalagrion xanthomelas	Orangeblack Hawaiian damselfly	Endangered	KX, O, L, Mo, M, H	0	unknown
Spelaeorchestia koloana	Kauai cave amphipod	Endangered	K	1	unknown
VERTEBRATES					
Akialoa stejnegeri	Kauai akialoa	Endangered	K	1	unknown
Anas laysanensis	Laysan duck	Endangered	La, Mi	2	611
Anas wyvilliana	Koloa maoli, Hawaiian duck	Endangered	K, Ni, O, H , M	1	2,000

Scientific Name	Common Name	Listing Status	Island Distribution*	Known or estimated number of populations	Known or estimated number of individuals
Branta sandvicensis	Nene, Hawaiian goose	Endangered	K, M, Mo, H	4	<2,0000
Chelonia mydas	Green turtle	Threatened	Statewide	1	400
Fulica alai	Alae keokeo, Hawaiian coot	Endangered	K, Ni, O, Mo, L, M, H	6	~1,500
Gallinula galeata sandvicensis	Alae ula, Hawaiian common moorhen	Endangered	K, O, MoX, MX, HX	2	<400
Hemignathus hanapepe	Kauai nukupuu	Endangered	K	1	unknown
Himantopus mexicanus knudseni	Aeo, Hawaiian stilt	Endangered	K, Ni, O, Mo, L, M, H	6	<2,0000
Lasiurus cinereus semotus	Opeapea, Hawaiian hoary bat	Endangered	K, O, L, Mo, M, H	5	unknown
Loxops caeruleirostris	Akekee, Kauai akepa	Endangered	K	1	945
Moho braccatus	Oo aa, Kauai oo	Endangered	K	1	unknown
Myadestes myadestinus	Kamao, large Kauai thrush	Endangered	K	1	unkonwn
Myadestes palmeri	Puaiohi, small Kauai thrush	Endangered	K	1	494
Oceanodroma castro	Akeake, Band-rumped storm-petrel (Hawaii Distinct Population Segment)	Endangered	K, LX, KaX, MX, H, LeX	3	240
Oreomystis bairdi	Akikiki, Kauai creeper	Endangered	K	1	468
Psittirostra psittacea	Ou	Endangered	KX, OX, LX, MoX, MX, HX	1	unknown
Pterodroma sandwichensis	Uau, dark-rumped Hawaiian petrel	Endangered	K, L, M, , MO, H, Ka	5	19,000
Puffinus auricularis	Ao, Newell's shearwater	Endangered	Ni?, K, O?, M, Mo, H	4	19,000

*Island distribution – K-Kauai, Ni-Niihau, O-Oahu, L-Lanai, Mo-Molokai, M-Maui, Ka- Kahoolawe, H-Hawaii, Nh-Nihoa, Ne-Necker, La-Laysan, PH-Pearl and Hermes, Mi-Midway, Le-Lehua. An "X" after an island indicates the species is extirpated from that island. A "?" indicates current occurrence on an island is unconfirmed but species is not considered likely extirpated.

Habitat Requirements and Limiting Factors: The 175 species included in this draft recovery plan occur in 10 different ecosystems, including coastal, dry cliff, lowland dry, lowland mesic, lowland wet, montane mesic, montane wet, wet cliff, wetland, and stream. These species and the ecosystems in which they occur have been or are currently threatened by one or more of the following: habitat degradation or destruction from agriculture and urban development, feral ungulates, and/or ecosystem-altering invasive plant species; overcollection for scientific and other purposes; predation or herbivory by feral ungulates, other nonnative mammals, nonnative

invertebrates, and other nonnative species; disease spread by nonnative species, especially avian malaria and pox impacting native forest birds; lack of adequate regulations preventing new species introductions and controlling hunting; fire, drought, hurricanes, and other stochastic events; competition for space, light, water, and nutrients by species-specific introduced plant species; and loss of mutualists and an increased likelihood of extinction and/or reduced reproduction from demographic or genetic issues associated with small populations.

Recovery Strategy: The overall strategy for the recovery of the species in this draft plan is to address recovery actions at three levels. The first addresses threats that are island or statewide issues, such as biosecurity (*i.e.*, preventing the influx of new invasive species to Hawaii). The second addresses recovery actions needed within the management units, and addresses ecosystem-level threats such as invasive species. The third addresses species-specific actions not covered in the first two levels, such as *ex situ* genetic storage and propagation for reintroduction when appropriate. Any population that exists outside the boundaries of a management unit will be assessed to determine if it can be moved to within a management unit or if the population locality can be managed until adequately genetically stored or reintroduced or translocated to an adequately managed management unit.

The isolation of the Hawaiian Islands has contributed both to the endemism of the species in this plan and to their potential for endangerment. The main islands are 4,000 kilometers (2,500 miles) from the nearest continent. Natural colonization therefore has been rare, and those species that have successfully colonized Hawaii were effectively isolated from their continental source population. Many species in this plan have unique and often spectacular morphological and/or behavioral specializations that make them particularly vulnerable to changes in their environment and increased susceptibility to introduced organisms. The highest priority actions are biosecurity at the island and statewide level, ungulate removal at the management unit level, and disease control and controlled propagation at the species level, and are discussed more thoroughly in section XV.A. Many additional actions are necessary to achieve delisting of the species in this recovery plan and they are included in the recovery stepdown outline and narrative in section XVI.

Recovery Goals: The goals of this draft recovery plan are to:

- Achieve and protect self-sustaining populations of the 175 listed species that occur on Kauai in management units throughout as much of their ecologic, geographic, and genetic range as possible, by minimizing or eliminating the threats that caused the species to be listed.

- Restore and maintain the ecosystems which support the 175 listed species.

- Delist the 111 Kauai endemic listed species (*i.e.,* remove from the Federal List of Endangered and Threatened Wildlife and Plants) based on an analysis of the 5 factors listed under section 4(a) of the Endangered Species Act (Act) and the delisting criteria identified in this recovery plan. For the 64 multi-island listed species occurring on Kauai, implement Kauai-specific recovery actions to support delisting based on 5-factor analysis and criteria to be identified in future in the multi-island recovery plan.

Interim goals of this draft recovery plan are to:

- Stabilize those species most at risk of extinction. Ecosystem management cannot occur fast enough to prevent the extinction of species whose numbers are currently low, so emergency actions are needed to prevent imminent extinction while ecosystem management progresses.

- Reclassify Kauai endemic endangered species to threatened (*i.e.*, downlist). Reclassification will be appropriate when each species is no longer in danger of extinction throughout a significant portion of its range based on an analysis of the 5 factors listed under section 4(a) of the Act.

- Maintain or increase the Kauai populations of listed species found on multiple islands as appropriate.

Recovery Objectives: This section of the draft recovery plan sets general objectives for the downlisting and delisting of the species in this plan that are endemic to Kauai. The order in which the recovery tasks are listed in the stepdown outline and narrative is not necessarily the order in which the tasks should be implemented. Priorities for action and recommended time frames are contained in section XVII. The objectives of this recovery plan are to:

- Stabilize and protect populations of the 175 listed species, so further declines in species' status and ranges are prevented.

- Minimize or eliminate the threats that caused these species to be listed and minimize newly identified threats to delist these species.

- Conduct research necessary to refine reclassification (*i.e*., downlisting) and delisting criteria for the 111 Kauai island endemics.

- Ensure the long-term conservation of the 64 multi-island listed species' populations that occur on Kauai.

- Restore and maintain ecosystems to sustain viable populations of listed species, and prevent additional threats from emerging over time. By doing so, other species in

these ecosystems that have not yet been listed will likely be conserved so that they may not need the protection of the Act.

Recovery Criteria: An endangered species is defined in the Act as a species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a species warrants downlisting or delisting, we consider whether the species meets either of these definitions. A recovered species is one that no longer meets the Act's definitions of threatened and endangered. These recovery criteria are our best assessment at this time of what needs to be completed so that the species may be downlisted or delisted (*i.e.*, meeting the definition of threatened but not the definition of endangered or meeting neither the definition of threatened nor endangered, respectively). Because the Service cannot envision the exact course that recovery may take and because our understanding of the vulnerability of a species to threats may change as more is learned about the species (*e.g.*, habitat, demography, genetics, etc.) and its threats, it is possible that a status review may indicate that downlisting or delisting is warranted even if not all recovery criteria are met. Conversely, it is possible that the recovery criteria could be met and a status review may indicate that downlisting or delisting is not warranted (*e.g.*, a new threat may emerge that is not addressed by the recovery criteria and causes the species to remain threatened or endangered). This is particularly true with respect to aspects of downlisting or delisting criteria related to the duration of monitoring periods (*e.g.*, stable or increasing population over 10 years). Specific recovery criteria are identified for the Kauai endemic plants, invertebrates, and forest birds. Recovery criteria for many multi-island species can be found in various species-specific or multi-species recovery plans that are currently available. These criteria will be reviewed and updated as needed in a separate multi-island recovery plan in the near future.

PLANTS

We lack current information on the status of the species and their habitats, breeding systems, genetics, and propagule storage options for many Hawaiian plant species. The following downlisting and delisting criteria for plants are based on the revised recovery objective guidelines developed by the Hawaii and Pacific Plants Recovery Coordinating Committee (HPPRCC), which functions as the Recovery Team for Hawaiian plant species (HPPRCC 2011; see Appendix G for additional details). Many Hawaiian plant species persist at very low numbers, so to assist in tracking progress toward the ultimate goal of recovery we also developed criteria based on HPPRCC recommendations to categorize species into two additional stages prior to downlisting: Preventing Extinction Stage and Interim Stage. These criteria should be assessed on a species-by-species basis, especially as additional information becomes available, before considering downlisting and delisting.

For the purposes of recovery criteria in this draft recovery plan, a plant population is a group of conspecific individuals in close proximity to each other (*i.e.*, less than 1,000 meters [3,280 feet] apart), and are presumed to be genetically similar and capable of sexual reproduction. Since we do not have adequate data to determine the effective population size for most species, the number of reproducing individuals per population is used as a surrogate for effective population size (*i.e.*, the number of individuals contributing to the next generation). The number of mature individuals per population identified for the Preventing Extinction and the Interim stages address concerns about the number of individuals needed to avoid inbreeding, while those numbers in the downlisting and delisting criteria address concerns about the number of mature individuals needed to maintain evolutionary potential so that a species can adapt to changing environments (Reed *et al*. 2002; Traill *et al*. 2010). Several life history traits in addition to life span were identified as important to maintaining a relatively stable effective population size and were therefore incorporated into the numbers of populations or mature individuals, depending on the impact of each life history trait (Pavlik 1996).

Reintroduction will be a crucial action to achieving recovery for many of these Hawaiian plants. Each reintroduction effort should take into account the genetic composition of the founders, number of founders used, number of individuals from each founder, and consider the species' reproductive capacity and habitat availability. It is recognized that for all species, some level of habitat management will be required to maintain viable populations, and in some cases, such as lowland dry forest, habitat restoration will be necessary.

In general, long-lived perennials are those taxa with life spans greater than 10 years; short-lived perennials are those with life spans greater than 1 year but less than 10 years; and annuals are those with life spans less than or equal to 1 year. When it is unknown whether a species is long- or short-lived, we have erred on the side of caution and considered the species short-lived. This will be revised as more is learned about the life histories of these species. A species with a narrow geographic range is one currently known from one or two adjacent gulches or ridges within the same mountain range. Some species have historically been known from only one population. For these species, given the limited information known of their habitat requirements, the number of mature individuals needed to prevent extinction was doubled within the known population rather than expanding the known range of the species for preventing extinction and the interim stage. Obligate outcrossers are those species that either have male and female flowers on separate plants or otherwise require cross-pollination to fertilize seeds, and therefore require equal numbers of individuals contributing to reproduction as males and females, doubling the number of mature individuals. Species that reproduce vegetatively may reproduce sexually only on occasion, resulting in the majority of the genetic variation being between populations, therefore requiring additional populations. Species that have a tendency to fluctuate in number from year to year require a larger number of mature individuals on average

to allow for decline in years of extreme habitat conditions and recuperation in numbers in years of more normal conditions.

Preventing Extinction. In addition to achieving the number of mature individuals identified in the table below, to meet the Preventing Extinction Stage target all major threats must be controlled in the immediate vicinity of the populations, each population must show evidence of some stage of natural reproduction (demonstrate some replacement regeneration, *i.e.*, viable seeds, seedlings, saplings), and 50 mature individuals from each population, or less if fewer than 50 remain, must be represented in an *ex situ* collection that is secure and well managed.

Number of populations and individuals needed to meet Preventing Extinction Stage based on population and life history characteristices.

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Long	No specific characteristics known	3	25	*Hibiscus waimeae ssp. hannerae* *Kokia kauaiensis* *Myrsine linearifolia* *Platydesma rostrata* *Polyscias racemosa* *Pritchardia hardyi* *Pritchardia napaliensis* *Pteralyxia kauaiensis*
Long	Narrow extant range	3	25	*Hibiscus clayi* *Pritchardia viscosa*
Long	Obligate outcrosser	3	50	*Charpentiera densiflora* *Hesperomannia lydgatei* *Melicope degeneri* *Melicope haupuensis* *Melicope paniculata* *Melicope puberula* *Melicope quadrangularis* *Nothocestrum peltatum* *Pittosporum napaliense* *Polyscias bisattenuata* *Polyscias flynnii* *Psychotria grandiflora* *Psychotria hobdyi* *Xylosma crenatum*
Long	Narrow extant range and obligate outcrosser	3	50	*Hibiscadelphus distans* *Hibiscadelphus woodii*
Long	Broad contiguous range and obligate outcrosser	3	50	*Exocarpos luteolus*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	No specific characteristics known	3	50	*Cyrtandra cyanaeoides* *Cyrtandra limahuliensis* *Cyrtandra oenobarba* *Dubautia imbricata* subsp. *imbricata* *Dubautia pauciflorula* *Dubautia waialelae* *Euphorbia eleanoriae* *Euphorbia halemanui* *Euphorbia remyi* var. *kauaiensis* *Euphorbia remyi* var. *remyi* *Geranium kauaiense* *Lysimachia daphnoides* *Lysimachia venosa* *Phyllostegia renovans* *Poa sandwicensis* *Poa siphonoglossa* *Schiedea helleri* *Schiedea lychnoides* *Schiedea stellarioides* *Stenogyne kealiae* *Wilkesia hobdyi*
Short	Narrow extant range	3	100	*Cyrtandra paliku* *Dubautia kalalauensis* *Dubautia kenwoodii* *Dubautia plantaginea* subsp. *magnifolia* *Lysimachia iniki* *Lysimachia pendens* *Myrsine knudsenii* *Myrsine mezii* *Phyllostegia knudsenii* *Phyllostegia wawrana* *Viola helenae*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Obligate outcrosser	3	100	*Cyanea recta* *Cyanea remyi* *Dryopteris crinalis* var. *podosorus* *Keysseria erici* *Keysseria helenae* *Labordia helleri* *Labordia lydgatei* *Labordia pumila* *Lipochaeta fauriei* *Lipochaeta micrantha* subsp. *exigua* *Lipochaeta micrantha* subsp. *micrantha* *Lipochaeta waimeaensis* *Remya kauaiensis* *Remya montgomeryi* *Schiedea apokremnos* *Schiedea kauaiensis* *Schiedea membranacea* *Schiedea perlmanii* *Schiedea spergulina*
Short	Narrow extant range and obligate outcrosser	3	100	*Asplenium dielmanii* *Asplenium dielpallida* *Astelia waialealae* *Cyanea asarifolia* *Cyanea kolekoleensis* *Cyanea rivularis* *Cyanea undulata* *Doryopteris angelica* *Kadua st.-johnii* *Labordia tinifolia* var. *wahianaensis* *Lysimachia scopulensis* *Phyllostegia waimeae* *Stenogyne campanulata* *Viola kauaiensis* subsp. *wahiawaensis*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Known from only one population and obligate outcrosser	1	200	*Cyanea dolichopoda* *Cyanea eleeleensis* *Cyanea kuhihewa* *Schiedea attenuata*
Short	Vegetatively reproducing	6	50	*Canavalia napaliensis*
Short	Tendency for decline or fluctuation in numbers	3	150	*Schiedea viscosa*
Short	Tendency for decline or fluctuation in numbers and obligate outcrosser	3	150	*Dubautia latifolia*
Annual	No specific characteristics known	3	100	*Poa mannii*

Interim Stage. In addition to meeting the Preventing Extinction Stage target and achieving the number of mature individuals identified in the table below, to meet the Interim Stage target all major threats must be controlled around each population designated for recovery at this stage, and each population must be naturally reproducing for a minimum of 5 years and adequately represented in an *ex situ* collection as defined in the Center for Plant Conservation's guidelines (Guerant *et al.* 2004). Reintroduced individuals can be counted when it is demonstrated that they are producing viable seed or vegetatively regenerating. There should be demonstrated regeneration of seedlings and growth to at least sapling stage for woody species and documented replacement regeneration within each of the populations. Genetic analysis should be conducted on all wild and any reintroduced populations to ensure maintenance of adequate genetic variation within and between the populations, incorporating any stock in controlled propagation from populations that have been lost in the wild. The results of the genetic analysis will be used to determine whether to mix founders in reintroduced populations. If the genetic variation within or among populations is demonstrated to be limited, this is less of a concern. Adequate monitoring must be in place and conducted to assess individual plant survival, population trends, trends of major limiting factors, and response of major limiting factors to management.

Number of populations and individuals needed to meet Interim Stage based on population and life history characteristics.

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Long	No specific characteristics known	3	100	*Hibiscus waimeae* ssp. *hannerae* *Kokia kauaiensis* *Myrsine linearifolia* *Platydesma rostrata* *Polyscias racemosum* *Pritchardia hardyi* *Pritchardia napaliensis* *Pteralyxia kauaiensis*
Long	Narrow extant range	3	100	*Hibiscus clayi* *Pritchardia viscosa*
Long	Obligate outcrosser	3	200	*Charpentiera densiflora* *Hesperomannia lydgatei* *Melicope degeneri* *Melicope haupuensis* *Melicope paniculata* *Melicope puberula* *Melicope quadrangularis* *Nothocestrum peltatum* *Pittosporum napaliense* *Polyscias bisattenuata* *Polyscias flynnii* *Psychotria grandiflora* *Psychotria hobdyi* *Xylosma crenatum*
Long	Narrow extant range and obligate outcrosser	3	200	*Hibiscadelphus distans* *Hibiscadelphus woodii*
Long	Broad contiguous range and obligate outcrosser	3	200	*Exocarpos luteolus*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	No specific characteristics known	3	300	*Cyrtandra cyanaeoides* *Cyrtandra limahuliensis* *Cyrtandra oenobarba* *Dubautia imbricata* subsp. *imbricata* *Dubautia pauciflorula* *Dubautia waialelae* *Euphorbia eleanoriae* *Euphorbia halemanui* *Euphorbia remyi* var. *kauaiensis* *Euphorbia remyi* var. *remyi* *Geranium kauaiense* *Lysimachia daphnoides* *Lysimachia venosa* *Phyllostegia renovans* *Poa sandwicensis* *Poa siphonoglossa* *Schiedea helleri* *Schiedea lychnoides* *Schiedea stellarioides* *Stenogyne kealiae* *Wilkesia hobdyi*
Short	Narrow extant range	3	300	*Cyrtandra paliku* *Dubautia kalalauensis* *Dubautia kenwoodii* *Dubautia plantaginea* subsp. *magnifolia* *Lysimachia iniki* *Lysimachia pendens* *Myrsine knudsenii* *Myrsine mezii* *Phyllostegia knudsenii* *Phyllostegia wawrana* *Viola helenae*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Obligate outcrosser	3	600	*Cyanea recta* *Cyanea remyi* *Dryopteris crinalis* var. *podosorus* *Keysseria erici* *Keysseria helenae* *Labordia helleri* *Labordia lydgatei* *Labordia pumila* *Lipochaeta fauriei* *Lipochaeta micrantha* subsp. *exigua* *Lipochaeta micrantha* subsp. *micrantha* *Lipochaeta waimeaensis* *Remya kauaiensis* *Remya montgomeryi* *Schiedea apokremnos* *Schiedea kauaiensis* *Schiedea membranacea* *Schiedea perlmanii* *Schiedea spergulina*
Short	Narrow extant range and obligate outcrosser	3	600	*Asplenium dielmannii* *Asplenium dielpallida* *Astelia waialealae* *Cyanea asarifolia* *Cyanea kolekoleensis* *Cyanea rivularis* *Cyanea undulata* *Doryopteris angelica* *Kadua st.-johnii* *Labordia tinifolia* var. *wahianaensis* *Lysimachia scopulensis* *Phyllostegia waimeae* *Stenogyne campanulata* *Viola kauaiensis* subsp. *wahiawaensis*
Short	Known from only one population and obligate outcrosser	1	1,200	*Cyanea dolichopoda* *Cyanea eleeleensis* *Cyanea kuhihewa* *Schiedea attenuata*
Short	Vegetatively reproducing	6	300	*Canavalia napaliensis*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Tendency for decline or fluctuation in numbers	3	900	*Schiedea viscosa*
Short	Tendency for decline or fluctuation in numbers and obligate outcrosser	6	900	*Dubautia latifolia*
Annual	No specific characteristics known	3	500	*Poa mannii*

Downlisting Criteria. To consider downlisting the 99 listed plant species endemic to Kauai to threatened, the following criteria should be met:

Criterion 1: Population size. In addition to meeting the Interim Stage target and achieving the number of mature individuals identified in the table below, to be considered for downlisting all populations designated for recovery must be stable, secure, and naturally reproducing for a minimum of 10 years. Downlisting should not be considered until an adequate viability analysis has been conducted to confirm the number of individuals needed to achieve a viable population. This analysis should be based on current management and monitoring data collected at intervals determined by the life history, threats and management of the species (*i.e.*, limiting factors, breeding system, population structure and density, and proven management methods for major threats). However, viability analysis should only be one of the factors used in making a decision to downlist a species.

Criterion 2: Management and monitoring plans. Adequate habitat to support each population must be managed to ensure that it will provide for the long-term persistence of the species. To achieve this, each of the priority 1 subunits within the management units identified for plant recovery will be actively managed to mitigate all threats based on the criteria in a management and monitoring plan with the goal of prioritizing species-specific actions needed to ensure population growth.

Criterion 3: Habitat quality. All of the populations designated for recovery shall be within large areas fenced and protected from ungulates, with agreements from conservation partners to maintain protections over the long-term. These agreements will include protocols for removing ecosystem altering invasive plant species, the maintenance of management unit and species-specific threats (see Table 7 for threats to each species) at levels that do not preclude recovery, and adaptive management plans to address any other unforeseeable threats. In addition, the agreements will include the goal of maximizing native plant biodiversity in these units.

Number of populations and individuals needed for Downlisting based on population and life history characteristics.

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Long	No specific characteristics known	10	200	*Hibscus waimeae* ssp. *hannerae* *Kokia kauaiensis* *Myrsine linearifolia* *Platydesma rostrata* *Polyscias racemosum* *Pritchardia hardyi* *Pritchardia napaliensis* *Pteralyxia kauaiensis*
Long	Narrow extant range	10	200	*Hibiscus clayi* *Pritchardia viscosa*
Long	Obligate outcrosser	10	400	*Charpentiera densiflora* *Hesperomannia lydgatei* *Melicope degeneri* *Melicope haupuensis* *Melicope paniculata* *Melicope puberula* *Melicope quadrangularis* *Nothocestrum peltatum* *Pittosporum napaliense* *Polyscias bisattenuata* *Polyscias flynnii* *Psychotria grandiflora* *Psychotria hobdyi* *Xylosma crenatum*
Long	Narrow extant range and obligate outcrosser	10	400	*Hibiscadelphus distans* *Hibiscadelphus woodii*
Long	Broad contiguous range and obligate outcrosser	10	400	*Exocarpos luteolus*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	No specific characteristics known	10	500	*Cyrtandra cyanaeoides* *Cyrtandra limahuliensis* *Cyrtandra oenobarba* *Dubautia imbricata* subsp. *imbricata* *Dubautia pauciflorula* *Dubautia waialelae* *Euphorbia eleanoriae* *Euphorbia halemanui* *Euphorbia remyi* var. *kauaiensis* *Euphorbia remyi* var. *remyi* *Geranium kauaiense* *Lysimachia daphnoides* *Lysimachia venosa* *Phyllostegia renovans* *Poa sandwicensis* *Poa siphonoglossa* *Schiedea helleri* *Schiedea lychnoides* *Schiedea stellarioides* *Stenogyne kealiae* *Wilkesia hobdyi*
Short	Narrow extant range	10	500	*Cyrtandra paliku* *Dubautia kalalauensis* *Dubautia kenwoodii* *Dubautia plantaginea* subsp. *magnifolia* *Lysimachia iniki* *Lysimachia pendens* *Myrsine knudsenii* *Myrsine mezii* *Phyllostegia knudsenii* *Phyllostegia wawrana* *Viola helenae*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Obligate outcrosser	10	1,000	*Cyanea recta* *Cyanea remyi* *Dryopteris crinalis* var. *podosorus* *Keysseria erici* *Keysseria helenae* *Labordia helleri* *Labordia lydgatei* *Labordia pumila* *Lipochaeta fauriei* *Lipochaeta micrantha* subsp. *exigua* *Lipochaeta micrantha* subsp. *micrantha* *Lipochaeta waimeaensis* *Remya kauaiensis* *Remya montgomeryi* *Schiedea apokremnos* *Schiedea kauaiensis* *Schiedea membranacea* *Schiedea perlmanii* *Schiedea spergulina*
Short	Narrow extant range and obligate outcrosser	10	1,000	*Asplenium dielmannii* *Asplenium dielpallida* *Astelia waialealae* *Cyanea asarifolia* *Cyanea kolekoleensis* *Cyanea rivularis* *Cyanea undulata* *Doryopteris angelica* *Kadua st.-johnii* *Labordia tinifolia* var. *wahianaensis* *Lysimachia scopulensis* *Phyllostegia waimeae* *Stenogyne campanulata* *Viola kauaiensis* subsp. *wahiawaensis*
Short	Known from only one population and obligate outcrosser	5	1,000	*Cyanea dolichopoda* *Cyanea eleeleensis* *Cyanea kuhihewa* *Schiedea attenuata*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Vegetatively reproducing	20	500	*Canavalia napaliensis*
Short	Tendency for decline or fluctuation in numbers	10	1,500	*Schiedea viscosa*
Short	Tendency for decline or fluctuation in numbers and obligate outcrosser	20	1,500	*Dubautia latifolia*
Annual	No specific characteristics known	10	1,000	*Poa mannii*

Delisting Criteria. To consider delisting the 99 listed plant species endemic to Kauai, the downlisting criteria above should be met for a 20 year-period, as well as the following criteria:

Criterion 1: Population size. In addition to meeting the Interim Stage and Downlisting targets and achieving the number of mature individuals identified in the table below, to consider delisting all populations designated for recovery must be stable, secure, and naturally reproducing for a minimum of 20 years within secure and viable habitats (HPPRCC 2011). These numbers are initial targets, but may be revised as additional information is available, including adequate viability analyses for individual species. Genetic analyses should be conducted to ensure that adequate genetic representation is present within and among populations compared to the initial variation assessed in the interim stage. Numbers need to be considered on a species-by-species basis, based on additional information about the species learned during the interim and downlisting monitoring periods.

Criterion 2: Management and monitoring plans. Species-specific management actions (*e.g.*, hand-pollination, propagation and outplanting) should no longer be necessary, but ecosystem-wide management actions may be ongoing if there are long-term agreements in place to continue management. Management and monitoring plans shall be fully implemented for each management unit so that habitat level threats are controlled.

Criterion 3: Habitat quality. All of the populations designated for recovery shall be within large areas fenced and protected from ungulates, with agreements from conservation partners to maintain those protections long-term. The agreements will also include provisions for the maintenance of all habitat threats (see Table 7 for threats to each species) at levels that will maintain populations at the levels identified in Criterion 1, and adaptive management plans to address any other unforeseeable threats. In addition, the agreements will include provisions for maximizing native plant biodiversity in these areas.

Number of populations and individuals needed for delisting based on population and life history characteristics.

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Long	No specific characteristics known	10	200	*Hibiscus waimeae* ssp. *hannerae* *Kokia kauaiensis* *Myrsine linearifolia* *Platydesma rostrata* *Polyscias racemosum* *Pritchardia hardyi* *Pritchardia napaliensis* *Pteralyxia kauaiensis*
Long	Narrow extant range	10	200	*Hibiscus clayi* *Pritchardia viscosa*
Long	Obligate outcrosser	10	400	*Charpentiera densiflora* *Hesperomannia lydgatei* *Melicope degeneri* *Melicope haupuensis* *Melicope paniculata* *Melicope puberula* *Melicope quadrangularis* *Nothocestrum peltatum* *Pittosporum napaliense* *Polyscias bisattenuata* *Polyscias flynnii* *Psychotria grandiflora* *Psychotria hobdyi* *Xylosma crenatum*
Long	Narrow extant range and obligate outcrosser	10	400	*Hibiscadelphus distans* *Hibiscadelphus woodii*
Long	Broad contiguous range and obligate outcrosser	10	400	*Exocarpos luteolus*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	No specific characteristics known	10	500	*Cyrtandra cyanaeoides* *Cyrtandra limahuliensis* *Cyrtandra oenobarba* *Dubautia imbricata* subsp. *imbricata* *Dubautia pauciflorula* *Dubautia waialelae* *Euphorbia eleanoriae* *Euphorbia halemanui* *Euphorbia remyi* var. *kauaiensis* *Euphorbia remyi* var. *remyi* *Geranium kauaiense* *Lysimachia daphnoides* *Lysimachia venosa* *Phyllostegia renovans* *Poa sandwicensis* *Poa siphonoglossa* *Schiedea helleri* *Schiedea lychnoides* *Schiedea stellarioides* *Stenogyne kealiae* *Wilkesia hobdyi*
Short	Narrow extant range	10	500	*Cyrtandra paliku* *Dubautia kalalauensis* *Dubautia kenwoodii* *Dubautia plantaginea* subsp. *magnifolia* *Lysimachia iniki* *Lysimachia pendens* *Myrsine knudsenii* *Myrsine mezii* *Phyllostegia knudsenii* *Phyllostegia wawrana* *Viola helenae*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Obligate outcrosser	10	1,000	*Cyanea recta* *Cyanea remyi* *Dryopteris crinalis* var. *podosorus* *Keysseria erici* *Keysseria helenae* *Labordia helleri* *Labordia lydgatei* *Labordia pumila* *Lipochaeta fauriei* *Lipochaeta micrantha* subsp. *exigua* *Lipochaeta micrantha* subsp. *micrantha* *Lipochaeta waimeaensis* *Remya kauaiensis* *Remya montgomeryi* *Schiedea apokremnos* *Schiedea kauaiensis* *Schiedea membranacea* *Schiedea perlmanii* *Schiedea spergulina*
Short	Narrow extant range and obligate outcrosser	10	1,000	*Asplenium dielmannii* *Asplenium dielpallida* *Astelia waialealae* *Cyanea asarifolia* *Cyanea kolekoleensis* *Cyanea rivularis* *Cyanea undulata* *Doryopteris angelica* *Kadua st.-johnii* *Labordia tinifolia* var. *wahianaensis* *Lysimachia scopulensis* *Phyllostegia waimeae* *Stenogyne campanulata* *Viola kauaiensis* subsp. *wahiawaensis*
Short	Known from only one population and obligate outcrosser	5	1,000	*Cyanea dolichopoda* *Cyanea eleeleensis* *Cyanea kuhihewa* *Schiedea attenuata*
Short	Vegetatively reproducing	20	500	*Canavalia napaliensis*

Life Span	Population and Life History Characteristics	Number of Populations	Mature Individuals per Population	Species
Short	Tendency for decline or fluctuation in numbers	10	1,500	*Schiedea viscosa*
Short	Tendency for decline or fluctuation in numbers and obligate outcrosser	20	1,500	*Dubautia latifolia*
Annual	No specific characteristics known	10	1,000	*Poa mannii*

PICTURE-WING FLIES

Recovery of the two listed Hawaiian picture-wing flies on Kauai, *Drosophila musaphilia* and *Drosophila sharpi*, is currently envisioned as follows: 1) protect habitats known to support populations; 2) stabilize populations within their known distributions; and 3) conduct research necessary to redefine recovery criteria.

Viable populations of each listed Hawaiian picture-wing fly species must be able to persist in habitat that is protected from and managed for threats within a representative subsection of their historical range. Because data are incomplete, criteria for downlisting and delisting provided herein are preliminary. The recovery criteria presented in this recovery plan represent our best assessment of the conditions that would result in a determination that downlisting or delisting of a Hawaiian picture-wing fly species is warranted. Revised or additional criteria may be developed as completion of recovery actions provides necessary information on the life history and ecology of these species and their host plants.

Downlisting Criteria. To consider downlisting the two Hawaiian picture-wing fly species to threatened status, the following criteria should be met:

Criterion 1: The species occurs in one or more viable populations (viable is defined in Criterion 2) that represent the ecological, morphological, behavioral, and genetic diversity of the species.

Criterion 2: Viability of the population is demonstrated through quantitative surveys which demonstrate that the number of individuals in management subunits and any isolated population has been stable or increasing over a 5 year trend, and demographic monitoring shows that the total population size is not likely to decline by more than 20 percent within the next 10 years.

Criterion 3: Sufficient habitat and number of host plants in management subunits are protected and managed to achieve Criteria 1 and 2.

Criterion 4: The threats that were responsible for the decline of the species have been identified and controlled.

Delisting Criteria. To consider delisting the two Hawaiian picture-wing fly species, the downlisting criteria above should be met for a 20-year period, as well as the following criteria:

Criterion 1: Systematic surveys and research over at least 10 years indicate that the species' host plants are maintaining a viable reproducing population whose long-term persistence in the recovery area is not significantly threatened by ungulates or invasive plants.

Criterion 2: Regulatory measures and quarantine and inspections procedures have been implemented by HDOA and APHIS to prevent accidental introductions of nonnative insects and screen potential biocontrol introductions so as not to release potential predators or parasitoids of non-target *Drosophila* spp.

KAUAI CAVE INVERTEBRATES

The recovery criteria for downlisting and delisting the Kauai cave arthropods (the Kauai cave wolf spider and Kauai cave amphipod) are based on achieving population goals to ensure long-term viability and removing or reducing known threats to the species, as discussed earlier in this plan. Any new threats will need to be monitored and addressed appropriately. If new threats should become significant, recovery criteria will need to be revised.

In the recovery criteria that follow, we have identified the number of populations and caves required for downlisting or delisting the cave arthropods. These criteria are based on the best available information on range and available habitat, including both occupied and unoccupied suitable caves. To date, there are nine caves that have been located that are known to support or historically supported Kauai cave arthropods and an additional four to six caves that have been identified as either suitable or that may support cave arthropods once the habitat has been restored. In addition, the presence of land formations, such as lava rock out-croppings, indicate that there maybe additional suitable caves. These land formations were identified in the Critical Habitat Rule for these species (USFWS 2003a), and the presence of suitable habitat and cave arthropods will be explored as funds become available. A number of caves with self-sustaining, stable populations spread across the known range, represents what is necessary to protect against stochastic events such as flooding, cave-ins, exposure to contaminants, hurricanes that remove above ground vegetation, and disease. Several populated caves spread across the species' known range, also will maintain genetic diversity for both species.

The Kauai cave wolf spider is only reliably known from a single cave and appears to have disappeared from all other caves it was previously known from or populations within individual caves have declined to the point that detections are rare. For this species, recovery criteria cannot be met unless: (1) additional caves are found that support populations of the Kauai cave wolf spider, (2) the spider is reintroduced to caves with suitable habitat, or (3) the

spider naturally increases its range because of conservation measures, including healthy populations of their prey, the Kauai cave amphipod.

Specific downlisting and delisting criteria will be revisited as more is learned about Kauai cave arthropods. In the interim, the recovery criteria detailed below will guide conservation efforts.

Downlisting Criteria. Downlisting to threatened status may be considered for both species when nine caves with one population of each species, spread across the known range, meet criteria 1 – 4 below.

Delisting Criteria. Delisting of both species may be considered when 12 caves with 1 population of each species, spread across the known range, meet criteria 1 – 4 below.

Criterion 1: Each population contains representatives from all age classes and has a balanced sex ratio;

Criterion 2: Each population demonstrates a stable or increasing trend over a 10-year monitoring period;

Criterion 3: Each population is protected from nonnative, predatory species; human visitation or vandalism of caves (dumping area, party site); pesticides; development or other damaging land uses such as quarrying, filling, or diversion of rainwater into caves from impervious surfaces such as roads; and

Criterion 4: Caves and their surrounding above-ground habitat are managed and protected from future development, disturbance to cave interiors via gating, and restoring vegetation over the cave.

NEWCOMB'S SNAIL

The following delisting criteria provide for the maintenance of genetic diversity of Newcomb's snail populations and provides assurance that a catastrophic event will not reduce the likelihood of the species' long-term persistence. Little is known about the population dynamics of Newcomb's snail and, thus, a minimum number of individuals required to have a viable isolated population has not been established. To determine if delisting Criterion 1 has been met, a minimum viable population threshold will need to be quantified. Newcomb's snail is currently listed as threatened and, therefore, does not have downlisting criteria.

Delisting Criteria. The Newcomb's snail can be considered for delisting when:

Criterion 1: Viable populations are identified in a minimum of eight watersheds distributed throughout the range of Newcomb's snail;

Criterion 2: All populations demonstrate a stable or increasing trend over a 10 year period;

Criterion 3: Minimum in-stream flows required to support native aquatic species are established and implemented for stream reaches supporting Newcomb's snail populations; and

Criterion 4: The effects of non-native predators and competitors on the snail have been quantified, and appropriate control measures have been established and implemented to support the population goal established under criterion 1 above.

KAUAI FOREST BIRDS

These recovery criteria are based on the threats that have caused the decline of Hawaiian forest birds and address population stability and growth rates, habitat protection, and threat management. A metapopulation as used below is defined as a group of subpopulations belonging to the same species among which exchange of individuals occurs.

Kauai forest birds covered in this plan all face the same set of threats, including habitat loss and degradation, disease, predation, and natural stochastic events. In particular, non-native avian malaria and avian poxvirus have resulted in withdrawal of most of the native honeycreepers to high elevation forest where avian malaria and its mosquito vector are seasonally present or absent entirely due to cool temperature (van Riper *et al.* 1986, Benning *et al.* 2002). However, the severity of these threats varies among species depending on their life history and current distribution. Moreover, these factors interact in complex and dynamic ways that are only partly understood, and the degree to which each threat must be managed to recover each species is difficult to ascertain. For example, transmission and prevalence of avian diseases and abundance of nonnative predators vary from year to year and from site to site, resulting in changes in management effort needed to ameliorate these threats. If bird populations are stable in the long-term, despite periodic episodes of increased disease, predation, and other threats, then the species can be considered safe from extinction. Setting a recovery criterion of demographic stability highlights the need for effective monitoring, and helps ensure that all threats have been adequately managed and any population increases are not transient.

Given the relatively significant resources required, forest birds on each of the five main Hawaiian Islands are surveyed about once every 5 years, although on Kauai surveys have been conducted at more frequent intervals. As such, at the end of 15 years, at least four population estimates will be available for trend analyses. This should be adequate to determine if a species can be downlisted under recovery criterion 2, in conjunction with other downlisting criteria below. However, a greater number of population estimates will be needed to determine population trends with the improved confidence necessary for delisting, in conjunction with other delisting criteria. Populations may fluctuate in response to especially good or poor breeding years and environmental factors, thus it is important to survey over a long enough period so that long-term trends are captured.

Downlisting Criteria. A taxon may be considered for downlisting from endangered to threatened when all four of the following criteria apply.

Criterion 1: The species occurs in a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species.

Criterion 2: Quantitative surveys show that the number of individuals in the metapopulation has been stable or increasing for at least 15 years, or demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda λ) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason.

Criterion 3: Sufficient recovery area is protected and managed to achieve Criteria 1 and 2 above.

Criterion 4: The threats responsible for the decline of the species have been identified and mitigated.

Delisting Criteria. A taxon may be considered for delisting when the downlisting criteria described above, as well as any species-specific criteria in the table below for downlisting and delisting, have been satisfied for at least 30 consecutive years (USFWS 2006). Species-specific criteria are only provided for species known to be extant.

Puaiohi, or small Kauai thrush, exist at a density of about 16 birds/square kilometer (16 birds/0.39 square mile) in the core of their range that contains the best remaining habitat (Snetsinger *et al.* 2005). We estimate that there is, at best, about 100 square kilometers (38 square miles) of suitable or restorable habitat remaining. Therefore, it would be unreasonable to expect to achieve a total population size of puaiohi of more than about 2,000 birds. Furthermore, surrounding lowland habitats are too degraded to consider as possible habitat and are outside consideration until methods for dealing with avian disease have been developed. The lack of

suitable habitat elsewhere on the island makes it impossible to establish a second population that is functionally isolated from the Alakai population.

At current densities, akekee or Kauai akepa and akikiki or Kauai creeper recovery will require protecting and managing as much of the remaining habitat as possible, and as with the puaiohi, the lack of suitable habitat elsewhere on Kauai makes it impossible to establish a second population that is functionally isolated from the Alakai population.

Additional species-specific recovery criteria for some Kauai forest birds.

Species	Downlisting Criteria	Delisting Criteria
Puaiohi	Population of 1,000 adults in at least 5 subpopulations (Mohihi, Kawaikoi, Koaie, Halehaha/Halepaakai, and Halekua drainages) that constitute a single metapopulation, and Criteria 2 and 3 apply over a 15-year period.	Same as downlisting, but with population of 2,000 adults, and Criteria 2 and 3 apply over a 30-year period.
Akekee	Population of 5,000 birds throughout 75 percent of the recovery area in this plan, and Criteria 2 and 3 apply over a 15-year period.	Population of 8,000 birds throughout the entire recovery area in this plan, and Criteria 2 and 3 apply over a 30-year period.
Akikiki	Population of 5,000 birds throughout 75 percent of the recovery area in this plan, and Criteria 2 and 3 apply over a 15-year period.	Population of 8,000 birds throughout the entire recovery area in this plan, and Criteria 2 and 3 apply over a 30-year period.

For species that have not been detected in 10 years or more, recovery criteria still pertain in the long-term; however, the immediate recovery action is to continue searching for them, following the rare bird discovery protocol (USFWS 2006a), and to find nesting pairs if possible. These species include the ou, Kauai akialoa, Kauai nukupuu, Kauai oo or oo aa, and kamao or large Kauai thrush. In recent history, all five of these species were last observed within the current range of the puaiohi, and so for the purposes of this recovery plan, their recovery area is mostly included within that of the puaiohi. Fossil records indicate that some of these species (*e.g.*, Kauai nukupuu) originally were more widespread than puaiohi, existing in lower-elevation dry forests (James and Olson 1991). Presumably the Alakai was a last refuge from disease but not necessarily the preferred/optimal habitat for these species.

Recovery Area. The foremost concern in determining forest bird recovery area for Kauai is to provide areas that are free of nonnative mosquitoes and disease. This habitat occurs primarily at upper elevations because the cooler temperatures at these elevations are less suitable for both the nonnative mosquito vector and the malarial parasite (van Riper *et al.* 1986, Benning *et al.* 2002), and is decreasing due to a warming climate (Fortini *et al*. 2015). In addition, there is generally less habitat degradation and little human development at these higher elevations.

The forest bird recovery area therefore focuses on existing habitat and restorable high-elevation habitat. The lower elevational boundaries were chosen to include a buffer from transmission of avian disease by mosquitoes, which can travel up to 3 kilometers (1.9 miles) and possibly farther depending on environmental conditions (USFWS 2006a). Given the limited extent of high-elevation habitat on Kauai it is unlikely to support separate viable populations, translocation of individuals to other islands, or other management techniques, can be used to create a managed metapopulation among different habitat units. Forest bird recovery area for puaiohi, akekee, and akikiki includes:

- All known current and historical range that is restorable;
- All the high elevation montane wet forest remaining in the Alakai/Kokee region above 3,000 to 3,500 feet (900 to 1,060 meters), except steep unforested cliffs;
- Montane wet and mesic forest and scrub on Laau Ridge and Namolokama, based on historical distribution.
- However, Laau and Namolokama are small, isolated areas and therefore are unlikely to sustain viable populations separate from the main population in the Alakai; and
- All of Alakai Wilderness Preserve, portions of Kokee State Park, and private lands to the south deemed to be recoverable.

Actions Needed:

1. Island or Statewide recovery actions

1.1. Climate change vulnerability assessment – Assess impact of changing climate conditions on threats to listed species and their habitats.

1.2. Stochastic events – Build resilience and redundancy – Build resilience by increasing size and number of populations to persist through periods of drought and hurricanes.

1.3. Fire monitoring and control – Develop and implement fire prevention management plans.

1.4. Biosecurity (prevention) – Prevent the introduction and spread of invasive species.

1.5. Biosecurity (early detection and rapid response) – Detect, control, and manage mongoose.

1.6. Biosecurity (prevention) – Conduct essential research to support biosecurity efforts.

1.7. Biosecurity (legislation) – Eliminate importation of ohia rust vectors.

1.8. Biosecurity (planning and monitoring) – Decrease the threat of avian disease.

1.9. Alliance and partnership development – Work with the State of Hawaii to protect and manage species habitat on their lands.

1.10. Biosecurity (prevention) – Develop adequate prevention of aquatic invasive species.

1.11. Strategic planning – Develop wind energy plan to guide future wind development sites.

1.12. Outreach and education – Promote and support native species awareness and environmental education.

2. **Management unit recovery actions**
    2.1. Spring and instream flow protection – Maintain stream and spring flows to protect stream habitat.
    2.2. Strategic planning – Develop plan to identify impacts to species outside of the management unit due to altered hydrology.
    2.3. Invasive species control – Detect, control, and manage established target pest species on Kauai.
    2.4. Stochastic events – Build resilience and redundancy – Build resilience by increasing size and number of populations to persist through landslides, floods and tsunamis.
    2.5. Management unit planning and implementation – Ensure long-term protection and management of habitat.
    2.6. Fire monitoring and control – Develop and implement fire prevention management plans.
    2.7. Surveys / inventories – Determine which portions of survey and assess areas are needed to achieve recovery.
    2.8. Threats – other threats control research – Assess impacts and determine actions to rectify impacts from loss of pollinators.
3. **Plant species-specific recovery actions**
    3.1. Surveys / inventories – Conduct surveys for new populations on Kauai.
    3.2. Surveys / inventories – Identify and map all extant wild or outplanted populations on Kauai.
    3.3. Captive propagation protocol development – Develop protocols for captive propagation programs for genetic storage and reintroduction.
    3.4. Captive propagation for genetic storage and reintroduction – Maintain plant and seed sources *ex situ*.
    3.5. Captive propagation for genetic storage and reintroduction – Reintroduce endangered plants.
    3.6. Ungulate monitoring and control – Control ungulates in immediate vicinity of plant populations.
    3.7. Invasive plant monitoring and control – Eliminate or reduce and monitor ecosystem-altering and species-specific invasive weeds in the immediate vicinity of plant populations.
    3.8. Predator / herbivore monitoring and control – Eliminate or reduce and monitor predator and herbivore populations.
    3.9. Disease monitoring and control – Monitor populations to detect disease, assess impacts, and control outbreaks as soon as possible, if needed.
    3.10. Human interaction monitoring and management – Minimize and protect areas from collecting impacts.

3.11. Threats – predator / herbivore control research / Research recommendations implementation – Determine and implement effective methods to control and reduce predator and herbivore populations.
3.12. Population viability monitoring and analysis – Conduct long-term monitoring and assess population growth rates and viability.
3.13. Habitat and natural process management and restoration – Develop and implement effective methods to restore listed plant habitat.
3.14. Human interaction monitoring and management - Develop and implement methods to reduce ORV impacts.
3.15. Population biology research – Conduct biological and ecological research.
3.16. Genetic research – Conduct research to assess genetic diversity within and between populations.
3.17. Taxonomy research – Conduct research on the breeding system of species and determine the genetic diversity within and between taxonomic forms.
3.18. Stochastic events – Build resilience and redundancy – Increase numbers of individuals and populations to minimize impacts from frost.
3.19. Federal Register updates.
3.20. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
3.21. Post-delisting monitoring plan development – Develop a post-delisting monitoring plan for each species.
3.22. Outreach and education – Plan and implement a public information and awareness program to increase public awareness and support for endangered plant recovery.

4. Blackburn's sphinx moth species-specific recovery actions

4.1. Habitat and natural process management and restoration – Protect habitat and control threats.
4.2. Habitat and natural process management and restoration – Expand existing wild host plant populations.
4.3. Population biology research – Conduct additional research essential to recovery of Blackburn's sphinx moth.
4.4. Reintroduction / translocation – Reestablish and augment wild Blackburn's sphinx moth populations within historical range.
4.5. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
4.6. Outreach and education – Develop and initiate a public information program for Blackburn's sphinx moth.
4.7. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan.

5. Hawaiian picture-wing flies species-specific recovery actions

5.1. Surveys / inventories – Conduct surveys to establish a monitoring program.

5.2. Predator / herbivore monitoring and control – Identify predators and implement control methods.
5.3. Other threats monitoring and control – Control and manage other threats as appropriate.
5.4. Threats – other threats control research – Study native ecosystem components to identify limiting factors to Hawaiian picture-wing fly recovery.
5.5. Habitat and natural process management and restoration – Reestablish and expand existing wild Hawaiian picture-wing fly host plant populations.
5.6. Population biology research – Conduct biological and ecological research on Hawaiian picture-wing flies.
5.7. Population biology research – Conduct biological and ecological research on Hawaiian picture-wing fly host plants.
5.8. Revise recovery objectives and criteria – Validate recovery objectives and refine/revise downlisting and delisting criteria as necessary.
5.9. Outreach and education – Develop and implement a public information program.
5.10. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan for each species.

6. Kauai cave invertebrate species-specific recovery actions

6.1. Human interaction monitoring and management – Protect known populations of Kauai cave wolf spider and cave amphipod and their subterranean habitats from human-caused destruction and degradation.
6.2. Habitat and natural process management and restoration – Improve habitat of occupied or previously occupied caves through habitat restoration that will increase subterranean food resources.
6.3. Population viability monitoring and analysis – Conduct long-term monitoring to determine population trends and assess success of recovery actions.
6.4. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
6.5. Outreach and education – Conduct public outreach to facilitate better public understanding of and support for conservation of these cave arthropods.
6.6. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan for each species.

7. Newcomb's snail species-specific recovery actions

7.1. Surveys / inventories – Conduct surveys for new populations.
7.2. Predator / herbivore monitoring and control – Monitor and control predators.
7.3. Other threats monitoring and control – Monitor populations to detect negative interactions with other nonnative species.
7.4. Population viability monitoring and analysis – Conduct long-term monitoring to determine population trends and assess success of recovery actions.
7.5. Population biology research – Conduct biological and ecological research.

7.6. Revise recovery objectives and criteria – Revise recovery objectives and criteria as more information becomes available.
7.7. Outreach and education – Develop and implement a public information program.
7.8. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan.

8. Hawaiian damselflies species-specific recovery actions

8.1. Surveys / inventories – Survey all historical locations on Kauai.
8.2. Reintroduction / translocation – Reintroduce or translocate Hawaiian damselflies to restored and protected habitat.
8.3. Predator / herbivore monitoring and control – Identify and control threats to Hawaiian damselflies.
8.4. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
8.5. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan.
8.6. Outreach and education – Develop and implement a public information program.

9. Kauai forest bird species-specific recovery actions

9.1. Surveys / inventories – Monitor changes in the distribution and abundance of forest birds.
9.2. Predator / herbivore monitoring and control – Reduce or eliminate the detrimental effects of nonnative mammalian predators (rats, mice, and feral cats) on forest birds.
9.3. Disease monitoring and control – Control the mosquito vector (*Culex quinquefasciatus*) of avian pox and malaria.
9.4. Captive propagation for genetic storage and reintroduction – Develop captive propagation and related recovery strategies.
9.5. Threats – other threats control research – Conduct threats research as needed.
9.6. Genetic research – Identify individuals and genotypes that are tolerant or resistant to disease.
9.7. Genetic research – Conduct research that may lead to new tools for managing forest birds or their habitat, or for identification of emerging or unrecognized threats.
9.8. Population viability monitoring and analysis – Document population structure.
9.9. Population viability monitoring and analysis – Conduct population and metapopulation viability analyses.
9.10. Reintroduction / translocation – Research considerations for translocations and reintroduction programs.
9.11. Outreach and education – Public awareness and information.
9.12. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
9.13. Post-delisting monitoring plan development – Develop a post-delisting monitoring plan for each species.

10. Seabird species-specific recovery actions

10.1. Habitat and natural process management and restoration – Preserve and maintain existing habitat.
10.2. Predator / herbivore monitoring and control – Control direct mortalities by predators.
10.3. Other threats monitoring and control – Reduce mortalities caused by light attraction.
10.4. Other threats monitoring and control – Reduce light attractant problem.
10.5. Disease monitoring and control – Implement disease control measures (as needed).
10.6. Threats – human interaction management research – Assess impacts of fishing on mortality.
10.7. Human interaction monitoring and management – Implement removal of barbed wire.
10.8. Threats – human interaction management research – Assess impacts of powerline.
10.9. Surveys / inventories – Determine status and distribution.
10.10. Reintroduction / translocation – Establish additional nesting colonies.
10.11. Outreach and education – Develop a public awareness program.
10.12. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
10.13. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan for each species.

11. Hawaiian waterbirds species-specific actions

11.1. Site / area / habitat protection – Protect (including securing from development) and manage all core wetlands and 85percent of supporting wetlands (see Table 18 for Kauai). Once identified, add select montane streams to list of core or supporting wetlands for koloa recovery.
11.2. Other threats monitoring and control – Remove the threat of mallard-koloa hybridization on all islands where koloa occur and establish a self-sustaining population of koloa on Maui and/or Molokai.
11.3. Population biology research – Conduct research to better understand population biology and limiting factors, evaluate recovery objectives, and improve management techniques.
11.4. Outreach and education – Plan and implement a public information and awareness program to increase public awareness and support for waterbird recovery.
11.5. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
11.6. Post-delisting monitoring plan development – Develop post-delisting monitoring plans for each species when appropriate.

12. Laysan duck species-specific recovery actions

12.1. Population biology research – Assess status of and threats to the Laysan duck on Laysan Island and Midway Atoll
12.2. Reintroduction / translocation – Improve distribution and total population size.

12.3. Captive propagation for genetic storage and reintroduction – Assess and conduct captive propagation if needed.
12.4. Outreach and education – Conduct public outreach.
12.5. Revise recovery objectives and criteria – Update recovery criteria and objectives.
12.6. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan.

13. Nene or Hawaiian goose species-specific actions

13.1. Habitat requirements research – Identify and protect nene habitat.
13.2. Habitat and natural process management and restoration – Manage habitat and existing populations for sustainable productivity and survival.
13.3. Predator / herbivore control – Control nonnative predators in nene habitat.
13.4. Reintroduction / translocation – Establish additional nene populations in suitable, uninhabited areas that are protected.
13.5. Human interaction monitoring and management – Address conflicts between nene and human activities.
13.6. Population biology research – Identify new research needs and continue research on known limiting factors and management techniques.
13.7. Outreach and education – Provide a public awareness and information program to build public support for nene recovery.
13.8. Revise recovery objectives and criteria – Validate recovery objectives.
13.9. Post-delisting monitoring plan development – Develop a post-delisting monitoring plan.

14. Opeapea or Hawaiian hoary bat species-specific recovery actions

14.1. Population biology research – Conduct research essential to conservation of the subspecies.
14.2. Existing population management and restoration – Protect key roosting and foraging areas.
14.3. Threats – predator / herbivore control research – Identify predators and develop control measures that can be implemented to minimize predation.
14.4. Predator / herbivore monitoring and control – Implement predator monitoring and control measures identified in research stage.
14.5. Threats – other threats control research – Determine the effect of barbed wire on Hawaiian hoary bat populations on Kauai.
14.6. Other threats monitoring and control – Reduce usage or strategically use barbed wire if needed.
14.7. Human interaction monitoring and management – Reduce the effects of pesticides, if needed.
14.8. Other threats monitoring and control – Minimize other threats, as appropriate.
14.9. Outreach and education – Develop and conduct a public outreach program.
14.10. Alliance and partnership development – Coordinate with partners and stakeholders.

14.11. Revise recovery objectives and criteria – Evaluate the progress of recovery and revise recovery objectives and criteria as necessary.
14.12. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan.

15. Green turtle or honu species-specific recovery actions

15.1. Existing population management and restoration – Protect and manage green sea turtles on nesting beaches.
15.2. Site / area / habitat protection – Protect and manage nesting and basking habitat.
15.3. Alliance and partnership development – Coordinate with partners and stakeholders.
15.4. Outreach and education – Develop and conduct a public outreach program.
15.5. Revise recovery objectives and criteria – Revise recovery objectives as more information becomes available.
15.6. Post-delisting monitoring plan development – Develop a detailed post-delisting monitoring plan.

Estimated Date and Cost of Recovery: If all recovery criteria have been met, it is currently estimated that the species endemic to Kauai in this recovery plan may be eligible for downlisting by the year 2039, and delisting by the year 2049. The estimated cost to recover all of the species to the point where they may be delisted is approximately $774,714,600, in 2019 dollars (see table below). This table provides the overall cost for island or statewide actions, management unit actions, and species-specific actions for species groups endemic to Kauai and fully addressed in this recovery plan, and species-specific actions on Kauai for multi-island species without existing recovery plans. Other species will have final cost estimates in the multi-island recovery plan.

Total estimated cost of recovery actions for Kauai species through year 2049 (in $1,000).

Year	Island and statewide actions	Management unit actions	Plant actions	*Drosophila* actions	Kauai cave invert actions	Newcomb's snail actions	Damselfly actions	Kauai forest bird actions	TOTALS
2020	4,757.0	255,067.0	3,880.0	115.0	545.0	261.0	155.0	241.5	265,021.5
2021	3,705.0	16,330.0	2,550.0	136.0	495.0	281.0	175.0	233.7	23,905.7
2022	3,333.0	16,874.0	3,665.0	142.0	490.0	202.0	190.0	234.2	25,130.2
2023	3,920.0	16,559.0	2,320.0	106.0	520.0	108.0	190.0	230.2	23,953.2
2024	3,831.0	16,509.0	3,330.0	125.0	540.0	103.0	160.0	230.7	24,828.7
2025-2049	68,459.0	333,150.0	22,405.0	2,290.0	7,045.0	1,194.0	975.0	3,357.3	438,875.3
TOTALS	88,005.0	654,489.0	38,150.0	2,914.0	9,635.0	2,149.0	1,845.0	4,527.6	801,714.6