



★ HONUA'ULA
FOREST RESERVE
MANAGEMENT PLAN
2021

Hawai'i Department of Land and Natural Resources
Division of Forestry and Wildlife - Forestry Management Section



EXECUTIVE SUMMARY

This ten year management plan for Honua‘ula Forest Reserve (FR) on Hawai‘i Island is one in a series of site-specific natural resource management plans to be prepared by the Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) for individual forest reserves in the State of Hawai‘i. These plans present a brief history of the specific forest reserve, a complete record of land transactions and boundary changes over time, a description of natural and cultural resources, as well as an account of infrastructure and intended use(s) of the area. These plans serve to: (1) assist in preparation of regulatory compliance documents required to implement management actions outlined in the plan; (2) support DOFAW efforts to secure funding for plan objectives; (3) prioritize implementation of management objectives; (4) solicit requests for proposals or bids to implement plan objectives; and (5) inform the public of short and long-term goals.

Honua‘ula FR is located on the west side of the island of Hawai‘i in the north Kona District. The FR was established by Governor’s Proclamation on April 4, 1906 moving 665 acres out of pasture lease in order to protect forested areas, especially large stands of koa, from further deforestation. Subsequent additions of land and modifications of boundaries, including a large addition in 2006, expanded the reserve to its current extent of roughly 8,489 acres.

The reserve is now composed of two non-contiguous sections, the smaller Maka‘ula-‘O‘oma Tract to the north and the larger section, or “main reserve,” to the south. Both sections lay on the mid to upper elevation leeward slopes of Hualālai volcano where mesic to wet ‘ōhi‘a & koa forests are the most common land cover. The reserves also contains large areas of non-native grassland and non-native forest, as well as native sub-alpine shrubland.

Hawai‘i County Department of Water Supply has identified Honua‘ula FR as a Priority 1 Watershed for Hawai‘i Island servicing the Kailua-Kona area. The reserve supports essential watershed values and ecosystem services, such as stormwater retention and water recharge of aquifers that are used by the surrounding communities.

Priority management actions for the reserve are divided into six categories and are summarized as follows:

- Watershed Values – Cattle removal, through cattle control and fence construction. Reforestation, both passively and actively as needed. Continued monitoring of forest composition over time following cattle removal. Erosion reduction and prevention and climate change adaptation.
- Resource Protection – Forest health monitoring of insects and diseases, especially for Rapid ‘Ōhi‘a Death. Fire prevention, management, and preparation. Targeted invasive weed species control and/or eradication.
- Access, Trails, Hunting & Other Public Uses– Establish a new public and staff access road to the main section of the reserve (Hienaloli Access Road). Creation of a new trail system in the lower section of the main reserve (Tract III). Increase access for hiking, hunting and other public uses.

- Native Ecosystems – After cattle removal is complete, determine areas of suitable native habitat with high biodiversity based on monitoring and surveys. Implement additional protection measures for native ecosystems in targeted priority areas, which may include fencing, native species outplanting/reforestation, and invasive species control.
- Threatened and Endangered (T&E) Species Management – Continued maintenance of current rare plant exclosures. After cattle removal and based on further flora and fauna surveys, determine where and if further rare plant exclosures can be created, with appropriate threat control measures, to allow for out planting of T&E species.
- Commercial Activity – Generate revenue to fund forest management. Implement a reforestation and/or improved forest management project (carbon sequestration); explore opportunities for salvage logging and timber sales, and explore other forest product uses and sales, as appropriate.

Details of these management priorities, including specific tactical goals, action items, and expected costs can be found in Table 10. This plan is intended to describe short-term resource management planning and implementation strategies, as well to serve as a basis for future updates and modifications to accommodate evolving natural resource concerns or additional management objectives. Future recommendations and goals can be found in Section 6.

Table of Contents

EXECUTIVE SUMMARY	1
MANAGEMENT PLAN SIGNATURE PAGE	5
DEVELOPMENT PROCESS TIMELINE	6
1. INTRODUCTION & METHODS	7
2. HISTORY	8
3. FOREST RESERVE DESCRIPTION	13
3.1 Location	13
3.2 Geology	15
3.3 Soils	15
3.4 Climate	17
3.5 Vegetation	17
3.6 Wildlife	23
3.7 Critical Habitat	27
3.8 Archaeological & Historical Sites	28
3.9 Access	30
3.10 Infrastructure	32
3.11 Public Use Opportunities	32
3.12 Revenue	34
4. THREATS	35
4.1 Invasive Plants	35
4.2 Invasive Animals	36
4.3 Insects & Disease	37
4.4 Climate Change	42
4.5 Fire	43
4.6 Volcanism	44
4.7 Flooding	45
4.8 Other	45
5. MANAGEMENT	46
5.1 Summary of Management Activities	46
5.2 Management Guidelines	52
5.3 Management Priorities	54
5.4 Overall Measures of Success	63
5.5 Past & Related Plans	63

6.	FUTURE RECOMMENDATIONS	64
	6.1 Desired Outcome for the Forest Reserves	64
	6.2 Future Management Recommendations	64
7.	REFERENCES	65
8.	APPENDICES	68

Maps and Important Figures

Figure 3	Portion of a 1901 Hawai‘i Territory Survey map.....	10
Figure 4	Historical Changes to Honua'ula Forest Reserve	11
Figure 5	Current Extent & Tracts of Honua'ula Forest Reserve.....	14
Figure 7	Soil Types of Honua'ula Forest Reserve	16
Figure 8	Hydrological Features of Honua'ula Forest Reserve.....	17
Figure 10	Vegetation Cover of Honua‘ula Forest Reserve.....	19
Figure 12	Plantation Timber Stands in Honua‘ula Forest Reserve.....	22
Figure 15	Critical Habitat in Honua'ula Forest Reserve	27
Figure 16	Threatened and Endangered Species in Honua‘ula Forest Reserve.....	28
Figure 19	Infrastructure of Honua‘ula Forest Reserve	31
Figure 22	Hunting Units in Honua'ula FR.....	33
Figure 25	Known & Potential Areas of Rapid ‘Ōhi‘a Death in Honua‘ula FR.....	41
Figure 28	Wildfire Incidents Near Honua‘ula FR	44
Figure 29	Volcanic Hazard Zones on Hawaii Island.....	45
Figure 31	Honua'ula Forest Reserve Fenceline & Grazing Areas	47
Figure 32	Current Vegetation Photo Monitoring Points in Honua‘ula FR.....	48
Figure 35	Proposed Hienaloli Access Road.....	50
Figure 37	Honua'ula FR Draft Management Guidelines	52
Table 1	Summary of Lands Added and Withdrawn (A/W) from Honua‘ula Forest Reserve.....	10
Table 2	Historical Land Use Agreements in Honua‘ula Forest Reserve.....	11
Table 3	Tax Map Key (TMK) Parcels Comprising Public Lands of Honua‘ula FR.....	12
Table 4	Rare & Endangered Plants in Honua'ula Forest Reserve.....	20
Table 5	Native Wildlife in Honua'ula Forest Reserve.....	23
Table 6	Non-Native Wildlife in Honua‘ula Forest Reserve.....	24
Table 10	Honua‘ula Forest Reserve Management Priorities.....	55

HONUA‘ULA FOREST RESERVE MANAGEMENT PLAN SIGNATURE PAGE

Hawai‘i District certification: This plan was prepared by a team of Division of Forestry and Wildlife (DOFAW) staff to provide a management framework for Honua‘ula Forest Reserve.

Steven T. Bergfeld – DOFAW Hawai‘i District Manager

Date

Division of Forestry and Wildlife Administrator’s approval: I have reviewed the enclosed Forest Reserve Management Plan and concur with the recommendations herein. I agree that resource management implementation will follow those specified in the Management Plan for Honua‘ula Forest Reserve.

David G. Smith – DOFAW Administrator

Date

Department of Land and Natural Resources Board approval: This plan is in accordance with the mandates of the State Forest Reserve System which includes Chapter 183, Hawai‘i Revised Statutes, and Chapter 13-104, Hawai‘i Administrative Rules.

Suzanne D. Case – BLNR Chairperson

Approved by the Board
of Land and Natural
Resources at its meeting
held

DEVELOPMENT PROCESS TIMELINE

Honua'ula Forest Reserve, Hawai'i

Stage of Development	Date Achieved	Comments
District review	4/15/2021	
DOFAW review	4/15/2021	
Partner agency consultation		
Public consultation		
DOFAW approval		
BLNR approval		

Draft

1. INTRODUCTION & METHODS

The Division of Forestry and Wildlife (DOFAW) conducts on-going planning efforts to develop and update management plans for all forest reserves across the State. The format and content of the respective reserve plans are generally consistent across the State and serve to guide field operations, assist in budgeting and funding concerns, and make the management process transparent for partner organizations and the public. These plans also help to fulfill certain recommendations made in the Hawai'i Tropical Forest Recovery Action Plan, which came about as a result of the 1992 Federal Hawai'i Tropical Forest Recovery Act.

Management plans will be developed for each individual forest reserve, which will in part reflect the Division's management guidelines specific to that area. This document represents the management plan for Honua'ula Forest Reserve (FR) and addresses concerns and strategies only on the public lands within these forest reserves.

This management plan for Honua'ula FR was developed using a variety of methods. Initial development consisted of reviewing the 2007 Environmental Assessment for the Honua'ula Forest Reserve Reforestation Project and reviewing and analyzing DOFAW historic and current files (found at the Administrative and Hawai'i District office). Documents were also obtained from other state agencies including the Department of Land and Natural Resources Land Division and Bureau of Conveyances, and the Department of Accounting and General Services (DAGS) Survey Division. Hawai'i Statewide Geographic Information System (GIS) data relating to biological, historical, and environmental resources were referenced extensively to develop this plan.

Additional resources utilized for the development of this plan (including other plans that identified the forest reserve or the general area), were the Hawaiian Forester and Agriculturalist, Hawai'i Biodiversity and Mapping Program (HBMP), Hawai'i Statewide Assessment of Forest Conditions and Trends, Hawai'i Comprehensive Wildlife Conservation Strategy, biological surveys and others. The plan then evolved into its final iteration through discussions with DOFAW staff from all program areas, both at the district and administrative offices, other Divisions and State agencies, DOFAW partners, and the public.

Once finalized by DOFAW, the Honua'ula FR management plan will be submitted for review and approval by the Board of Land and Natural Resources (Board). If approved by the Board, the following actions may be triggered:

1. Preparation of regulatory compliance documents as required for implementation of management actions as outlined in the plan.
2. DOFAW efforts to secure operational and planning funding for plan objectives.
3. Prioritized implementation of plan objectives by DOFAW.
4. Periodic solicitation of requests for proposals or bids for implementation of plan objectives, including issuance of permits, licenses, or contracts (Chapter 104-22, HAR), as necessary.

2. HISTORY

Honua‘ula FR lies in the moku (district) of North Kona on the western slopes of Hualālai. Prior to European contact the North Kona region was a densely populated area producing some of the largest and most powerful societies in Hawai‘i, culminating with the ascension of Kamehameha the Great. One reason such a vibrant civilization flourished here was the vast agricultural area collectively known as the Kona field system. Spanning roughly 55 square miles north from Kalaoa and south to Honaunau, fields grew a variety of crops from sweet potato, taro, bananas, gourds, breadfruit, mountain apple, and sugarcane among others. In fact, the plantation that Kamehameha himself worked, named Kuahewa (huge), may have been directly makai of modern day Honua‘ula FR, or even covering some of the lower sections (Hoku o Hawaii, May 3 1927).

While Hawaiians cultivated and greatly modified many lowland environments, impacts on higher elevation forested areas were less extensive. One early account of the Kona region by William Ellis, an English missionary, describes his mauka ascent from Kailua town, first passing through the gardens of the Kona field system: “Having traveled three or four miles through this delightful region, we arrived at the thick woods, which extend several miles up the sides of the lofty mountain” (Ellis 1825). Further accounts corroborate that agricultural fields extended about 3-5 miles upland in the Kona region before reaching more heavily forested areas. The lower edges of Honua‘ula FR lie about 4-5 miles from the coast, so most of the area was likely covered in forests as seen by Ellis and others, but this would change over the course of the 19th century.

Cattle and sheep were first introduced to the area in 1794, and overtime feral and domesticated populations ballooned. By the turn of the 20th century livestock outnumbered humans in the islands by orders of magnitude (Culliney 2002). Many lands in the north Kona area were leased for grazing, including areas that would eventually become Honua‘ula FR. Deforestation of the mauka uplands became a cause for concern for land managers, mainly for the protection of water resources.



Figure 1 Stand of koa with native understory in Honua‘ula FR, early 20th century

With the advent of the Hawai‘i Forest Reserve System in 1903, the Forestry Superintendent Ralph Hosmer, proposed designation of a forest reserve in the north Kona region “in view of the benefit to the district from the continuance of a forest belt on the mountain, of the danger which results when a forest like that on Honuaula is subjected to grazing, and especially because of the increasing market value of Koa and the development of Koa lumbering on Hawaii” (Hosmer 1906, p.109).



Figure 2 Boundary fence separating forest within the reserve from private land outside, heavily impacted by grazing. Early 20th century.

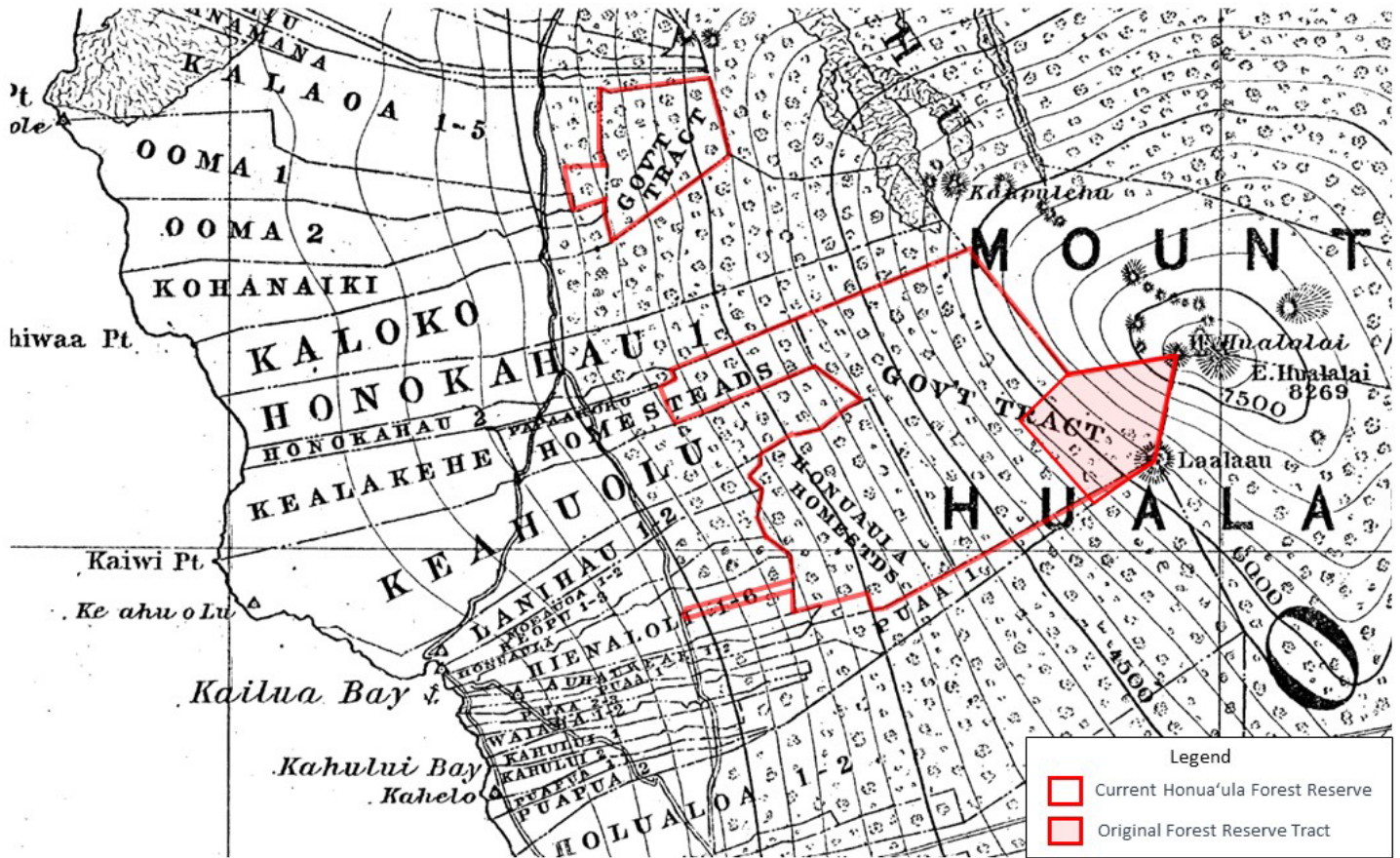
Honua‘ula FR was established by Governor’s Proclamation on April 4, 1906, taking 665.0 acres of land out of pasture lease. The area was fenced to protect it from grazing on neighboring lands still leased. Subsequent additions and modifications of the reserve boundary in 1926 and 1928 expanded the reserve to 1,345.8 acres. This configuration lasted through the 20th century, and is what is referred to as the original Honua‘ula Forest Reserve Tract, or “Tract I” in this plan (see Figure 3).

When forest reserves were first being established, private lands were also included in these designations by the Territorial Government to encourage landowners to manage their lands for watershed values. There is a sliver of land in the mauka section of the ahupuaa of Pua‘a 1 (see Figure 3) that was included in the Honua‘ula FR boundary. Even though these privately owned parcels were included, they are not subject to the rules and statutes established for the public lands in the Forest Reserve System under the State of Hawai‘i. In order for the State to be able to manage private lands in the FR, these parcels must be surrendered by the landowner to the State for use as a forest reserve (Section 183-15, HRS).

A section of a survey map made in 1901 (Figure 3) also documented plans to create homesteads in Honua‘ula and Kealakehe, but lots were never developed. Instead, state lands in Honua‘ula and were either set aside for the original forest reserve, leased for grazing, or left unencumbered for the majority of the 20th century.

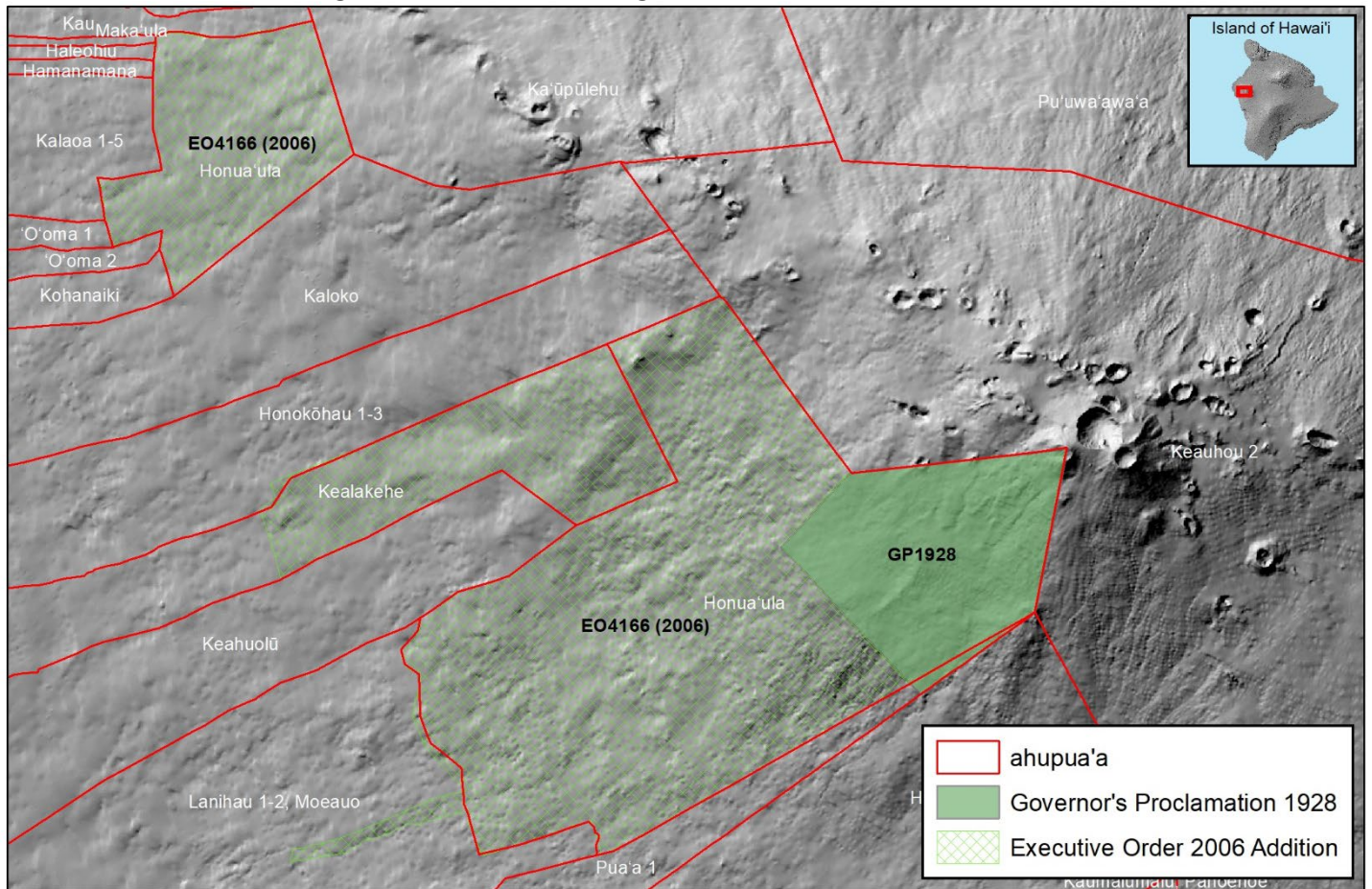
Figure 3 Portion of a 1901 Hawai'i Territory Survey map.

Note: Current and original FR boundaries have been added in red, and all areas are approximate.



By the late 1980's, continued concerns over deforestation led to efforts to expand Honua'ula FR. This expansion came to fruition in 2006, when an additional 7,146.36 acres of land were added to the reserve by Executive Order 4166 to "provide watershed protection benefits, allow for reforestation for water resource enhancement, protect and enhance native wildlife habitat, provide additional area for public recreation along with nature study, and opportunities for commercial timber resource production." These additions created the extent of the FR today, with the additions of Tract II, Tract III, Kealakehe Tract, Hienaloli section, and Maka'ula-'O'oma Tract (see Figure 5).

Figure 4 Historical Changes to Honua'ula Forest Reserve



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 October 2020

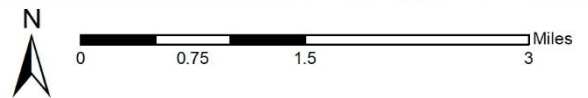


Table 1. Summary of Lands Added and Withdrawn (A/W) from Honua'ula Forest Reserve.

Action	Date	A/W	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Governor's Proclamation	04-Apr-1906	A	Land set aside for establishment of Honua'ula FR	665.0	1669	374001004 (por.)
Governor's Proclamation	24-Dec-1926	A	Addition of land of Pua'a I belonging to B.P Bishop Estate	32.7	4568	374001005
Governor's Proclamation	22-Dec-1928	A	Modify boundaries and change area of Honua'ula FR	1345.8	5064	374001004 374001005
Executive Order 4166	20-Jul-2006	A	Addition of lands for inclusion within the Honua'ula FR (Addition of Tract II, Tract III, Hienaloli, Kealakehe, & Maka'ula-'O'oma Tracts)	7146.4	24129 24156 24161 24178 24179	373001002 374001002 374001003 374002007 375013013 375013022

(Data relating to these items are filed at the DOFAW Administrative Office & DAGS State Survey)

Table 2. Historical Land Use Agreements in Honua‘ula Forest Reserve.

Type of Action	Action Number	Duration	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Lease	No. 570	10-Jan-1905 to 29-Jul-1924	Lease to Henriques and Gomes. This lease was originally larger, a portion was taken out for the original FR	1,744	1671	374001003, 374001004
Lease	No. 606	4-Nov-1907 to 4-Nov-1928	Lease to J.A. Maguire Estate, Ltd., upper portion of Tract I.	646	1671	374001004
Lease	No. 645	1-Mar-1909 to 1-Mar-1923	Honua‘ula Tract III Section; Lease to Manuel Gomes	2,943	1841	374001002 373001003
Lease	GL4025	29-Nov-1966 to Nov-1991	Lease to James Greenwell, owner of Palani Ranch Company	1608.5	9966	374001003
Lease	GL4239	15-April-1969 to Apr-1994	Lease to James Greenwell, owner of Palani Ranch Company	1232	15,590	374002007
Permit	RP 05930	1-July-1982-?	Permit to Huehue ranch for pasture. Not current.	1252		373001002
Easement	LOD 28020; GL4025	19-Nov-1992 to 13-Apr-1994	Honua‘ula Tract II Section; Perpetual easement giving Palani Ranch Company the right, privilege and authority to construct, use and maintain easement for water line purposes	1.204	21,813	374001003
Easement	LOD 28190	8-Apr-97	Hienaloli Section; Perpetual non-exclusive anchor and overhead transmission line easement to Hawai‘i Electric Light Company	0.024 (total easement 0.124)	22,387	375013013, 375012022
Easement			Holualoa-Pu‘uwa‘awa‘a Pipeline easement (5ft wide) to State of Hawai‘i	N/A	N/A	374001002
Permit		1-Mar-2007 to 28-Feb-2009	Permit to Palani Ranch Company to allow livestock grazing and phased approach to cattle removal and for wildfire prevention	1,500	N/A	374002007, 374001003 por.
Permit	RP6971	4/15/1994 to 28-Feb-2014	Permit to Palani Ranch Company to allow livestock grazing; area of lease reduced	1,232	N/A	374002007
Permit		1-Mar-2014 to current	Permit to Palani Ranch Company to allow continued livestock grazing access to previously permitted areas minus 664 acres. Reduction of grazing area is consistent with long-term objective of transition from active pasture use to reforestation.	487	N/A	374002007 por.

3. FOREST RESERVE DESCRIPTION

3.1 Location

Honua‘ula Forest Reserve (FR) is comprised of 8,489.34 acres of public land in the moku of North Kona on the island of Hawai‘i. The reserve lies mainly within the ahupua‘a of Honua‘ula with smaller portions in Kealakehe and Lanihau 1-2 Moeauo. There are currently two non-contiguous sections of the forest reserve.

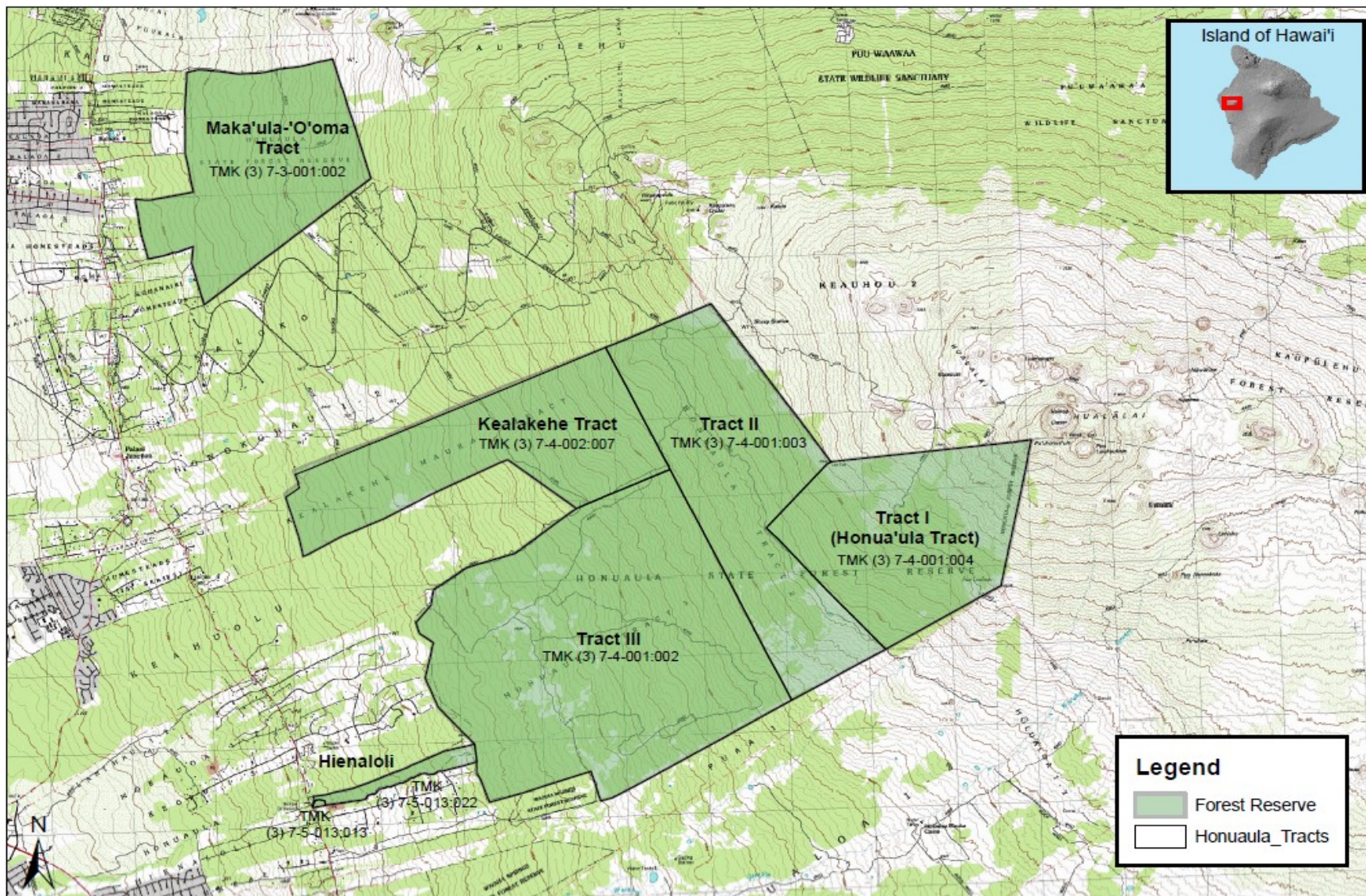
The larger section of the reserve (7,237 acres), herein called the “main reserve” consists of 5 tracts: Tract I (also known as the Honua‘ula Forest Reserve Tract), Tract II, Tract III, Kealakehe Tract, and Hienaloli (Figure 5). Elevation ranges from approximately 8,000 feet near the summit of Hualālai, to 1,500 feet at its base near Mamalahoa Highway. The non-contiguous Maka‘ula-‘O‘oma Tract (1,252 acres) is approximately 1.5 miles north of the main reserve. Maka‘ula-‘O‘oma ranges from 1,800-3,400 feet in elevation.

Honua‘ula FR is primarily surrounded by private landowners, most notable are Bishop Estates/Kamehameha Schools and Palani Ranch Company Inc. Residential parcels are present along the narrow Hienaloli Tract and Kaloko Drive. A small portion on the southern border is adjacent to Wai‘aha Spring State Forest Reserve. The communities in closest proximity to Honua‘ula FR are Kailua-Kona, Holualoa, and the Kalaoa subdivision. Most of the reserve, with the exception of Kealakehe Tract, is included in the Three Mountain Alliance Watershed Partnership. A portion of Kealakehe Tract is currently under a special use permit for grazing with Palani Ranch Company Inc.

Table 3. Government Tax Map Key (TMK) Parcels Comprising Public Lands of Honua‘ula FR.

TMK Number	Owner	Tax Acres (entire TMK)	GIS Acres (entire TMK)	Tract Name
373001002	State of Hawai‘i	1252.00	1252.97	Maka‘ula-‘O‘oma Tract
374002007	State of Hawai‘i	1232.00	1289.48	Kealakehe Tract
374001002	State of Hawai‘i	2976.10	2937.55	Tract III
375013022	State of Hawai‘i	78.36	85.14	Hienaloli
375013013	State of Hawai‘i	2.85	2.79	Hienaloli entrance
374001003	State of Hawai‘i	1608.5	1603.16	Tract II
374001004	State of Hawai‘i	1312.00	1318.25	Tract I (Honua‘ula Tract)
	State of Hawai‘i	8461.81	8489.34	(Total)

Figure 5. Current Extent & Tracts of Honua'ula Forest Reserve



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 February 2019

0 0.25 0.5 1 1.5 2 Miles



Figure 6 View of Hualālai from Honokōhau, makai of Honua'ula FR

3.2 Geology

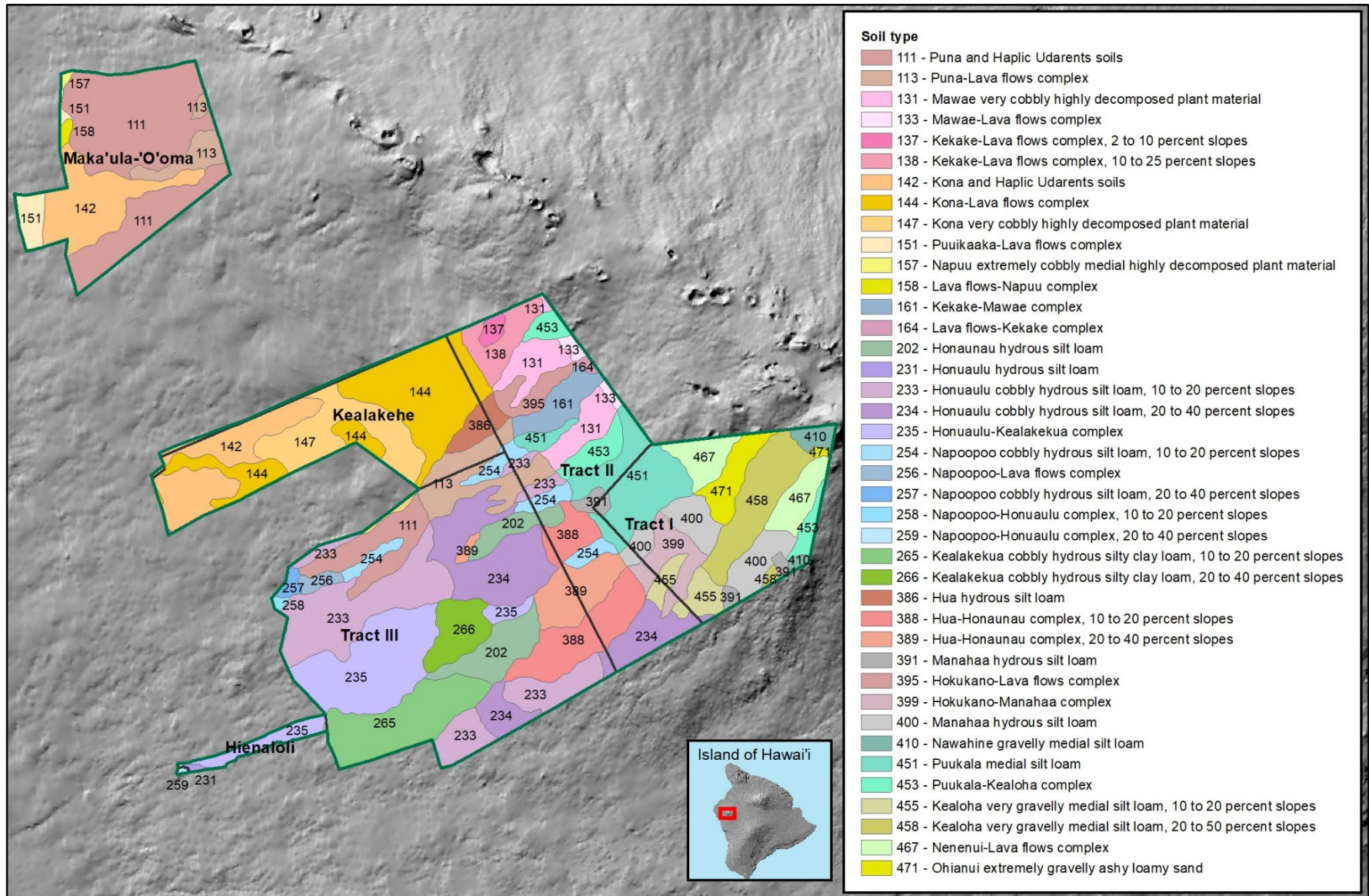
Honua‘ula FR is located on the slopes of Hualālai, the third most active volcano on the island of Hawai‘i. Hualālai, with its summit reaching 8,278 feet, is believed to have breached sea level 300,000 years ago. The volcano has three rift zones, or areas where the land is breaking apart and magma is most likely to reach the surface. (UH Hilo 2020). The most notable rift zones trend NNW from the summit, creating a prominent ridgeline with Honua‘ula FR on the southwestern side. Multiple craters and pu‘u exist near the top of Hualālai. Pu‘u Honua‘ula, around 8,100 feet in elevation, marks the very top of Honua‘ula FR, resting just south and west of Hualālai summit. Pu‘u La‘alā‘au, at around 6,500 feet in elevation, is another prominent landmark creating the southeastern tip of Tract I, and is where the ahupua‘a of Honua‘ula, Pua‘a 1-2 and Holualoa 1-2 all meet.

The majority of lava flows that created the ‘aina of Honua‘ula FR originated from Hualālai, with some intrusions from Mauna Loa flows. Surface geology of Hualālai is geologically young. Half of its surface substrate is less than 3,000 years old, and another quarter is less than 1,000 years old (Smithsonian Institution 2013). The most recent eruption on Hualālai ended in 1801 and experts say it will likely erupt again (Hawaii Volcano Observatory 2017).

3.3 Soils

Honua‘ula literally translates to red earth, possibly a reference to the soils found in the area. The United States Department of Agriculture’s Natural Resource Conservation Service (USDA NRCS) has mapped 22 soil types in Honua‘ula FR (Figure 7). Further descriptions of all soil series can be found using the NRCS web soil app at: <https://websoilsurvey.nrcs.usda.gov/app/> There are no prevailing soil types for the entire the forest reserve, some tracts do have a dominant soil series. The Kealakehe Tract is covered almost exclusively by variations of the Kona soil series, while Maka‘ula-‘O‘oma Tract is predominantly covered by Puna soil series. The remaining tracts contain a mosaic of soil types.

Figure 7 Soil Types of Honua'ula Forest Reserve (USDA NRCS Web Soil Survey)



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 August 2020

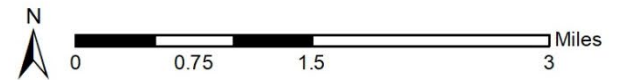
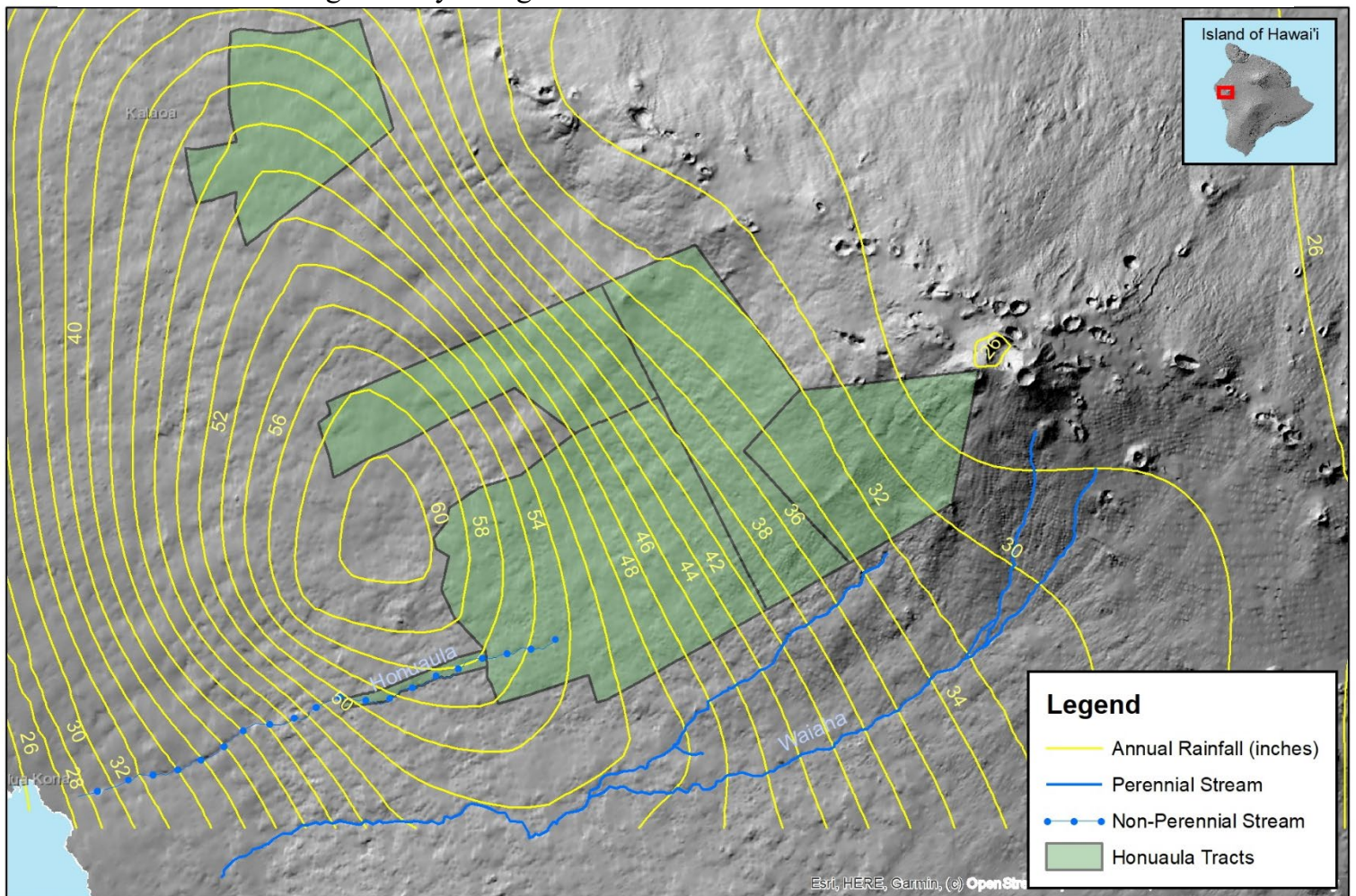


Figure 8 Hydrological Features of Honua'ula Forest Reserve



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 October 2020



0 0.5 1 2 3 4 Miles

3.4 Climate

Honua'ula FR is located in the northern section of the Kona coast climate zone, the only area in Hawai'i where summer rainfall regularly exceeds winter rainfall. The unique climatic conditions in the Kona region are attributed to the lack of the normally dominant northeasterly tradewinds, which are blocked by Hualālai, Mauna Loa, and Mauna Kea. Instead, diurnal winds from the coast are dominant. The lands heat up throughout the day bringing onshore breezes and afternoon showers.

Average rainfall in the reserve ranges from approximately 26 to 60 inches annually with the highest levels of precipitation occurring between 1,500 to 3,000 feet. The non-perennial Honua'ula stream is the only stream in the reserve, with headwaters in the lower part of Tract III continuing through the Hienaloli Tract (Figure 8). Honua'ula FR lies in the Wai'aha watershed, and precipitation charges the Keauhou aquifer which serves the majority of the population of the north Kona district (County of Hawai'i 2016).



Figure 9 Predominantly Native Forest in Tract II

3.5 Vegetation

Vegetation in the lowest elevation section of the main reserve (Hienaloli Tract and the bottom of Tract III) is predominantly non-native wet and mesic forest intermixed with small patches of native ‘ōhi‘a (*Metrosideros polymorpha*) forest. At around 3,400 ft in elevation in Tract III, wet ‘ōhi‘a forests become more common, especially in the interior areas. Non-native grasslands are scattered throughout. The Kealakehe Tract, while at roughly the same elevation as Tract III, is highly altered and covered predominantly by non-native forest and grassland due to the continued presence of grazing (see [History](#) and [Management](#) sections).

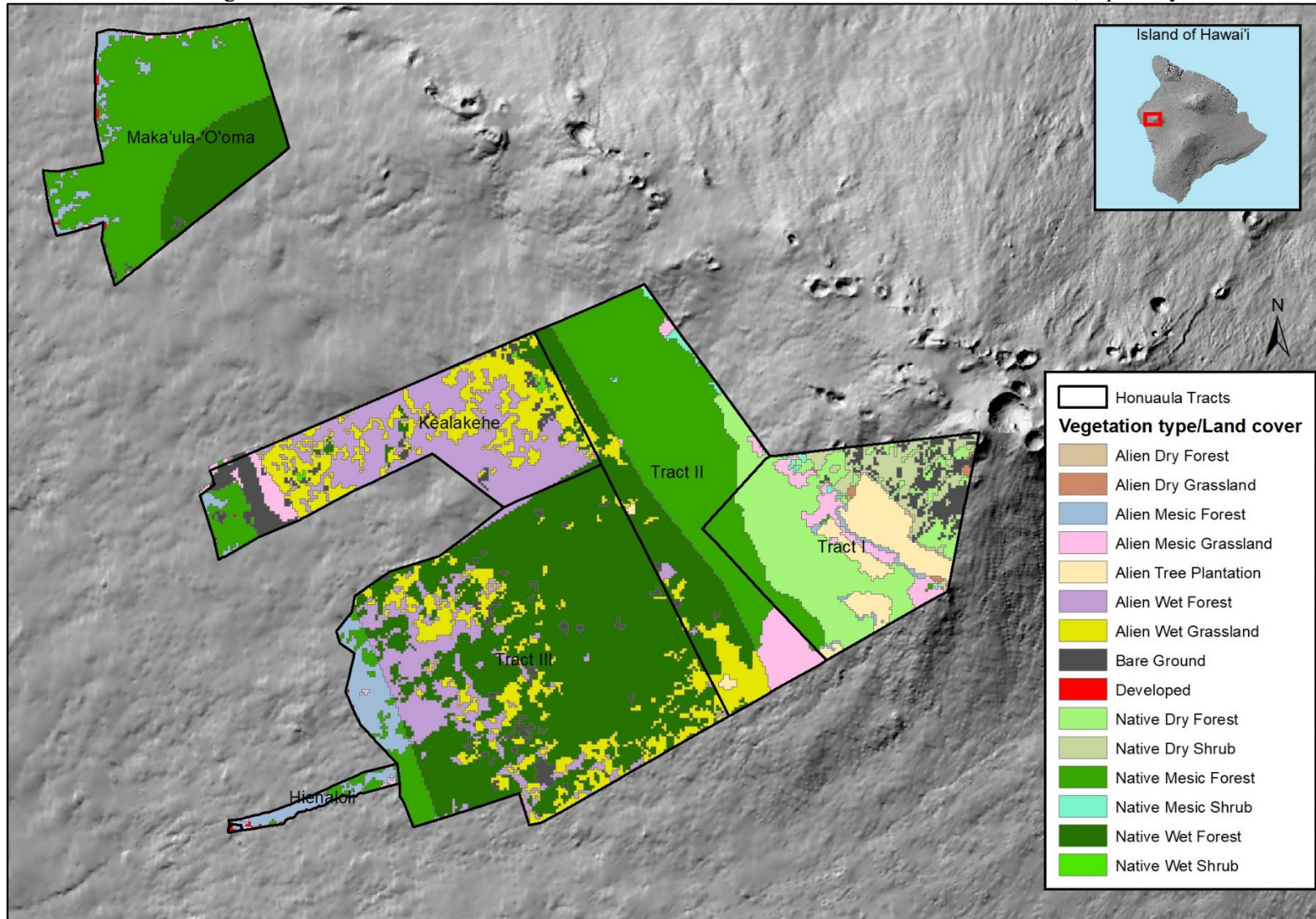
At the boundary between Tract III and Tract II, the forest transitions to open koa (*Acacia koa*) and ‘ōhi‘a mesic forest with koa becoming more dominant with increasing elevation. The mauka portion of Tract II and the bottom of Tract I are covered with dry montane forests of koa and māmane (*Sophora chrysophylla*) interspersed with naio (*Myoporum sandwicense*) which is present between 5,500-6,500ft.

Within Tract I, there are stands of non-native tree plantations that were planted in the early 20th century. Most are located between 6,200-6,800 ft. in elevation, where there are also patches of non-native grassland. The upper reaches of Tract I, near Hualālai summit, are unvegetated or covered with native subalpine dry shrubland composed of pukiaawe (*Leptecophylla tameiameiae*), ‘a‘ali‘i (*Dodonaea viscosa*), and low stature ‘ōhia, among others.

Lastly, the non-contiguous Maka‘ula-‘O‘oma Tract is covered by wet to mesic ‘ōhi‘a dominated forest with hapu‘u (*Cibotium sp.*) and ‘ie‘ie (*Freycinetia arborea*) in the understory. Non-native

Figure 10 Vegetation Cover of Honua‘ula Forest Reserve (Jacobi et al. 2017).

Note: Resource managers have noted that areas of non-natives are more extensive than what this dataset shows, especially in Tract III.



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 October 2020



species such as strawberry guava (*Psidium cattleianum*), kahili ginger (*Hedychium gardnerianum*), and banana poka are also common in the understory. Some areas on the NW boundary are dominated by non-native plants, mostly Christmas berry (*Schinus terebinthifolius*) and silk oak (*Grevillea robusta*).

The most current GIS land cover dataset available for Honua‘ula FR is included as Figure 10 (Jacobi et al. 2017). It shows that a majority of the reserve is covered with native mesic and wet forest. Based on field observations, DOFAW staff indicate that this map over-estimates the amount of native forest cover in the lower elevations of the main reserve. It should be noted that while the dataset was revised in 2017, it is still largely based on the 2005 Hawaii Gap Analysis Project. Even with this limitation, it is still a valuable dataset as it the only quantitative vegetation cover information available. It also illustrates how vegetation in the reserve varies greatly between tracts and across elevational gradients.

At this time, a complete botanical survey of the reserve has not been completed. A biological inventory of Maka‘ula-‘O‘oma Tract was contracted by DOFAW and conducted by The Nature Conservancy’s Hawai‘i Natural Heritage Program (HINHP) in 1994. HINHP also completed a Natural Resource Management Assessment of Tract III in 1996. Botanical surveys were conducted by DOFAW staff in other targeted areas of the reserve in 1999, 2005, and 2007. For a current working list of plant species found in Honua‘ula FR see Appendix A.

3.5.1 Rare and Endangered Plants: Threatened and endangered plant species in Hawai‘i are listed under and protected by the Federal Endangered Species Act (ESA) and the State Endangered Species Law, Chapter 195D, HRS. Wild populations of at least three rare plant species exist within Honua‘ula FR, as well as six additional species that have been outplanted (Table 4).

Cyanea hamatiflora ssp. *carlsonii* can be found in Tract I. Plants in the *Cyanea* genus are part of the Hawaiian lobelioids clan, the largest family of flowering plants in Hawai‘i. All 276 species of Hawaiian lobelioids appear to be the product of one colonization event to Hawai‘i, which is perhaps the largest radiation of plants on an island chain in the world (Givnish et. al 2009). *Cyanea hamatiflora* has two subspecies, *hamatiflora* and *carlsonii*. Subspecies *carlsonii* is endemic to Hawai‘i Island and is only known from two wild populations. One population is in Honua‘ula FR and the other is in south Kona near Keokea. Exclosures were built around the original plants, and additional outplantings have been added to supplement wild populations.

Three *Flueggea neowawraea*, or mehamehame trees were recently found in Maka‘ula-‘O‘oma Tract in 2017. When fully grown, these trees, were once one of



Figure 11 *Cyanea hamatiflora* ssp. *carlsonii* growing in Honua‘ula FR

the largest trees in the mesic/dry forest. Reports of the species in the first half of the 1900s indicate that it had already been declining in numbers and health for a considerable period of time prior to its discovery. Unfortunately, the black twig borer (*Xylosandrus compactus*), a non-native pest first documented in Hawai‘i in 1961, is contributing to this decline and the tree is an endangered species. Many of the remaining wild trees are partially dead, with only strips of living bark extending to crowns that have died back; this is true of the individuals in Honua‘ula FR.

In 1994, one individual plant of *Melicope hawaiiensis* was found in the Maka‘ula-‘O‘oma Tract. It was once listed as a “species of concern” by the U.S. Fish and Wildlife Service (USFWS), but this designation is no longer recognized by the agency. However, land managers and other conservation organizations still consider this species as rare and vulnerable. Six additional endangered plant species, listed in Table 4, have been outplanted by DOFAW in Maka‘ula-‘O‘oma Tract. Currently none of these outplantings are fenced, and are not being monitored.

The Plant Extinction Prevention Program (PEPP) conducts in-situ management actions to preserve the rarest Hawaiian plants, focusing on plants that have fewer than 50 plants remaining in the wild, listed as “PEPP Species”. PEPP assists in the management of rare species in Honua‘ula FR (Table 4).

Table 4. Rare & Endangered Plants in Honua'ula Forest Reserve (HBMP 2008 & survey data). Observations are considered historical if made > 30 years ago

	Species	Common name	Current/ Historical	Endangered Species Act List	PEPP Species	Within Fenced Exclosure
Naturally Occurring	<i>Cyanea hamatiflora</i> subsp. <i>carlsonii</i>	hāhā	Current	Endangered	Yes	Yes
	<i>Flueggea neowawraea</i>	mehamehame	Current	Endangered	Yes	
	<i>Melicope hawaiiensis</i>	‘alani	Current	Not listed; previous “Species of Concern”	No	
Outplanted	<i>Chrysodracon hawaiiensis</i>	halapepe		Endangered	No	
	<i>Colubrina oppositifolia</i>	kauila		Endangered	No	
	<i>Delissea argutidentata</i>			Endangered	Yes	Yes
	<i>Hibiscadelphus hualalaiensis</i>	hau kuahiwi		Endangered	Yes	
	<i>Kokia drynarioides</i>	koki‘o		Endangered	Yes	
	<i>Mezoneuron kavaiensis</i>	uhiuhi		Endangered	Yes	

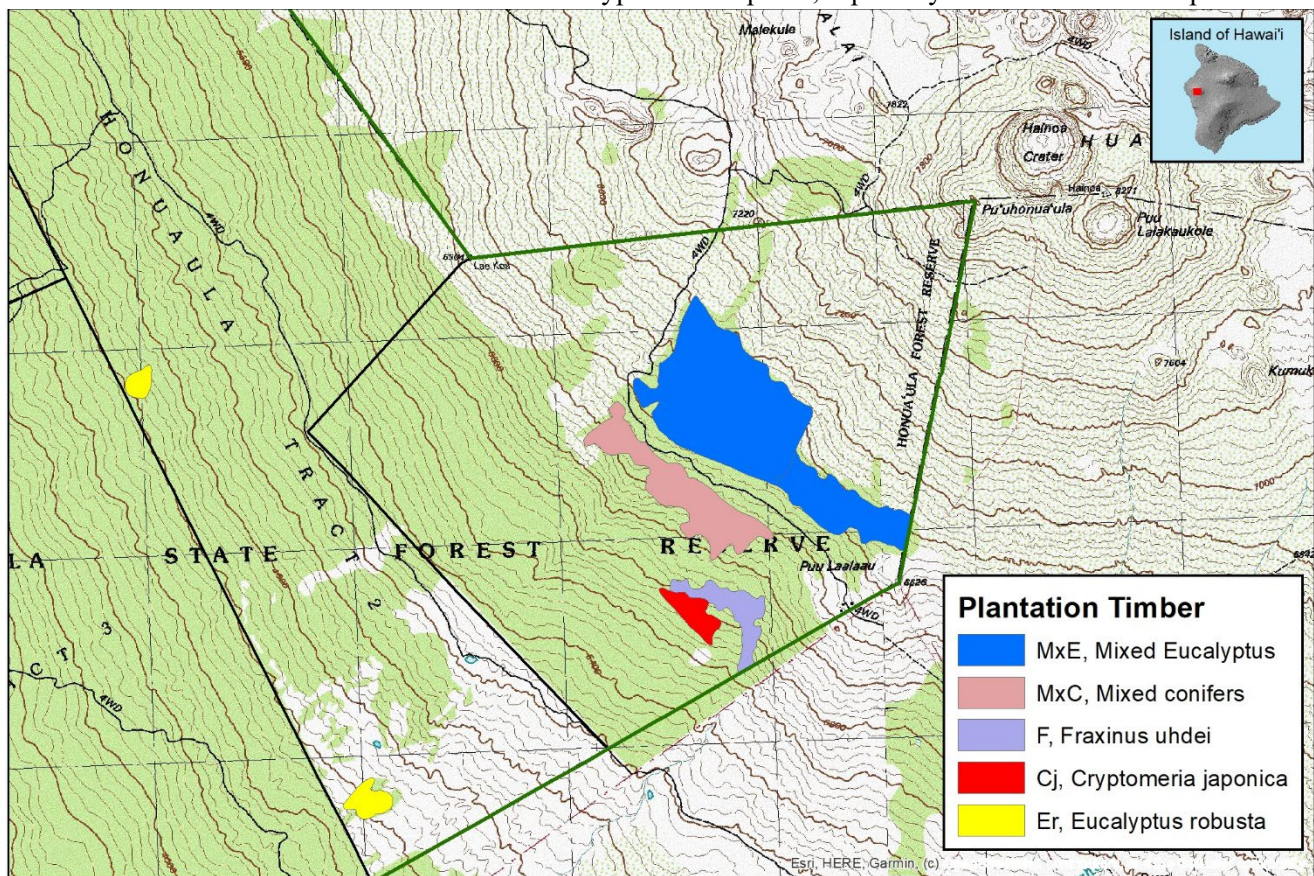
3.5.2 Timber and Plantation Species: In the early 20th century, the Territorial Government, in tandem with private ranchers and sugar plantation owners, implemented reforestation efforts across Hawai‘i in areas that had been severely reduced or degraded due to grazing, fire, and harvesting. The majority of trees used in early reforestation projects were non-native species. Many became naturalized, and in some cases are now considered invasive species. The extent of early reforestation efforts that occurred between 1908-1960 in Honua‘ula FR can be seen in Figure 12. During this time Honua‘ula FR was only composed of Tract I, therefore the majority of tree plantations are located within that area. However, small sections of *Eucalyptus* plantations are present near the boundary between Tract II and Tract III, potentially planted by previous ranching operations. Records show that none of the tree plantations within Honua‘ula FR have been harvested.

Species that were planted and are still present in Honua‘ula FR:

- *Cryptomeria japonica* (sugi)
- *Eucalyptus globulus* (southern blue gum)
- *Eucalyptus robusta* (swamp mahogany)
- *Eucalyptus saligna* (Sydney blue gum)
- *Fraxinus uhdei* (tropical ash)
- *Pinus* spp. (pine)
- *Sequoia sempervivens* (redwood)

Figure 12 Plantation Timber Stands in Honua‘ula Forest Reserve (Klingensmith 1967)

(Note: Staff indicate some areas of conifers and eucalyptus have spread, especially NW of the blue and pink sections.)



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 October 2018



3.6 Wildlife

Native Birds: Honua‘ula Forest Reserve harbors a variety of native bird species, a complete list of which can be seen in Table 5. The most recent forest bird survey occurred in 2019 (Appendix B), with transects in Tract I, Tract II, and Maka‘ula ‘O‘oma Tract. Three native species, ‘apapane (*Himatione sanguinea*), Hawai‘i ‘amakihi (*Chlorodrepanis virens*), and the threatened i‘iwi (*Vestiaria coccinea*), were documented, with Hawai‘i ‘amakihi being the most common. Tract I and II appear to have the largest populations of native forest birds in the reserve, which surprised surveyors considering the fact that the forest is highly altered after decades of grazing (DOFAW 2019).

A 1996 survey of Tract III, while not specifically done for bird species, incidentally found the same three species mentioned above as well as the Hawai‘i ‘elepaio (*Chasiempis sandwichensis*), ‘io (*Buteo solitarius*), and the Hawai‘i creeper (*Loxops mana*). The ‘io is no longer a federally listed species but is still considered an endangered species by the state of Hawai‘i.

There are three additional bird species that have not been detected in the reserve for over 30 years. This includes the ‘alalā (*Corvus hawaiiensis*), Hawai‘i ‘akepa (*Loxops coccineus*), and nēnē (*Branta sandvicensis*) who have not been detected since 1986, 1985, and 1978 respectively. Of these three birds only the nēnē is believed to still be present in the immediate area, with populations just north of Maka‘ula-‘O‘oma Tract at the Makalei Golf Course. Additional information on all the species mentioned above can be found in Hawaii’s State Wildlife Action Plan (2015).

Hawaiian Hoary Bat: The endangered ‘ōpe‘ape‘a (*Lasirus cinereus semotus*), or Hawaiian hoary bat, are known to occur within Honua‘ula FR and was detected most recently in 1994 (HBMP 2008). Bat surveys were conducted along a narrow corridor for the construction of Roger’s Trail Road in October 2005; however, no bats were detected in that particular area. Further monitoring would be necessary to determine their full extent within the reserve, but they are known to utilize a wide variety of habitat types and have seasonal variability between lowlands and high elevations.



Figure 13. Three Native Birds Seen in 2019 Forest Bird Surveys (from top): ‘Apapane, Hawai‘i Amakihi, & ‘I‘iwi. PC: Sherman Wing

Table 5. Native Wildlife in Honua'ula Forest Reserve

Species	Common name	Current / Historical Observation	Endangered Species Status
<i>Asio flammeus sandwichensis</i>	pueo	Current	N/A
<i>Branta sandvicensis</i>	nēnē	Historical	Threatened
<i>Buteo solitarius</i>	Hawaiian hawk/‘io	Current	State: Endangered Federally: de-listed
<i>Chasiempis sandwichensis</i>	Hawai‘i ‘elepaio	Current	N/A
<i>Chlorodrepanis virens</i>	Hawai‘i ‘amakihī	Current	N/A
<i>Corvus hawaiiensis</i>	‘alalā	Historical	Endangered
<i>Himatione sanguinea</i>	‘apapane	Current	N/A
<i>Lasiurus cinereus semotus</i>	Hawaiian Hoary Bat/ ‘ōpe‘ape‘a	Current	Endangered
<i>Loxops mana</i>	Hawai‘i Creeper/ ‘alawī	Current (but no longer believed to be present)	Endangered
<i>Pluvialis fulva</i>	Pacific Golden Plover/ kōlea	Current	N/A
<i>Vestiaria (Drepanis) coccinea</i>	‘i‘iwi	Current	Threatened

(HBMP 2008 & DOFAW Surveys). Note: Observations are historical if made > 30 years ago.

Invertebrates: Native invertebrates are highly correlated with native vegetation, which is still abundant in portions of the reserve (see [Vegetation](#) section). Staff have seen native moths near the ranger cabin in Tract I, and other native species of insects and other invertebrates are believed to be present as well. There have been no surveys of invertebrate species in the reserve to date, which are needed to better understand the presence and location of native invertebrates.

One endangered insect, *Drosophila heteroneura*, a Hawaiian picture-wing fly endemic to Hawai‘i Island, has been documented on the neighboring Hualālai Ranch. Two populations were found, one just north of Tract II, and the other east of Maka‘ula-‘O‘oma Tract, both in ‘ōhi‘a forest with mixed grass understory. Historically, this species is known between 3,000-6,000 ft, where larvae primarily feed on decomposing bark and stems of *Clermontia* sp. and ‘ōlapa



Figure 14. A male *Drosophila heteroneura* PC: Karl Magnacca

(*Cheirodendron trigynium*). Given proximity and host plant occurrence within the reserve, it is possible that the species could exist within Honua‘ula FR (Federal Register 2007).

Non-Native Wildlife: Thirty-three non-native forest and game birds are known to occur in Honua‘ula FR and are listed below in Table 6. Results from the 2019 survey indicate that the Japanese white-eye, followed by northern cardinal and red-billed leiothrix are the most common non-native forest bird species.

Nine non-native mammal species are also known to occur within the reserve, and they are listed below in Table 6. Sheep are present in the reserve, but usually only seasonally and in small numbers. Larger populations do live at higher elevations on neighboring land, but only come into the reserve at large populations during times of drought. Cattle are still present, but DOFAW is actively removing them from the reserve. Further information on non-native wildlife impacts, management, and hunting can be found in Threats, Management, and Public Use Opportunities sections.

Table 6. Non-Native Wildlife in Honua‘ula Forest Reserve

Species	Common name	Game species
Birds		
<i>Acridotheres tristis</i>	common myna	No
<i>Alauda arvensis</i>	(Eurasian) skylark	No
<i>Alectoris chukar</i>	chukar	Yes
<i>Aratinga mitrada</i>	mitred conure	No
<i>Callipepla californica</i>	California quail	Yes
<i>Cardinalis cardinalis</i>	northern cardinal	No
<i>Carpodacus mexicanus</i>	house finch	No
<i>Estrilda astrild</i>	common waxbill	No
<i>Estrilda caerulescens</i>	lavender waxbill	No
<i>Euodice cantans</i>	African silverbill	No
<i>Gallus gallus</i>	red junglefowl (domestic)	No
<i>Garrulax canorus</i>	melodious laughing thrush	No
<i>Geopelia striata</i>	zebra dove	No
<i>Haemorhous mexicanus</i>	house finch	No
<i>Horornis diphone</i>	Japanese bush warbler	No
<i>Leiothrix lutea</i>	red-billed leiothrix	No
<i>Lonchura oryzivora</i>	Java sparrow	No
<i>Lophura leucomelanos</i>	Kalij pheasant	Yes
<i>Meleagris gallopavo</i>	wild turkey	Yes
<i>Mimus polyglottos</i>	Northern mockingbird	No

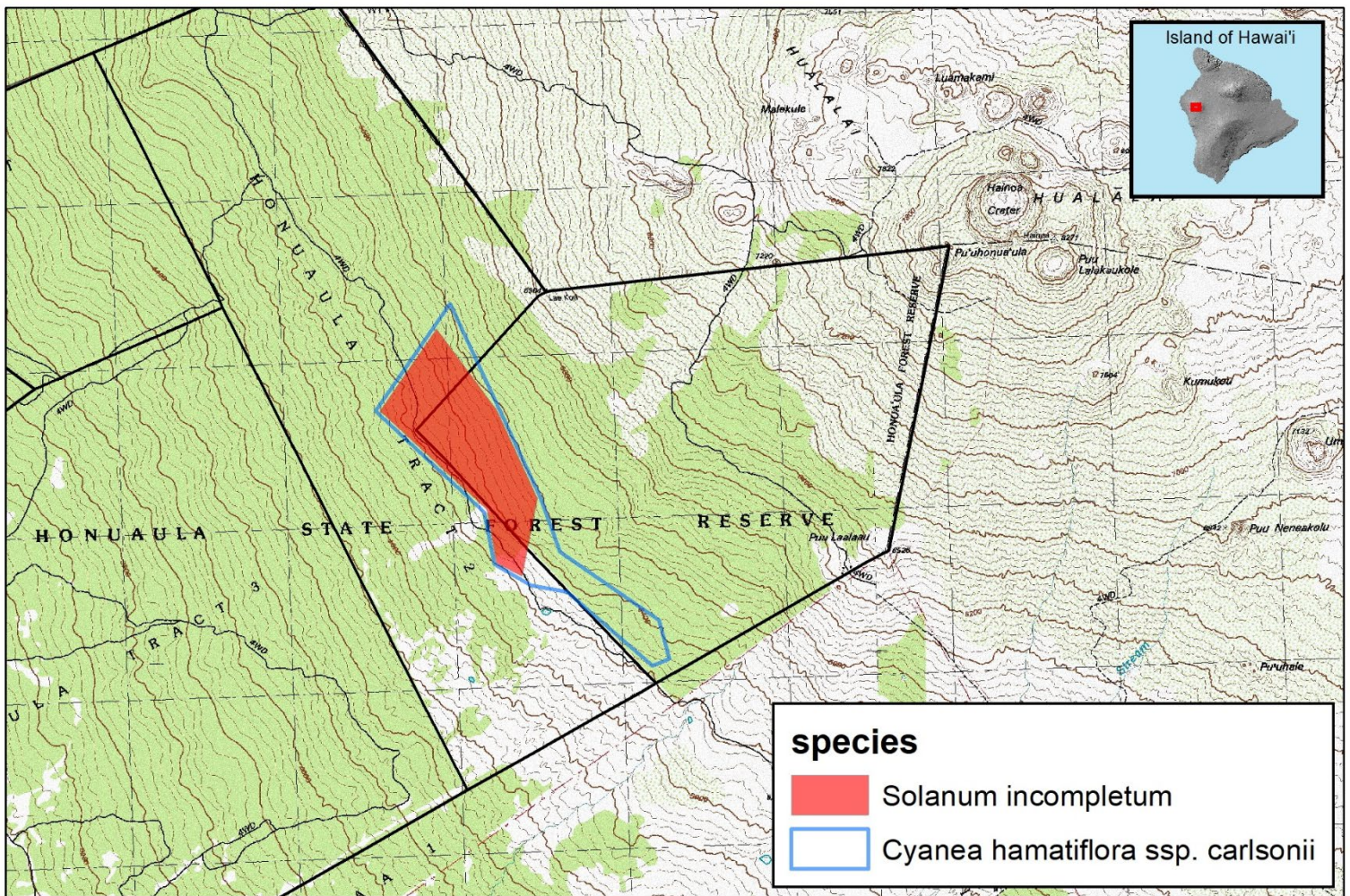
Species	Common name	Game species
<i>Paroaria capitata</i>	yellow-billed cardinal	No
<i>Passer domesticus</i>	house sparrow	No
<i>Pavo cristatus</i>	Indian peafowl	No
<i>Phasianus colchicus</i>	common “ring-necked” pheasant	Yes
<i>Psittacara erythrogenys</i>	red-masked parakeet	No
<i>Pternistis erckelii</i>	Erckel’s francolin	Yes
<i>Serinus mozambicus</i>	yellow-fronted canary	No
<i>Sicalis flaveola</i>	saffron finch	No
<i>Streptopelia (Spilopelia) chinensis</i>	spotted dove	Yes
<i>Tyto alba</i>	barn owl	No
<i>Zosterops japonicus</i>	Japanese white-eye	No
Mammals		
<i>Bos taurus</i>	cattle	No
<i>Canis lupus familiaris</i>	dog	No
<i>Felis catus</i>	cat	No
<i>Herpestes auropunctatus</i>	mongoose	No
<i>Mus musculus</i>	house mouse	No
<i>Ovis aries</i>	sheep	Yes
<i>Rattus rattus</i>	black rat	No
<i>Rattus exulans</i>	Polynesian rat	No
<i>Sus scrofa</i>	pig	Yes

3.7 Critical Habitat

As outlined by the Endangered Species Act, critical habitat is defined as “specific geographic areas, whether occupied by a listed species or not, that are essential for its conservation and that have been formally designated by rule” (USFWS 2004). Small areas of Honua‘ula FR have been designated as critical habitat (Figure 15) for *Cyanea hamatiflora* ssp. *carlsonii* (226.54 acres) and *Solanum incompletum* (140.60 acres). *S. incompletum* is only currently known to exist at nearby Pu‘u Anahulu and Pōhakuloa Training Area.

Approximate location and density of all observations of threatened and endangered species in the reserve can be found in Figure 16. To avoid disclosing exact species locations, species counts are given for a grid of hexagons that are roughly 200 acres in size. This map only represents wild populations of species (i.e. does not show outplantings or released wildlife). See Table 4 for list of T&E flora species and Table 5 for T&E fauna.

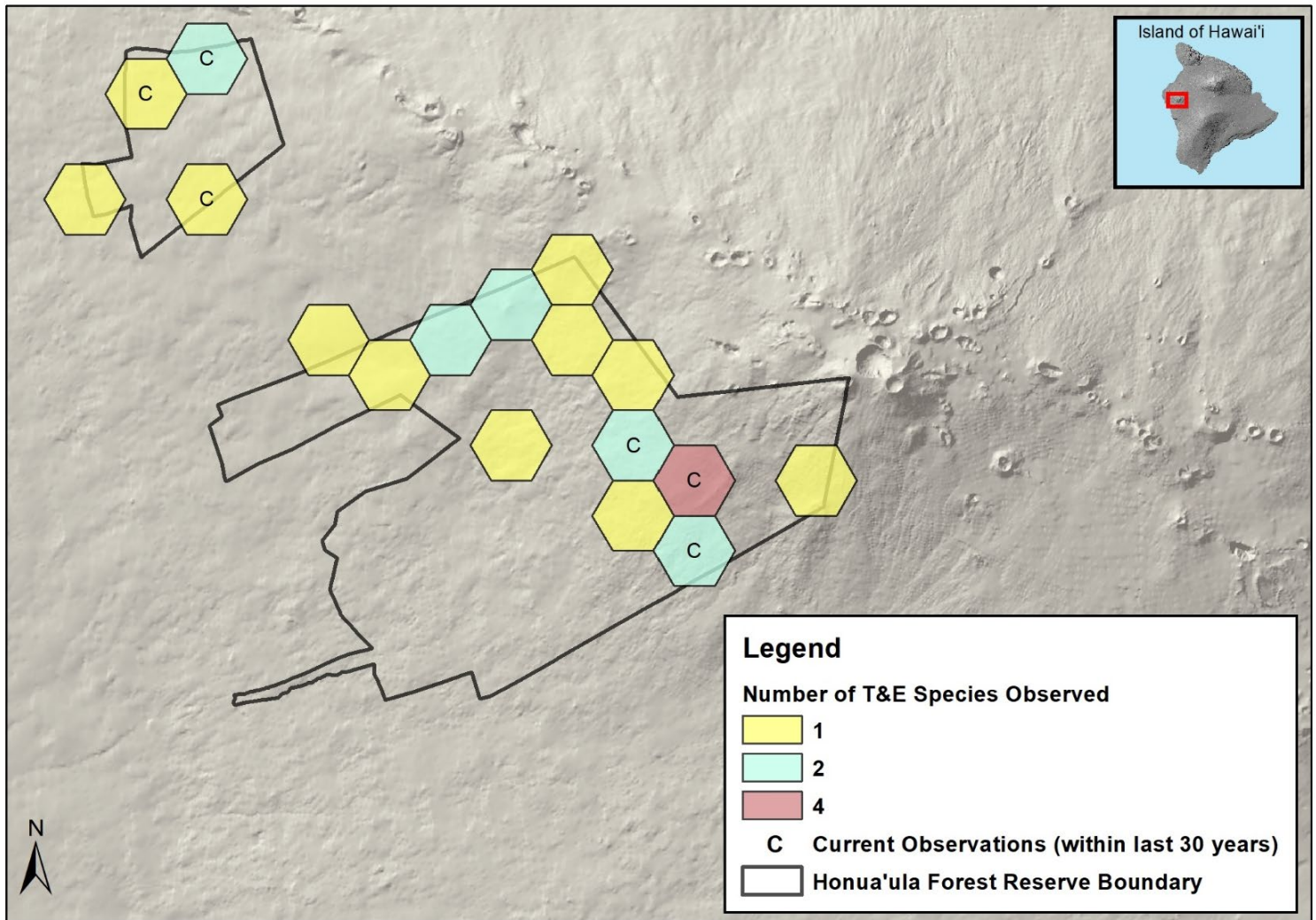
Figure 15 Critical Habitat in Honua'ula Forest Reserve



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 August 2019



Figure 16 Threatened and Endangered Species in Honua‘ula Forest Reserve.
 Note: each hexagon is 213 acres. (Hawai‘i Biodiversity and Mapping Program 2008; USFWS 2016).



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 August 2020

0 ½ 1 2 3 4 Miles

3.8 Archaeological & Historical Sites

Comprehensive archaeological surveys of Tract II and Hienaloli section were completed in 2007 as part of an Environmental Assessment (EA) for the Honua‘ula Forest Reserve Reforestation Project. Archaeologists and staff from the U.S. National Park Service (NPS), Hawai‘i State Parks, and DOFAW all participated in the surveys. Complete survey records can be found at Hawai‘i Volcanoes National Park, Cultural Resource Management Division. Four previous archaeological investigations have also occurred within Hienaloli section. The 2007 survey results are as follows:

Tract II: A total of three sites comprised of ten individual features were identified in the extreme northern portion of Tract II. The three sites are 1) a boundary wall, 2) a ranch house complex, and 3) a corral complex, all located near the ranch house shown in Figure 19. The boundary wall consists of a stone wall in good condition, mostly intact with relatively few collapsed areas. The wall is functionally interpreted as a historic-era boundary/ranch wall based on its formal characteristics and its location on the boundary between Honua‘ula Tract II and Honokahau ahupua‘a. The ranch house complex consists of two concrete water troughs, a redwood water tank, and a stone wall that encloses the main ranch house. This complex, which dates to at least the mid-1900s, is believed to be remnants of Palani Ranch Company, Inc. who previously leased the area for cattle ranching operations. The ranch house and its ancillary features have fallen into disrepair and its overall condition is rated fair to poor. The corral complex is comprised of four adjoining enclosures, three small and one larger livestock corrals.



Figure 17 Historic Ranch House located in Tract II

Hienaloli: No new features were located during the 2007 surveys, but a total of 17 unique sites have been recorded previously. The sites represent the physical remains of traditional dry land agricultural pursuits and subsequent horse/cattle ranching efforts. Additional wall/terrace like features were found in the reserve, but because of their deteriorated conditions positive feature identification could not be made. No archaeological sites or features were located along the proposed road segment within the reserve.

Archaeological and historical sites are categorized based on the period of their construction. The first type “archaeological” belongs to the pre-western contact period. The second type “historic” are associated with the period following the arrival of westerners. Many of the features found in the reserve meet the definition of “historic property” as defined in Section 6E-2, Hawaii Revised Statutes (HRS). Any projects that could potentially affect these structures are subject to review by the State Historic Preservation Division (SHPD), pursuant to Section 6E-8, HRS.

Other areas of the reserve, besides the ones listed above, have not been surveyed to date. In the event any surface and/or subsurface evidence of historic properties including cultural deposits or features, human remains, lava tubes, structural remnants or concentrations of artifacts are uncovered during any management activities, work will cease immediately in the area of the discovery. The discovery will be protected from further disturbance, and the SHPD will be consulted regarding appropriate documentation. If historic properties are present which require mitigation, the SHPD will request that a detailed mitigation plan (e.g., archaeological monitoring plan or a preservation plan) be submitted to the SHPD for review and acceptance prior to

initiation of project work, along with written and photographic documentation providing verification that appropriate interim protection measures have been implemented.

3.9 Access

Vehicle Access & Roadways:

Main Reserve: All current vehicular access routes into the main forest reserve are unpaved, 4x4 roads that cross privately-owned lands and are for management access only. There are seven dirt roads that enter/exit the main reserve, some leading to dead ends on neighboring properties. The access road most commonly used by staff for forest management is on the north side of the reserve near the historic ranch house (Figure 19). DOFAW has plans to construct a public access road from Mamaloa Highway into Tract III, see **Management** section for more information.



Figure 18. Unimproved Roadway in Tract I.

Interior roads consist of a network of dirt roads that were used for ranching activities in the past. All roads within Tract I, Tract II, and Kealakehe Tract (including the road along the border of Tract II/Tract III) are 4WD vehicle accessible. All roads within Tract III are seasonally impassable and can only occasionally be accessed via ATV/UTV.

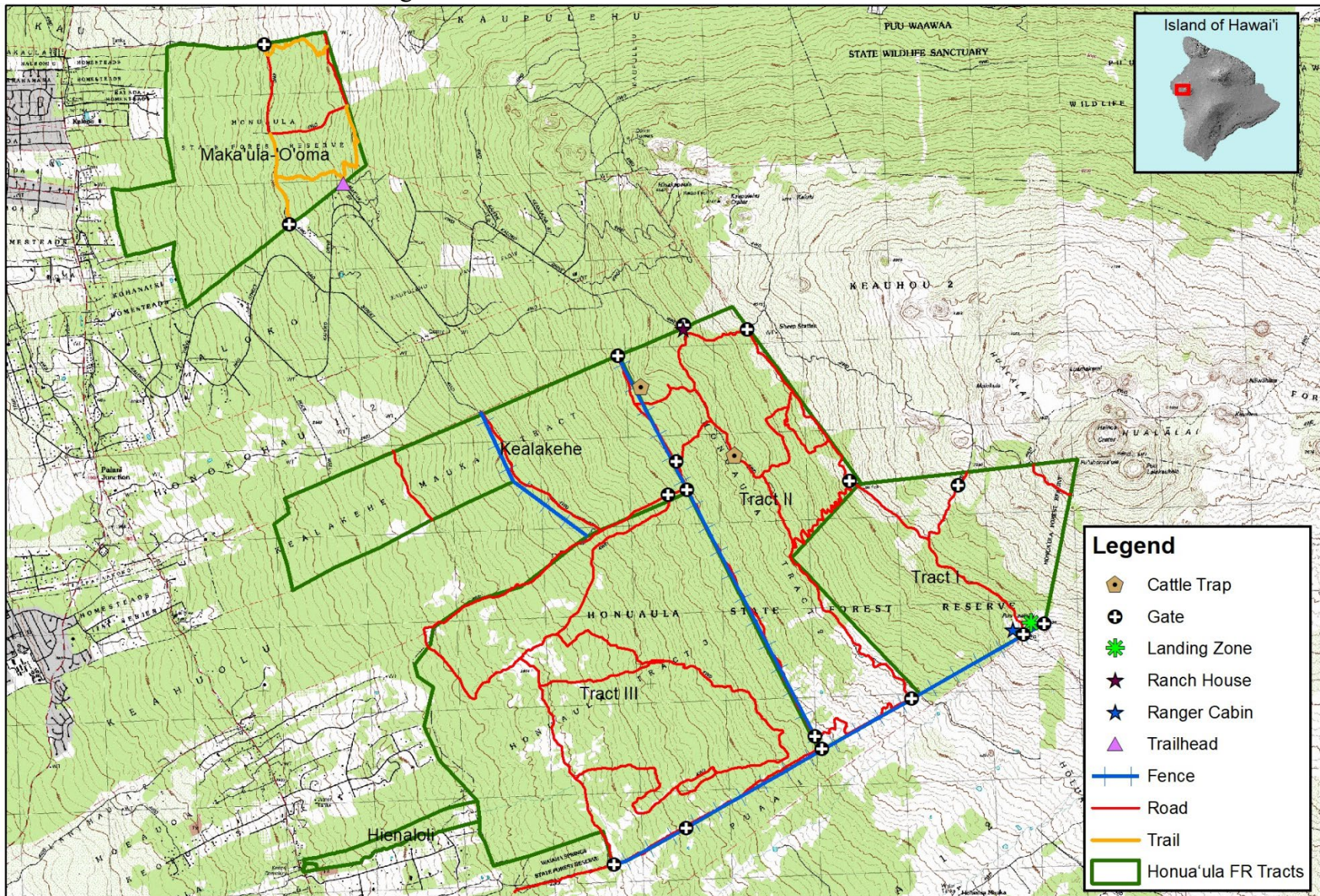
Maka‘ula-‘O‘oma Tract: There is one 4x4 road on the north side of the tract, but access is limited to management purposes only as it passes through private land. Interior roadways are constricted to the northeastern side of the tract (Figure 19).

Trails: Public can access the Kaloko trail within Maka‘ula-‘O‘oma Tract at the Makahi Street Trailhead. From Highway 190 turn mauka between the 34 and 35 mile markers onto Kaloko Drive. Follow Kaloko Drive for almost 4 miles and turn left onto Makahi Street. Drive to the end of this dead-end street and park near signs for the trailhead. Trails are planned for Tract III pending the completion of the Hienaloli Access Road (see **Management**).

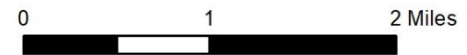
There is no public access to Hualālai summit via Honua‘ula FR. Attempts to do so trespasses through private land and are prohibited without gaining permission from other landholders.

Designated Helicopter Landing Zones: There is one designated landing zone located near the Ranger Cabin in Tract I (Figure 19).

Figure 19 Infrastructure of Honua‘ula Forest Reserve



State of Hawai‘i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 December 2020



3.10 Infrastructure

Infrastructure in Honua‘ula FR are used for management purposes only. Much of the infrastructure is centered around a staff ranger cabin located in the southeastern portion Tract I (Figure 19). There is one helicopter landing zone, a fiberglass water tank and a rain catchment system.

DOFAW currently maintains approximately 7.7 miles of fencing located along management unit boundaries, as well as 15 gates (Figure 19). Fences are constructed with bull wire to keep cattle out of the reserve. Additional fences are planned for the makai border of Tract III, see Management and Figure 32. There are also four small rare plant enclosures, maintained by DOFAW staff to protect the endangered plant *Cyanea hamatiflora* ssp. *carlsonii*.



Figure 20. Ranger cabin used by DOFAW staff

3.11 Public Use Opportunities

Hiking and Mountain Biking: Six miles of publicly accessible trails are located within Maka‘ula-‘O‘oma Tract, collectively known as the Maka‘ula-‘O‘oma trail system. The interconnecting web of trails are approximately six miles long, generally well marked and maintained, and are considered easy to moderate in difficulty as there are some steep areas. The trailhead is located at the end of Makahi Street off of Kaloko Drive (Figure 19). In the past, People’s Advocacy for Trails Hawai‘i (PATH) performed trail maintenance under a Memorandum of Agreement with DLNR. Currently, plans are in place to designate it as a Nā Ala Hele trail. DOFAW is looking for community groups to support/assist with trail management.

There is a Rapid ‘Ōhi‘a Death (ROD) sanitation station at the Kaloko trail head. Forest users should sanitize their gear before and after hiking in the reserve. Both fungal species known to cause ROD, have been detected in Maka‘ula-‘O‘oma (Figure 26). See Insects & Diseases for more information.

Horseback Riding: Horseback riding is allowed in forest reserves unless otherwise posted. However, access to suitable trails in Honua‘ula FR is currently limited. The Maka‘ula-‘O‘oma trail has steep areas and is not recommended for horseback riding.



Figure 21 Entrance to Maka‘ula-‘O‘oma trail system

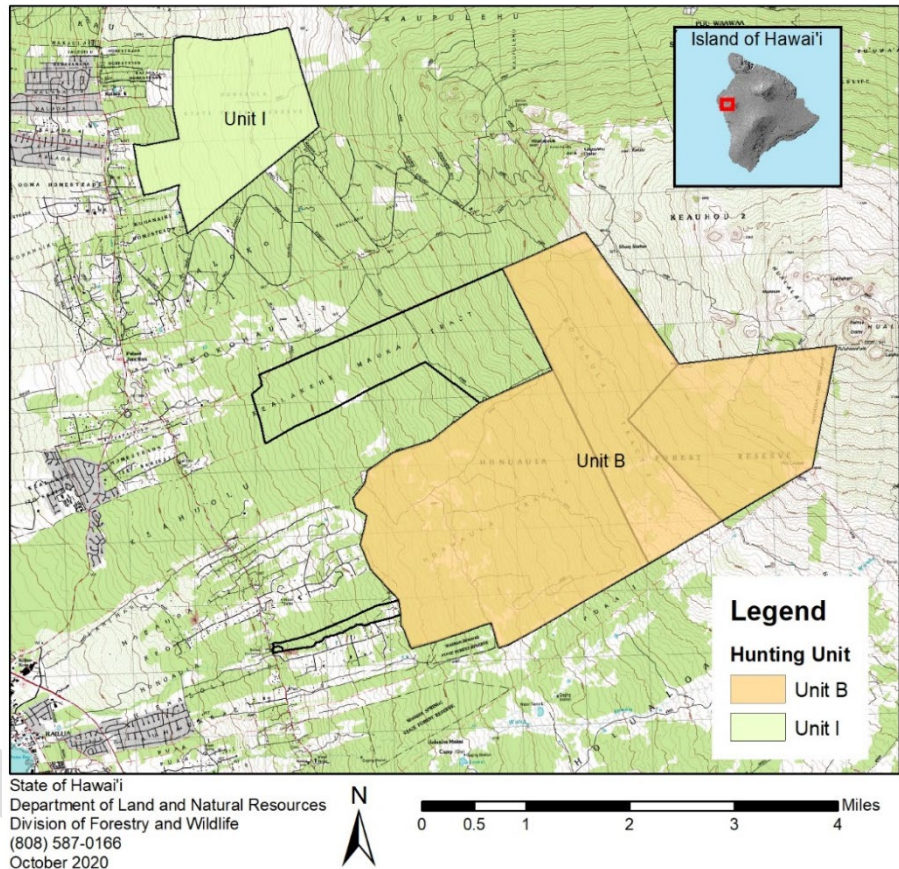
Dirt Bikes and All Terrain Vehicles: Dirt bikes and ATVs are not allowed in any part of Honua‘ula FR.

Camping: There are no designated camping areas within Honua‘ula FR.

Fishing: No fishing opportunities are available in Honua‘ula FR.

Hunting: DOFAW manages public hunting through regulations setting hunting days, seasons, bag limits, and means of take. Tract I, Tract II, and Tract III are part of Hunting Unit B, and Maka‘ula-‘O‘oma Tract is included in Unit I (Figure 22). No hunting is allowed in Kealakehe Tract or Hienaloli Tract. If individuals plan to cross private land to access the forest reserve, prior permission must be obtained from adjacent landowners. While sheep are currently considered a game species they are not usually present in the FR. They do occasionally move into the upper reserve during times of drought. Given the county watershed priority and their potential impacts to native ecosystems, the FR will not be managed for sustained sheep hunting opportunities (see [Invasive Animals](#)).

Figure 22 Hunting Units in Honua'ula FR



Forest Product Collection: Non-timber forest products may be gathered from the Forest Reserve System. Examples of items that can be collected include, but is not limited to:

- Ferns
- Flowers
- Fruits
- Greenery

Gathering of material from plant species that are not on federal or state threatened and endangered species lists is permitted and regulated by DOFAW through standard Forest Reserve System permit procedures as described in Chapter 13-104, Hawaii Administrative Rules (HAR). Gathering of non-listed species or common materials requested in quantities that are determined by DLNR as representing personal use, is regulated through issuance of a Collection Permit free of charge. If quantities are determined to represent commercial use, a Commercial Harvest Permit may be issued at a fee. Consult the Forest Product Price List on the DOFAW website for information on personal versus commercial use quantities, as well as current commercial use pricing.

Collection of listed threatened, endangered, or other rare species; common invertebrate species; or any migratory bird species is prohibited under state laws Chapter 183D and 195D, HRS and subject to regulation under applicable HAR. Applications for permits for such activities may be submitted to the “Administrator,” at the DOFAW Honolulu office. In these cases, a separate Access Permit may be required which is obtained through the district manager at the DOFAW Hawai‘i Island office. Both addresses follow:

Administrator
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, HI 96813
Phone (808) 587-0166

Hawai‘i Forestry Manager
Division of Forestry and Wildlife
19 E. Kawili Street
Hilo, HI 96720
Phone (808) 974-4221

The collection of any federally listed or migratory bird species is also subject to federal permits. Contact the USFWS for additional information.

Traditional and Customary Rights: Traditional and customary rights of the native Hawaiian people are protected under Hawai‘i law. The Constitution of the State of Hawai‘i, Article XII, Section 7 states: “The State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua‘a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights.” For any inquiries regarding traditional and customary rights, please contact the “Hawai‘i Forestry Manager” at the Hawai‘i Island DOFAW office at the address listed above.

3.12 Revenue

According to Section 183-1.5, HRS, the Department shall:

“Devise and carry into operation, ways and means by which forests and forest reserves can, with due regard to the main objectives of title 12, be made self-supporting on whole or in part.”

Previously, DOFAW generated revenue through feral cattle removal, where the permittee paid for each cow trapped and removed from the forest reserve. A future goal for generating revenue is to enter sections of the reserve into carbon markets, see Management for more details. Also, salvage logging, or logging of downed or dying trees, and accompanying timber sales is another form of potential revenue DOFAW may pursue.

4. THREATS

4.1 Invasive Plants

Invasive plants are non-native species that have the ability to invade natural areas, grow and reproduce rapidly, and reduce biodiversity. They are harmful to the environment, economy, and/or human health and can alter ecosystem functions such as freshwater collection, soil erosion, and flood control. Based on potential impacts, distribution, and available control methods, DOFAW has set a management objective for each species.

Invasive plant management objectives:

- Control – Reduce populations and/or the vigor of individuals
- Contain – Stop or minimize population growth and geographic spread
- Eradicate – Elimination of populations within geographic area

Many invasive plants are also designated as noxious weeds by the Hawai‘i Department of Agriculture. A noxious weed is defined as a plant species which is, or may be likely to become, injurious, harmful, or deleterious to the agricultural industry or natural resources of the state. Selling or transporting noxious weeds, their seeds or vegetative reproductive parts is prohibited under state law Chapter 152, HRS and subject to regulation under Chapter 4-68, HAR.

Within the reserve populations of invasive plant species are replacing native ecosystems, which has been accelerated by decades of cattle grazing (see History section). Therefore, cattle removal from the forest reserve is a current priority. However, in areas already dominated by non-native plants, grazing can help suppress the growth and spread of weeds. In some areas invasive plant populations are already expanding after being released from this grazing pressure. Table 7 lists the invasive plants known to occur in Honua‘ula FR and DOFAW’s management objectives for those plants; and Appendix C has further descriptions for some of these species.



Figure 23 Invasive banana poka growing on ‘ohi‘a lehua in Honua‘ula FR

Table 7. Invasive Plant Species in Honua‘ula Forest Reserve

Species	Common Name	DOFAW Objective	Regulatory Status
<i>Ageratina riparia</i>	Hāmākua pamakani	Contain (Biocontrol)	Hawai‘i Noxious Weed List
<i>Andropogon virginicus</i>	broomsedge	Contain	Hawai‘i Noxious Weed List
<i>Arthrostemma ciliatum</i>	arthrostema	Contain	None
<i>Clidemia hirta</i>	Koster’s curse	Biocontrol	Hawai‘i Noxious Weed List
<i>Dactylis glomerata</i>	orchard grass	Contain	None

Species	Common Name	DOFAW Objective	Regulatory Status
<i>Delairea odorata</i>	German ivy/cape ivy	Contain	None
<i>Ehrharta stipoides</i>	meadow rice grass	Contain	None
<i>Eucalyptus spp.</i>	Eucalyptus	Contain	None
<i>Fraxinus uhdei</i>	tropical ash	Contain	None
<i>Hedychium gardnerianum</i>	Himalayan ginger	Contain (Biocontrol)	None
<i>Hyptis pectinata</i>	comb hyptis	Contain	Hawai'i Noxious Weed List
<i>Lonicera japonica</i>	Japanese honeysuckle	Contain	None
<i>Panicum repens</i>	torpedo grass	Contain	Hawai'i Noxious Weed List
<i>Passiflora tarminiana</i>	banana poka	Contain (Biocontrol)	Hawai'i Noxious Weed List
<i>Pennisetum clandestinum</i>	Kikuyu grass	Contain	None
<i>Pennisetum setaceum</i>	fountain grass	Eradicate	Hawai'i Noxious Weed List
<i>Phenax hirtus</i>		Contain	
<i>Pinus patula</i>	Mexican weeping pine	Eradicate	None
<i>Psidium cattleianum</i>	strawberry guava	Contain (Biocontrol)	None
<i>Rubus argutus</i>	blackberry	Contain	Hawai'i Noxious Weed List
<i>Rubus ellipticus</i>	Himalayan raspberry	Contain (Biocontrol)	Hawai'i Noxious Weed List
<i>Rubus niveus</i>	Mysore raspberry	Contain (Biocontrol)	Hawai'i Noxious Weed List
<i>Schinus terebinthifolia</i>	Christmas berry	Contain (Biocontrol)	None
<i>Senecio madagascariensis</i>	fireweed	Contain (Biocontrol)	Hawai'i Noxious Weed List
<i>Sphaeropteris (Cyathea) cooperi</i>	Australian tree fern	Eradicate	None
<i>Tibouchina spp.</i>		Contain (Biocontrol)	Hawai'i Noxious Weed List

4.2 Invasive Animals

Invasive animal species, particularly ungulates, are a significant stressor on all native terrestrial ecosystems in Hawai'i. They have been shown to alter ecosystem processes, contribute to native species mortality, and undermine the integrity and persistence of native ecosystems (Gregg, 2018). Invasive animals known to occur in Honua'ula FR and their potential impacts are listed in Table 8. For a full list of non-native animals see table 6. Based on potential impacts, distribution, and available control methods, DOFAW has set a management objective for each non-native animal species.

Invasive animal management objectives:

- Control – Reduce populations and/or the vigor of individuals.
- Contain – Stop or minimize population growth and geographic spread.
- Eradicate – Elimination of populations within a geographic area.
- Public hunting – provide hunting opportunities.

Presence of feral cattle in the FR has significantly altered the native forest composition and structure and complete removal is a high priority (see Management). Feral sheep, while listed as a game species, are not often hunted in the area and there are no plans to sustain their populations in the reserve. The goal for feral sheep in the FR focus on managing populations to reduce impacts to native forest resources.

Table 8. Invasive Animals with Potential to Disrupt Ecosystems in Honua‘ula FR

Species	Common Name	Threat	DOFAW Objective
<i>Bos taurus</i>	cattle	Vegetation damage/erosion	Eradicate
<i>Canis lupus familiaris</i>	dog	Predate on native birds, game mammals and game birds; threat to public safety	Eradicate
<i>Ovis aries</i>	sheep	Vegetation damage/erosion	Public hunting
<i>Culex</i> spp. (especially <i>Culex quinquefasciatus</i>)	mosquito	Vectors for diseases that are a threat to public safety and native wildlife	Control
<i>Felis catus</i>	cat	Predate on native and game birds; vectors of toxoplasmosis, a zoonotic disease	Control
<i>Herpestes auropunctatus</i>	mongoose	Predate on native and game birds	Control
<i>Rattus</i> spp.	rat	Predate on native plant fruits/seeds and native and game birds	Control
<i>Sus scrofa scrofa</i>	pig	Vegetation damage; trail damage & erosion; decrease infiltration/water quality and increase runoff; spread of invasive species and pathogens such as ROD; creating breeding ground for mosquitos carrying avian malaria	Public hunting

4.3 Insects & Disease

Introduction of insects and disease are a serious threat to the natural areas of Hawai‘i. With globalization and an increased dependence on imports, approximately 20 insect species become established in Hawai‘i every year (State of Hawai‘i 2010). Of particular concern are those that have the potential to cause widespread dieback of predominant forest canopy species such as koa and ‘ōhi‘a. Below are some of the known insects and diseases either present in Honua‘ula FR or in the surrounding area. Based on potential impacts, distribution, and available control methods, DOFAW has set a management objective for each insect or disease.

Insect and disease management objectives:

- Control – Reduce populations and/or the vigor of individuals
- Contain – Stop or minimize population growth and geographic spread
- Early Detection Rapid Response (EDRR) – These species are not established in the area but pose a threat. Actions will be taken to try and control the population early if detected.
- Eradicate – Elimination of populations within a geographic area
- Monitor – Species is widespread and containment is not feasible. Monitor changes in population over time and evaluate if new control options become available.

Table 9 Insects and Diseases with Potential to Cause Damages in Honua‘ula FR

Species	Common Name	Threat	DOFAW Objective
<i>Ceratocystis lukuohia</i> , <i>C. huliohia</i>	rapid ‘ōhi‘a death	Widespread and rapid death and/or stress of ‘ōhi‘a lehua	Contain
<i>Klambothrips myopori</i>	naio thrips	Defoliation and potential death of naio	Monitor
<i>Fusarium oxysporum</i> f.sp <i>koae</i>	koa wilt	Dieback and/or decline of koa	Monitor
<i>Xylosandrus compactus</i>	black twig borer	Stunted growth and death of over 100 tree and shrub species	Monitor
<i>Prosapia bicincta</i>	two-lined spittlebug	Widespread damage and/or death of sod-forming grasses	EDRR
<i>Plasmodium relictum</i>	avian malaria	Deadly to many species of birds, especially native hawaiian species	Monitor

Rapid ‘Ōhi‘a Death (ROD): ROD is a disease that has killed over a million ‘ōhi‘a trees on Hawai‘i Island and has been found on Kaua‘i and O‘ahu. The fungi that cause the disease are wound fungi and enter the tree through wounds to the bark and then grow in the sapwood. There are two pathogens associated with ROD: *Ceratocystis lukuohia* which causes an aggressive wilt disease and is responsible for most of the stand-level die-off; and *Ceratocystis huliohia* which is a slower-acting, canker pathogen and is thought to have been present in Hawai‘i for a longer period of time.

ROD has been found infecting trees at a wide range of climates in Hawai‘i and there does not appear to be strong limiting climate factors. However, ROD does appear to be less aggressive in dry forest areas than in wet areas. In studies where healthy trees were inoculated with *Ceratocystis*, the disease spread and killed trees much faster at lower elevations, likely due to warmer temperatures.

Through various ROD survey and monitoring efforts, managers have recognized few strong patterns of disease occurrence on the landscape. Storm and wind events that wound ‘ōhi‘a trees can lead to infection by the fungus. Typically these storm events occur in an “episode” with a spike of tree mortality, followed by a decreased continuing mortality. In some cases, trees with crowns emerging from the canopy or on the edge of a forest have been anecdotally seen to be more prone to ROD.



SYMPTOMS OF ROD

- Crowns of 'ōhi'a trees that appear healthy turn yellowish or brown within days to weeks; dead leaves remain on branches for some time.
- Sometimes, single branches or limbs turn brown first and over two-three weeks the rest of the tree turns brown.
- All ages of 'ōhi'a trees can be affected and can have symptoms of browning of branches and/or leaves.
- If a tree with ROD is cut down, or a section of the tree is removed, the fungus shows up as dark staining in the sapwood along the outer edge, and there may be an over-ripe fruit-like odor.
- Trees within a given stand die in a haphazard pattern; the disease does not appear to radiate out directly from infected or dead trees.

Figure 24 'Ōhi'a killed by ROD in lower Puna on the island of Hawai'i Photo Credit: J.B. Friday

Another pattern that has been more recently observed in surveys is the higher incidence of *C. lukuohia* detections in areas where hoofed animals are present, compared to adjacent areas where animals have been removed. In one area that was previously ungulate-free, managers saw a sharp uptick in both symptomatic trees and positive detections for *C. lukuohia* when fences were damaged allowing animal ingress. The mechanisms are not fully understood, but it is thought that by wounding trees, animals might cause tree infection if spores are present. It is also possible that animals are moving spores of the fungus contained in soil, and research on animals directly spreading ROD are underway.

Ambrosia beetles which bore into 'ōhi'a trees are responsible for releasing frass which contains fungal spores into the environment. Entomologists have conducted controlled studies demonstrating that beetles can actually carry the fungus on their bodies and directly infect living 'ōhi'a seedlings. However, beetles normally attack dead and dying trees, and scientists do not think that beetles serve as the main disease vector.

ROD is now found throughout Hawai'i Island forests and will need to be managed in the long-term similar to invasive plants or effects of climate change. It is believed that spores of both *Ceratocystis* species are circulating widely on the island, and management actions can only help reduce wounding and entry points for the disease to enter trees. The relationship to feral animals offers potential management tools for preventing wounding and possibly spread of the disease by removing animals from the landscape. It is not currently clear which animals are responsible, but the pattern has been seen in forests with high populations of cattle and of pigs, the former which strip bark from 'ōhi'a trees and the latter which damage roots when digging for food. To protect important 'ōhi'a stands and forests, managers can utilize ungulate management (exclusion fences, hunting, or animal removal) to reduce incidence of ROD. This may be the most effective tool we have for managing ROD, but this only removes one potential vector and cannot prevent

storm damage that leads to wounds and ROD. Areas that are animal free are still likely to have ROD show up, but the rate of infection over time is likely to be reduced.

In late 2018, testing results confirmed that ROD had spread into Honua‘ula FR. Monitoring and surveys over the last two years have documented considerable spread in Tract II. Tract III has also been impacted but the spread of the disease has been slower. The full known extent, sites of ROD testing, and suspected areas based on aerial surveys can be seen in Figure 26.

Anyone entering or exiting Honua‘ula FR should brush and sanitize all footwear to minimize the risk of spreading ROD pathogens. There is a boot-brush sanitation station and signage warning of ROD at the Maka‘ula-‘O‘oma Tract - Makahi Street Trailhead. Further discussion of ROD management can be found in [Management](#).

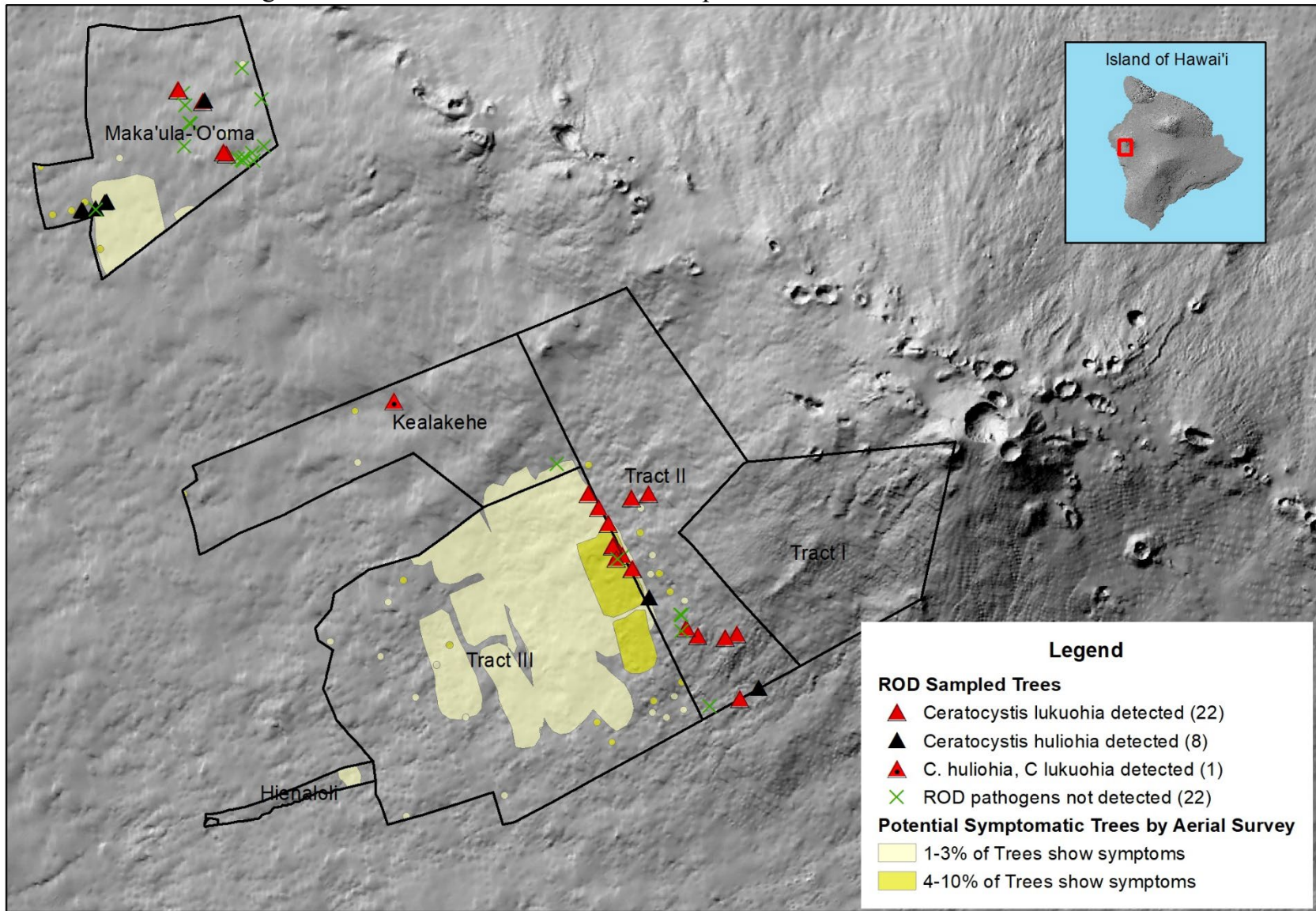
Myoporum thrips: Myoporum, or naio thrips (*Klambothrips myopori*) feed on and infest native naio (*Myoporum sandwicense*) trees. They cause leaf distortion, gall-like symptoms and in severe cases, death. While death has not been a common outcome, trees located in drier habitats are more vulnerable. Mortality rates could increase with climate change if rainfall decreases. Thrips have been observed on almost all the naio in Honua‘ula FR, except for a few trees in upper elevations that seem to remain unaffected. Myoporum thrips are likely native to Australia or New Zealand and were

detected in Southern California in 2005. In 2008, it was found on the island of Hawai‘i and then found in several locations on O‘ahu in 2018.



Figure 25. Close up of curled leaf damage due to naio thrips, *Klambothrips myopori*

Figure 26 Known & Potential Areas of Rapid 'Ōhi'a Death in Honua'ula FR



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 September 2020

Koa wilt: Koa wilt is a soil borne diseases that causes dieback and decline of koa, primarily in lowland plantation stands on former agricultural land. It is a fungal disease cause by *Fusarium oxysporum* f.sp *koae*. First sign of infection is usually a yellowing or wilting of leaves on a single branch or part of the tree's canopy. If the branch is cut, there are usually dark stains in the sapwood. While koa wilt is present in nearby Kaloko, it has not been detected in Honua‘ula FR. Koa seeds from the reserve could be collected and tested for resistance and if found, there is potential to start a koa seed orchard for *Fusarium* resistant trees at a selected location within Honua‘ula FR.

Black twig borer: Black twig borer (*Xylosandrus compactus*) is a small beetle that can cause damage and stunt growth of over 100 different shrubs and trees in Hawai‘i (Hara & Beardsley 1979). Female black twig borers tunnel into woody twigs, leaving pin-sized entry holes. Once inside they excavate galleries and lay eggs. This excavation, along with the introduction of pathogens, is the cause of damage to the host. This beetle is especially detrimental to mehamehame, an endangered native tree species found within Maka‘ula-‘O‘oma Tract (see Vegetation: Rare & Endangered Plants).



Figure 27 Close up of the black twig borer

Avian malaria: This disease is carried by mosquitos and is deadly to many native birds species, and is considered as one of the key factors limiting the distribution and abundance of native forest birds. Even when avian malaria isn't fatal, it can decrease lifespans, and female birds infected with malaria can pass down a genetic predisposition for shorter life spans (Asghar et al. 2015). The range of suitable habitat for mosquitos is expanding as temperatures rise due to climate change, placing Hawaii's birds at higher risk of avian malaria and further decreasing their available habitat. Of the three native birds detected in Honua‘ula FR during the 2019 survey, ‘i‘iwi is the most susceptible to avian malaria.

Two-lined spittlebug: The two-lined spittlebug (*Prosapia bicincta*) is a pasture pest that can cause severe damage to sod-forming grasses such as kikuyu (*Pennisetum clandestinum*) and pangola (*Digitaria eriantha*) grasses. Kikuyu is an aggressive non-native grass that forms dense, monotypic mats that can suppress establishment of native and non-native plant species alike. However, kikuyu in certain situations is arguably beneficial as it suppresses the growth of other weedy vegetative cover that could be more difficult to control. Infestation of the spittlebug, followed by poor recovery of grasses, allows for establishment of other, harder to remove invasive species. While not yet found in Honua‘ula FR, the two-lined spittlebug has been recently identified throughout North and South Kona areas, including adjacent ranch lands directly south of Honua‘ula FR.

4.4 Climate Change

According to the 2012 Pacific Islands Regional Climate Assessment (PIRCA), documented indicators of climate change in the region include increasing air temperature (more significant at higher elevation), decrease in rainfall across much of the region, decrease in ground water discharge to streams, changes to frequency and intensity of climatic extremes, mean sea level

rise (Western Pacific), and changes in species distributions. Potential impacts to our communities and natural environments include shifts in rainfall patterns, a decrease in freshwater supplies, increase in extreme weather events, flooding and erosion, increase in non-native biological invasions, increase in frequency and size of wildfires, and an increased risk of species extinction (Keener et al. 2012).

The primary mitigations for climate change are reduction in emissions and enhancement of sinks of greenhouse gases. Maintaining and ideally increasing carbon storage within our forests will help decrease atmospheric carbon. Reforestation efforts detailed in the Management section of this plan will increase carbon sinks within the reserve. In terms of reducing emissions, Governor David Ige signed into law the most aggressive clean energy goal in the nation. The goal set in 2015, is to achieve energy self-sufficiency utilizing 100 percent renewable sources of energy by the year 2045.

Forest ecosystems in Hawai‘i will face new environmental conditions associated with climate change. Individual species and ecosystems types may be more vulnerable to climate change if they are not able to adapt to these new conditions or migrate to suitable habitats. Researchers have started climate vulnerability assessment for Hawai‘i species, but additional information is needed at local scales to determine impacts within individual watersheds and forest reserves.

In 2018, the Pacific Island Climate Change Cooperative (PICCC) and EcoAdapt completed the Hawaiian Islands Climate Vulnerability and Adaptation Synthesis. Through literature reviews, expert elicitation, vulnerability mapping, and workshops with resource managers and conservation planners, the synthesis provides information to improve understanding of climate change impacts, increase capacity to reduce impacts, and facilitate decision-making by land managers (Gregg 2018).

The climate synthesis contains summaries of adaptation strategies and actions for habitats types and ecosystem services. Summaries that are relevant for Honua‘ula FR include mesic and wet forests, alpine/subalpine, cultural knowledge and values, flood and erosion control, fresh water, and food and fiber.

4.5 Fire

Native ecosystems in Hawai‘i are not adapted to wildfire, and the majority of native plant species are not able to regenerate after a fire. Increases in human caused ignitions, which lead to the majority of wildfires in Hawai‘i, plus an increase in non-native fire adapted species has led to a fourfold upsurge of area burned annually by wildfires in Hawai‘i (Trauernicht and Pickett 2016). Introduced fire adapted grasses and shrubs now cover 25% of the total land mass in Hawai‘i (Trauernicht 2014). Some areas in and around Honua‘ula FR consist of grasslands with heavy fuel loads, leading to high fire risk during times of drought. Fuel loads in the FR are currently considered high. There are no

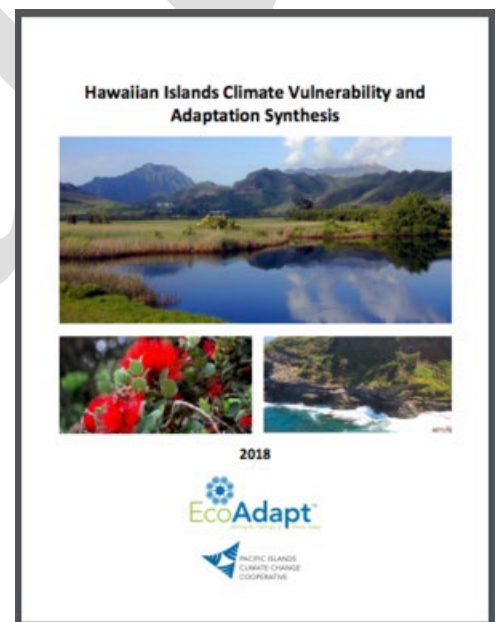


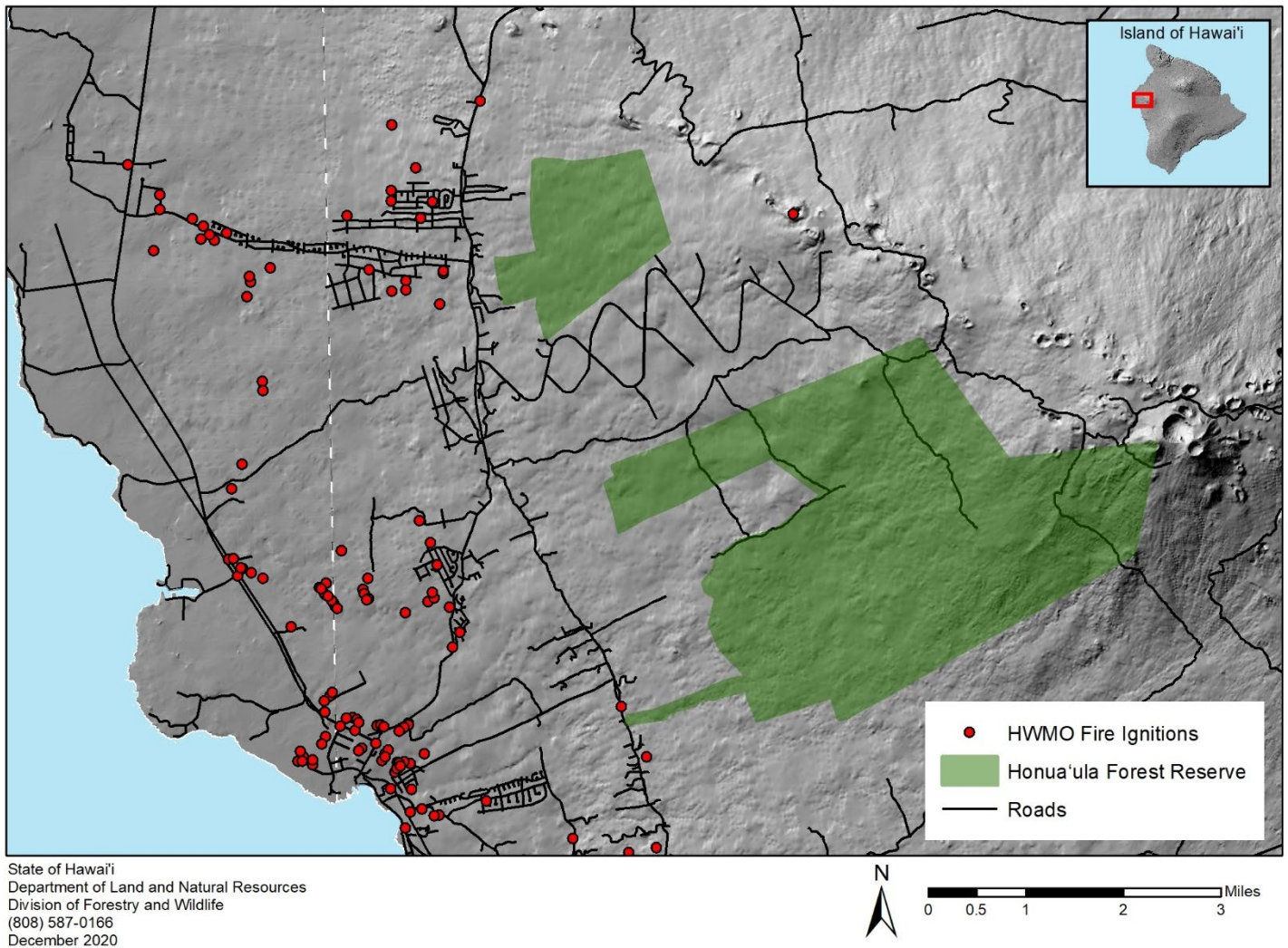
Figure 28 A complete guide or sections of the Hawai‘i climate synthesis can be downloaded at: <http://ecoadapt.org/programs/awareness-to-action/hawaiianislands/products>

documented fires within the reserve, but large fires and a handful of small fires have occurred very close to the reserve's boundaries.

Recent fires near Honua'ula FR:

- January 2006 near Hienaloli Tract (0.2 acres)
- January 2006 near Maka'ula-'O'oma & Mamalahoa Hwy (1 acre)
- December 2009 near Maka'ula-'O'oma & Mamalahoa Hwy (0.1 acres)
- December 2009 near southern boundary of Maka'ula-'O'oma (4 acres)

Figure 29 Wildfire Incidents Near Honua'ula FR (Hawai'i Wildfire Management Organization 2013)



4.6 Volcanism

As experienced in the 2018 Kilauea eruption, volcanic activity can occur rapidly, and is part of the ecosystem that shapes life and land on the island. Some hazards associated with eruptions

include lava flows, volcanic gases, ash fall, explosive eruptions, and ground cracks/settling and volcanic smog or “vog” (Juvik and Juvik 1998).

There are 9 lava hazard zones for the island of Hawai‘i; Zone 1 is the area of greatest hazard and Zone 9 is the least hazardous. Honua‘ula FR falls within lava hazard Zone 4, which encompasses all of Hualālai Volcano (Juvik and Juvik 1998). With three eruptions in the past 1,000 years and eight eruptions in the past 1,500 years, Hualālai has a high threat potential for volcanic events (Hawai‘i Volcano Observatory 2017). Hualālai last erupted in 1801 and is predicted to erupt within the next 200 years, but a volcanic event could occur in the next few decades (Decker et al., 1987).

4.7 Flooding

There have been records of regular flooding and continued flooding risk just south of the reserve in the perennial Wai‘aha Stream (Figure 8).

The waterways are not large enough to contain surface flow during heaving rains, and flooding could potentially expand into the southern edge of the reserve. Erosion from flooding is an issue along roads and fencelines. Nearby Holualoa, just south of Honua‘ula FR, experienced extremely destructive flooding in 1968 and flooding continues to be a common occurrence. DOFAW staff indicate recent years have been very wet within the reserve. During the wet season, which occurs roughly from summer to late fall, roadways in the lower sections of Tract III and Hienaloli have been impassable, which are usually only passable by atv/utv.

4.8 Other

There have been ongoing problems of public trespassing through private property to gain access into the FR. Documents from the late 1970s indicated that trespassing was of concern for Bishop Estate, who then requested that DOFAW provide advance notification of activities that were planned in the area and personnel involved. Adjacent landowners are not supportive of increased public access to the FR since trespass into their property could increase as well. The majority of current trespass involves people trying to access the summit.

Evidence of past marijuana cultivation has been noted by DOFAW staff at several locations in Honua‘ula Tract III and Maka‘ula-‘O‘oma Tract. Additionally, staff have noted parties occurring at Makahi trailhead in Maka‘ula-‘O‘oma Tract leaving behind trash and litter near the popular trail. Illegal trash and dumping is also a concern at the entrance to the Hienaloli tract.

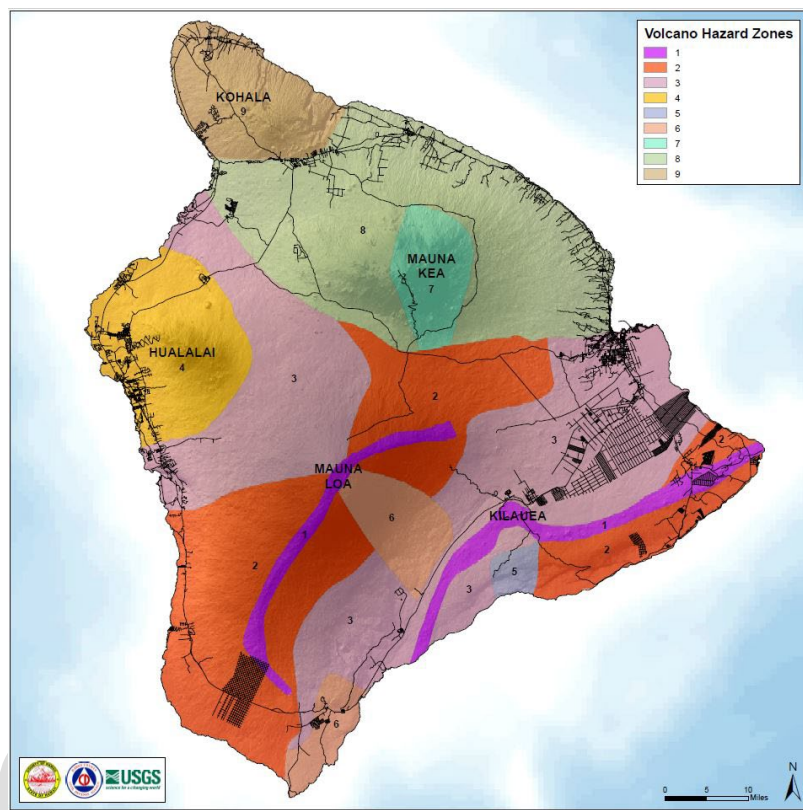


Figure 30 Volcanic Hazard Zones on Hawai‘i island (USGS)

5. MANAGEMENT

5.1 Summary of Management Activities

Early management of Honua‘ula Forest Reserve, which only consisted of Tract I throughout the 20th century, focused on cattle removal and reforestation. In 1906, two miles of wire fencing were constructed to protect large stands of koa trees from cattle. Reforestation mauka of the koa tree line with mostly non-native trees, occurred in the 1930s. Details and maps of early reforestation efforts can be found in Vegetation: Timber and Figure 12 of this plan. The areas surrounding the reserve were either leased for grazing or left fallow during the 20th century.

In the 1990s, grazing leases in Tract II and Maka‘ula-‘O‘oma Tract expired and plans to expand the reserve started to coalesce. Natural resource surveys were completed (see Vegetation and Wildlife) and populations of the endangered plant *Cyanea hamatiflora* ssp. *carlsonii* were found along the border of Tract I and II. DOFAW staff built two exclosures around these wild populations. Two additional exclosures were later built in Tract II to demonstrate forest composition without cattle, and were later used for outplantings of *C. hamatiflora* ssp. *carlsonii*. These four exclosures encompass a total of 3.5 acres. In addition, plantings of six rare and endangered species (see Table 4) were done in Maka‘ula-‘O‘oma Tract in the late 1990s as part of a wider effort to replant endangered species on Hawai‘i Island.

With the expansion of the reserve in 2006, plans were put in place to restore areas previously grazed by cattle. The Honua‘ula FR Restoration Project and accompanying Environmental Assessment, published in 2007, focused on fencing, removal of ungulates, reforestation in Tract II, and access to the reserve. Roger’s Trail Road, a 0.6 mile gravel road, was constructed in 2009, to help connect the northern and southern sections of Tract I and Tract II. Fencelines were constructed along the southern border of the main reserve and the makai boundary of Tract II (Figure 32), bringing the total fenceline in the reserve to around 7.7 miles. Efforts to trap and remove cattle were initiated in 2009 and continue to the present day.

Current Cattle Removal & Reforestation:

Removal of all cattle is one of DOFAW’s highest priority actions for Honua‘ula FR. Multiple goals are accomplished through this action including watershed protection, preservation of native ecosystems, and protecting rare and endangered species. The Hawai‘i County Department of Water Supply has designated the reserve as a Priority 1

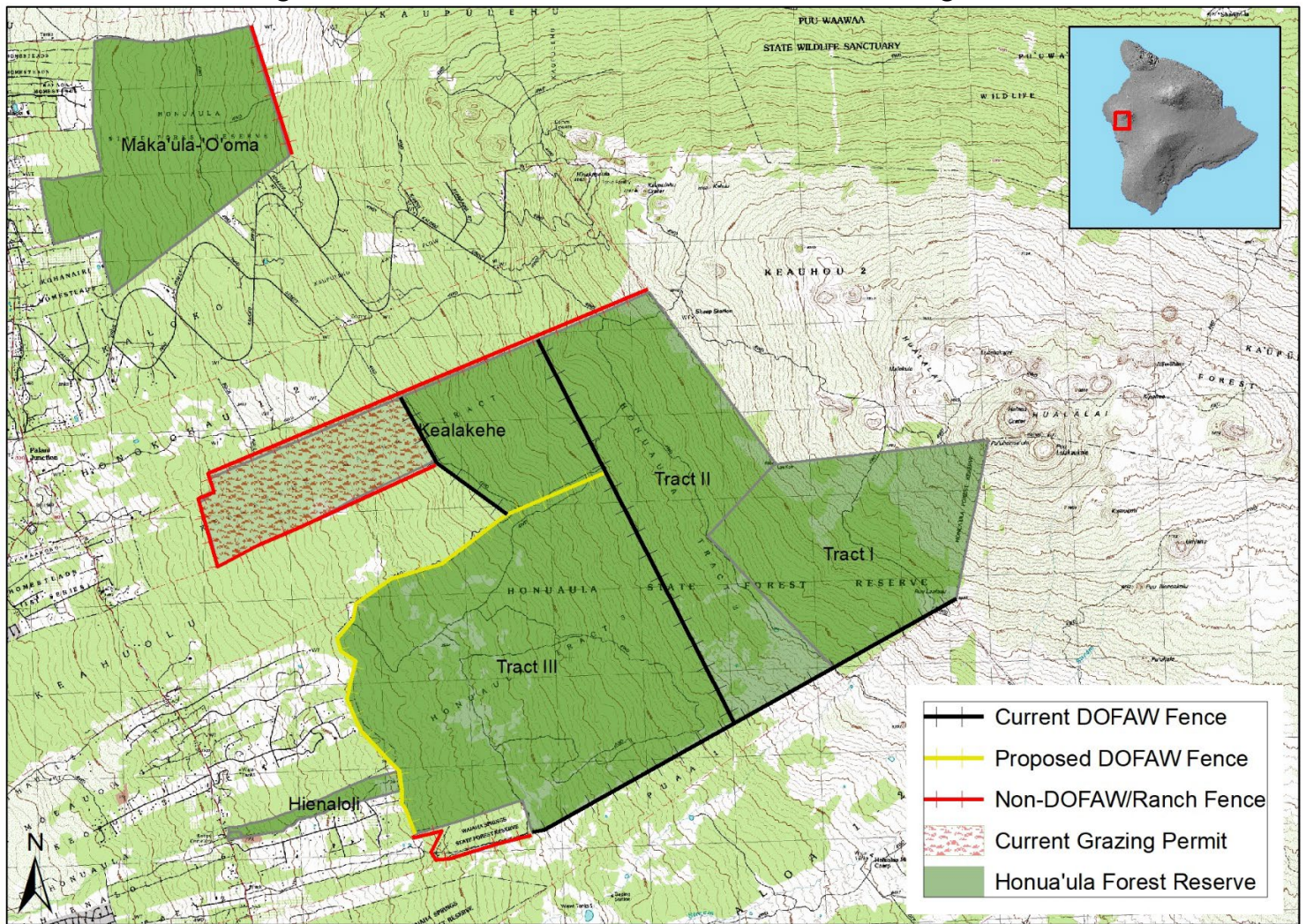
watershed area, meaning that reserve is essential for supporting ecosystem services such as aquifer recharge and stormwater retention to the Kona area. Removal of cattle is identified as one of the best ways to enhance and preserve forest cover and the watershed values of the reserve.



Figure 31. Cattle trap in Tract II.

Since 2009, over 700 feral cattle have been removed from the reserve. An estimated 200 still remain, primarily in Tract III. There are currently no cattle in the Maka‘ula-‘O‘oma Tract and control efforts are now focused within Tract I and Tract II (Figure 32). The primary method for removal are: (1) trapping and animal pushing done in partnership with Palani Ranch Company, and (2) ground control by DOFAW staff. Concurrently, four miles of fencing is being constructed along the lower boundaries of Tract III and to partition a portion of Kealakehe Tract for a paddock to push cattle into (“proposed DOFAW fence” in Figure 32). New fencelines in the reserve are being constructed with 12.5 gauge bull wire material that has proven to last longer than “hog wire” fencing that has been previously used. Bull wire fencing material was chosen for its superior durability and capacity to exclude cattle. The fenceline could be pinned to the ground and/or retrofitted with fence skirting to exclude feral pigs from the area in the future. Complete cattle removal from Tract I and II is expected by the end of 2021, and removal efforts will commence in Tract III after fencing along the lower boundary is completed.

Figure 32 Honua'ula Forest Reserve Fenceline & Grazing Areas



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 September 2020

0 0.5 1 2 3 4 Miles

Kealakehe Tract is the only area of the reserve where domestic cattle are still present. Palani Ranch Company holds a special use permit issued by DOFAW allowing for continued grazing in the area. The permitted area has been reduced over time and will continue to decrease as reforestation efforts progress. The permit currently covers 487 acres of land in the makai section of Kealakehe Tract (Figure 32). Due to limited personnel and operating budget, DOFAW proposed to transition out grazing and implement reforestation incrementally. In the interim controlled grazing helps reduce fuels loads and control invasive plant species, both critical actions to protect adjacent forested lands.

Forest Monitoring & Ecosystem Recovery:

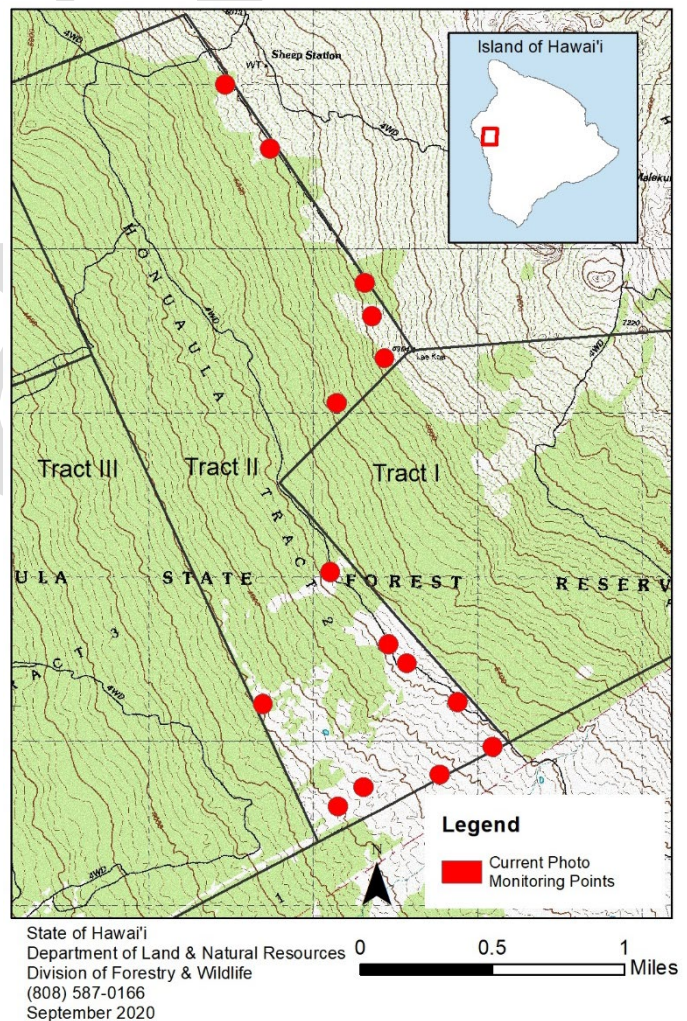
Forest composition is expected to change after cattle removal. To track this change, photo monitoring points were established in Tract I and II in April 2020 (Figure 33). Photos are taken in the four cardinal directions along with one panoramic shot, which will be repeated every 3-4 years as needed to track vegetation change over time. Tract III will also be monitored, but due to the density of the forest, photo point monitoring would be insufficient. Instead, vegetation transect will be established and monitored every 3-4 years to track changes in vegetation over time.

While it's difficult to predict how the forest will respond, it is expected that above 3,000 ft in elevation natural recruitment and regeneration of native forest will occur. Below 3,000 ft, invasive and non-native plant species are expected to increase in number and biomass.

Two years after cattle removal has been completed in the reserve, monitoring data will be used to determine the size and location of high value native ecosystems that could benefit from further management actions. This could include the construction of smaller ungulate-proof fenced enclosures, outplanting of native species, and/or focused invasive plant removal.

Access & Public Use: Access to public forested lands in the Kailua-Kona area is currently very limited. DOFAW has plans to construct a road (Hienaloli Access Road) creating the first public access route to the reserve. To better understand public interest in the FR a public use study was done by PBR Hawai'i and Associates at the request of DOFAW in 2019. Feedback from community engagement (public meeting and surveys) clearly shows a high demand for increased access to upland and forested areas. More access to hiking and trails was the most common response, but there was also interest in additional hunting opportunities as well. Most

Figure 33 Current Vegetation Photo Monitoring Points in Honua'ula FR



Please indicate the extent to which you agree or disagree with these statements:

Mentimeter

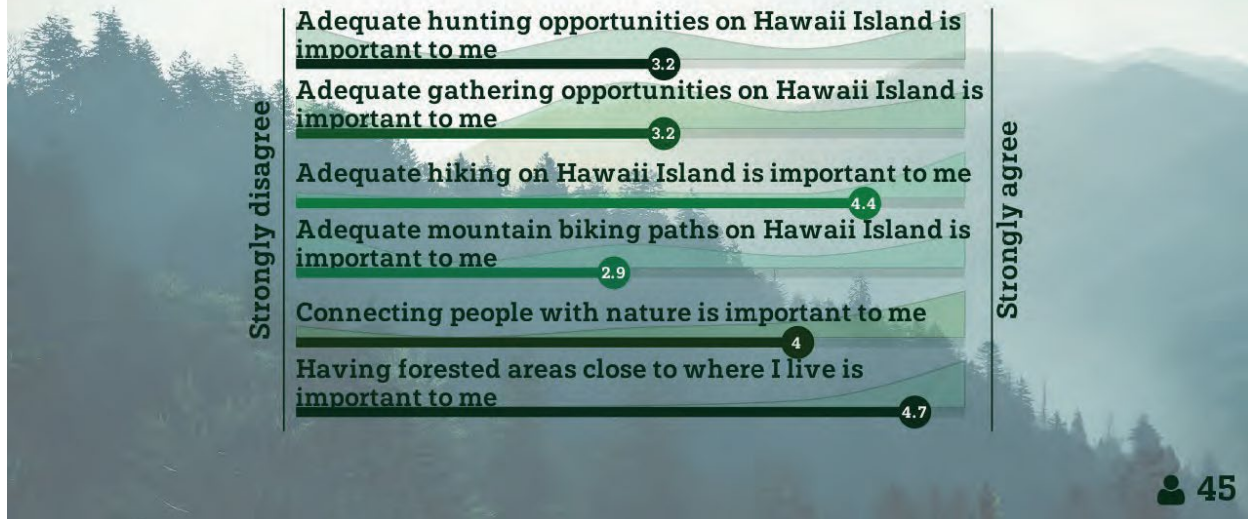


Figure 34 Results of a Public use Survey done in 2019. Full results can be seen in Appendix D.

respondents indicated that they would like to connect to nature and are not interested in being around others. People are interested in facilities like restrooms and trash cans, but concerns were also raised about overcrowding and general degradation. The full report from the study has been included as Appendix D.

Hienaloli Access Road: The narrow Hienaloli section connects Honua‘ula FR to Mamalahoa Highway (Figure 36). DOFAW plans to construct an access road along this narrow tract if funding for the project can be secured. This road will provide both public access and secure management access to the main reserve. Once constructed, this road will be the only access route to the main reserve that does not cross privately owned land. The proposed road would enter the reserve from Mamaloha highway as a two lane gravel road accessible by two-wheeled drive vehicles. After 0.1 miles there will be a 10 stall parking lot with one paved handicap stall, a hunter check-in station, and a ROD boot sanitation station. Public vehicular access will end at this point. The road past the parking lot will be gated and locked, and vehicular access will be restricted for forest management purposes only. Public pedestrian access will be available along the one-lane road that will continue into the reserve. The new roadway will terminate where it connects to existing roadways within Tract III. Another locked gate will be installed near this point.

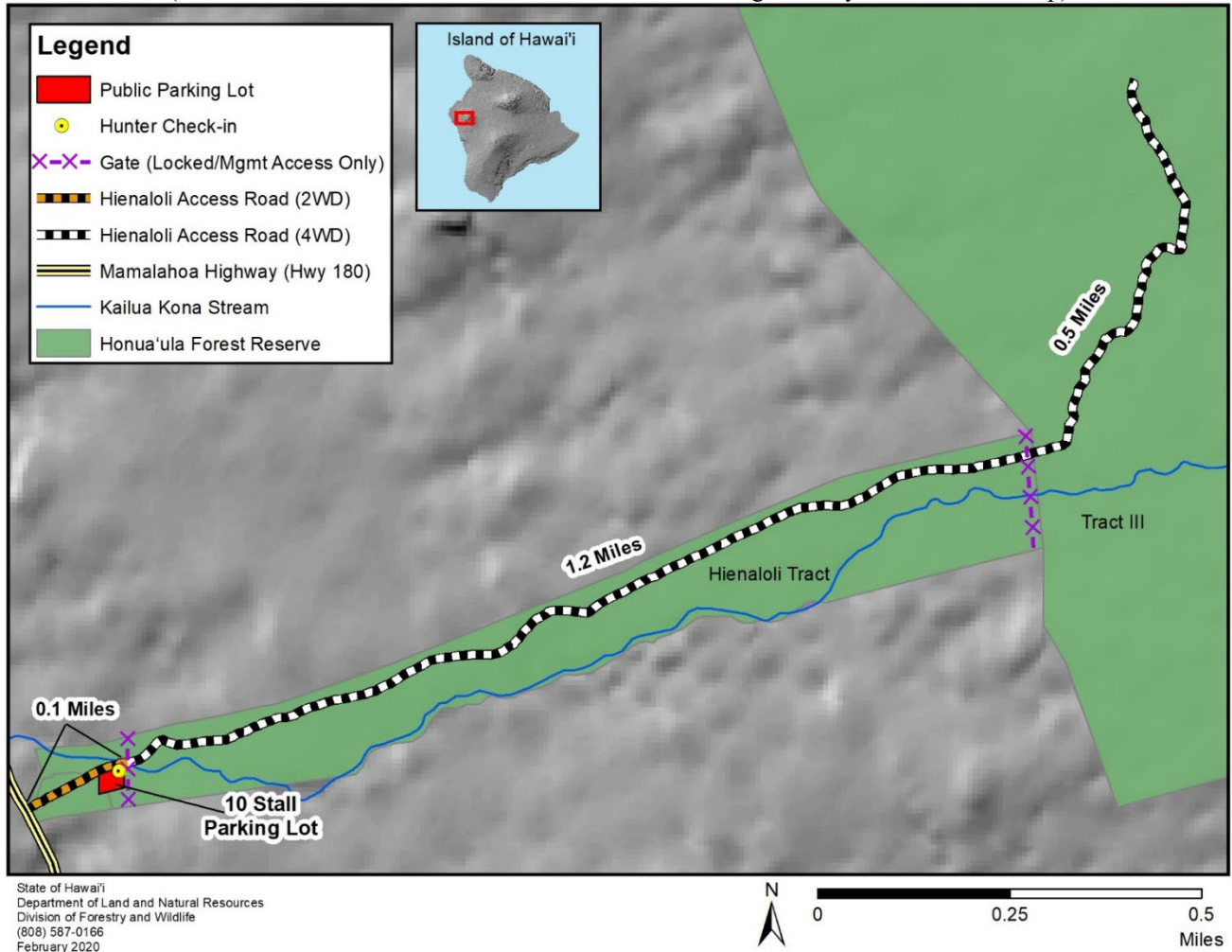
Trails: Upon completion of the access road, DOFAW plans to create a public trail system within Tract III under the Nā Ala Hele program. The old ranch roads in Tract III will be repurposed as trails and signage will be added to direct trail users. There are no plans to create trails within Tract I, Tract II, or Kealakehe Tract at this time. Although some public have expressed interest in accessing the summit of Hualalai, there is no public access to the summit, and any attempt to do so would cross private land.



Figure 35 New trails are proposed within Tract III.

Figure 36 Proposed Hienaloli Access Road

(Note: end of 4WD road in Tract III connects with existing roadways not shown on map)



Resource Protection

Rapid 'Ōhi'a Death: ROD was first detected in Honua'ula FR during aerial surveys in 2018. Since that time, DOFAW has mapped suspected ROD infected trees utilizing the USFS Digital Mobile Sketch Mapping (DMSM) application. Aerial surveys are currently done multiple times a year to track spread. If accessible, samples are taken from symptomatic trees to confirm presence or absence of the pathogen. If ROD pathogen(s) are confirmed, a number of factors go into whether or not the tree will be either left or felled and/or tarped. If the tree cannot be felled

without injuring nearby trees, it will be left alone. Also, if a tree is surrounded by other infected trees, it will likely be left, but if it is an area that is otherwise healthy it may be felled. At this time no positive trees have been felled in Honua‘ula FR, but monitoring of trees is ongoing. The known and potential extent of ROD within the reserve can be seen in Figure 26, and more information on ecosystem level protection can be seen in the cattle removal, forest monitoring and ecosystem recovery sections above.

Fire: Honua‘ula FR is a DOFAW primary response fire zone, meaning DOFAW staff are first to respond to a wildfire incident. To mitigate fire threats in the reserve DOFAW has issued a special use permit to Palani Ranching Company to graze a portion of Kealakehe Tract to reduce fuel loads. DOFAW also plans to reach an agreement with adjacent landowners for use of their water reservoirs for fire suppression. Lastly, staff also plan to fully map, identify and name all roadways, and install road signs and gate retrofits throughout the reserve in order to ensure accurate communication during response to a wildfire incident.

Invasive Species Control: Current efforts to contain invasive plant species include chemical control of Himalayan raspberry (*Rubus ellipticus*), Japanese honeysuckle (*Lonicera japonica*), and Mysore raspberry (*Rubus niveus*) throughout the reserve. Upon the complete removal of cattle, additional effort may be done to control invasive species in areas of native habitat. Biological controls, or biocontrols, using a natural living organism to control a targeted pest or invasive species, are also a part of invasive species management at Honua‘ula FR. The introduction of a biocontrol for banana poka in the 1990s, *Septoria passiflorae*, were unsuccessful mainly due to persistent volcanic smog (vog) conditions. Staff plans to re-release the biocontrol once environmental conditions are favorable. Other biocontrols for weeds such as strawberry guava, cane tibouchina, and Christmas berry may be considered in the future (see Table 7 for a full list of invasive plant species).

Threatened and Endangered (T&E) Plant Recovery: Sections of Honua‘ula FR with remnant and regenerating native forest may provide suitable habitat for the recovery of T&E plant species. The remaining wild populations of *Cyanea hamatiflora* subsp. *carlsonii* and *Flueggea neowawraea* within Honua‘ula FR are examples of the many rare species known from the region of West Hawai‘i. As part of DOFAW’s rare plant recovery strategy, outplantings of a few species have already been initiated in fenced exclosures within Honua‘ula FR (Table 4). Recovery planning for T&E plants on Hawai‘i Island is ongoing, and further botanical surveys will be needed to identify and prioritize areas for restoration outplanting across the region. Following cattle removal botanical surveys within Honua‘ula FR are planned to identify areas for creating new outplanting sites. A full list of rare plant species that have the potential to be outplanted in Honua‘ula FR can be found in Appendix E.

Threat control around restoration sites is important for outplant protection and plant regeneration. Management activities recommended around rare plant restoration sites may include ungulate removal, invasive plant control through manual, chemical, or biological control, control of small vertebrate pests, and suppression of snails and slugs, dependent on which species are planted.

Carbon Sequestration: DOFAW is exploring the possibility of certifying reforestation efforts in Honua‘ula FR under the State of Hawai‘i’s forest carbon project. Certification under Verra’s Verified Carbon Standard (VCS) as a Climate, Community, and Biodiversity (CCB) project (<https://verra.org/project/ccb-program/>), enables DOFAW to generate certified carbon credits that, in turn, can be sold to interested buyers, brokers, traders, or retailers who are looking to offset their carbon footprint. All revenue generated from the sale of carbon credits would be directed back into restoration and protection of Hawai‘i’s forests.



Figure 37 Staff are exploring options to enter sections of Honua'ula FR into a carbon certification project

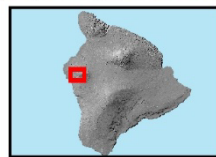
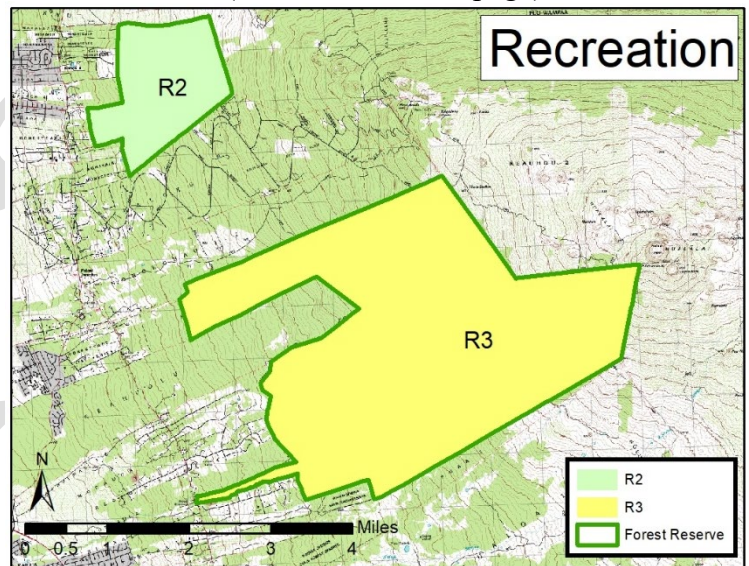
5.2 Management Guidelines

DOFAW has developed a set of draft management guidelines and associated maps to assist in evaluating and balancing human activities and resource management goals and objectives. The purpose of the guidelines is to provide administrative policy direction and prioritize resource management activities based on the integrity of existing natural resources and social needs in five principal classifications: Conservation Resources, Forest Products Management, Recreation Management, Vegetation Management, and Hunting Management. Detailed definitions of these classifications and their associated management strategies can be found in Appendix F.

Recreation Management Guidelines: There are four categories for Recreation Management: R-1 (High Recreation Management), R-2 (Medium Recreation Management), R-3 (Low Recreation Management), and R-4 (Restricted Access).

Maka‘ula-‘O‘oma Tract is designated as R-2, where outdoor recreation is of moderate intensity, or where it may be integrated with other uses. The main reserve is designated as R-3; areas where outdoor recreation is of low intensity and trails and roads receive limited use (Figure 38). The main reserve is currently inaccessible to public vehicle traffic which will change dependent on the construction of the proposed Hienaloli Access Road.

Figure 38 Honua'ula FR Draft Management Guidelines (continued on next page)



State of Hawai'i
 Department of Land & Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166
 August 2020

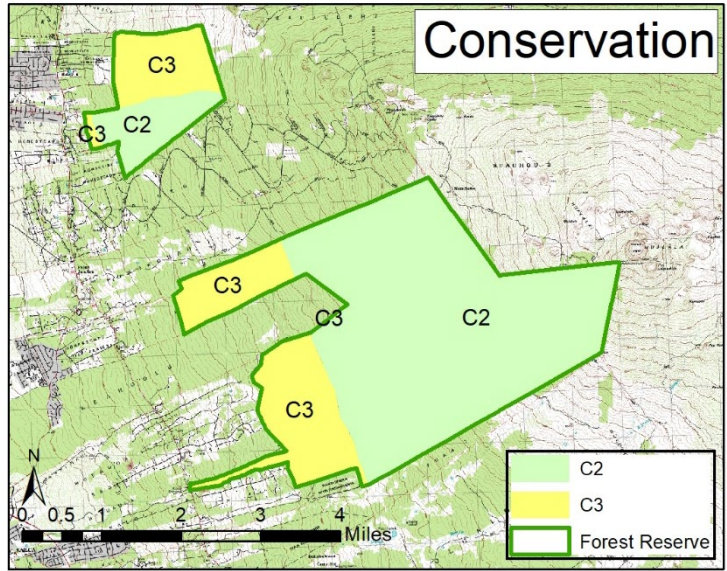
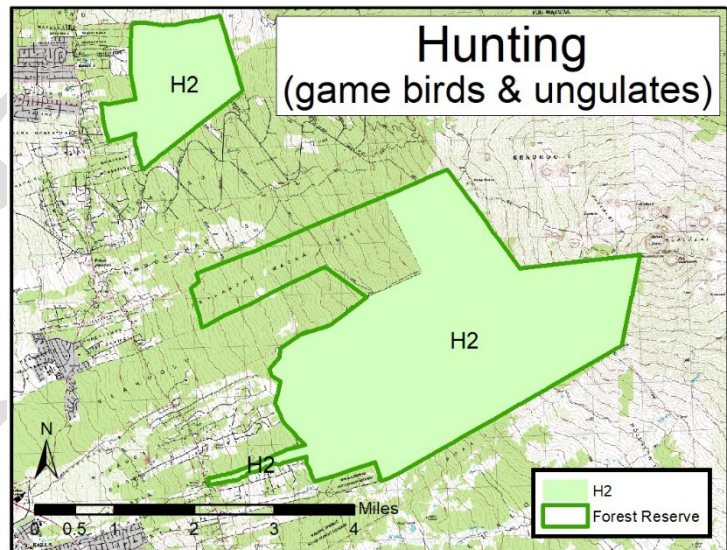
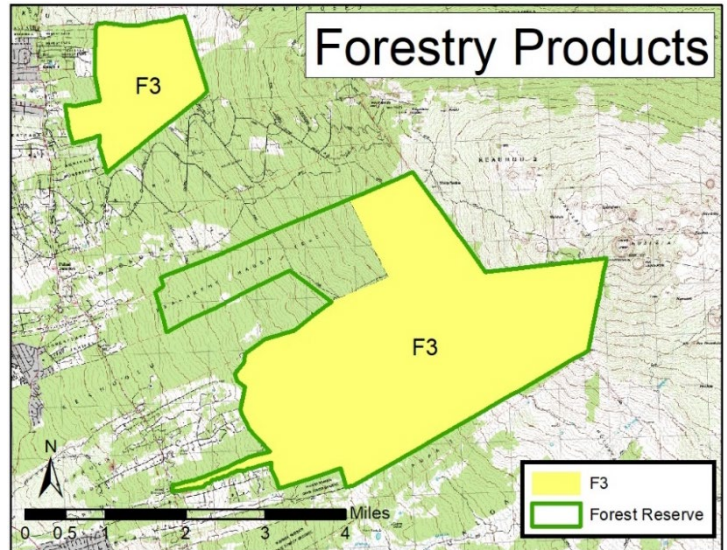
Figure 38 Honua'ula FR Draft Management Guidelines (continued from previous page)

Forest Products Management Guidelines: There are four categories for Forest Products Management: Large Scale Commercial (F-1), Small Scale Commercial (F-2), Personal Use (F-3), and Restricted (F-4). All of Honua'ula FR, except Kealakehe tract, is designated as F-3 where selective non-commercial timber harvesting and commercial timber salvage is allowed (Figure 38). DOFAW does not have any current plans for large scale timber harvesting or issuing commercial salvage permits. Harvesting of non-timber products is considered on a case by case basis. Permits will not be issued for harvesting forest products for direct resale, and the value of the raw material to be harvested

cannot exceed \$10,000. At this time any salvage of dead or downed logs will be done by DOFAW staff.

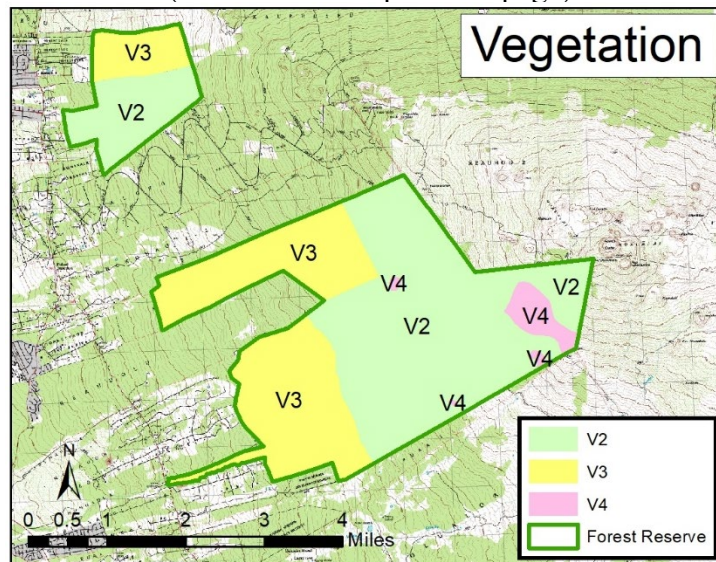
Hunting Management Guidelines: There are four categories for Hunting Management: Active Hunting Management (H-1), Moderate Hunting Management (H-2), Low Intensity Hunting Management (H-3), and No Hunting Management (H-4). All of Honua'ula FR, with the exception of Kealakehe track under grazing permits, is listed as H-2 for both game bird and ungulate hunting. See Figure 22 for hunting units in the reserve.

Conservation Resource Guidelines: There are four categories for Conservation Resources: C-1 (High Conservation Resources), C-2 (Medium Conservation Resources), C-3 (Low Conservation Resources), and C-4 (Little to No Conservations Resources). Honua'ula FR contains roughly 6,123 acres of C-2 designated land and 2,443 acres of C-3 designated land, as shown in Figure 38. As shown on the map, the lower elevations of the main reserve (<3000ft) and the north section of Maka'ula-'O'oma Tract are areas of lower conservation value.



Vegetation Management Guidelines: There are four categories for Vegetation Management: V-1 (Highest Quality Native Vegetation), V-2 (Predominantly Native Areas), V-3 (Considerable Degraded Native Vegetation Areas) and V-4 (Heavily Degraded Areas). In Honua'ula FR V2, V3, and V4 are present, with the majority designated as V2 (4,821 acres), meaning there is a relatively intact community with a predominance (51-90%) of native plants. A large portion is designated as V3 (3,344 acres) or considerably disturbed where non-native predominate. The remaining 286 acres designated as V4, represent areas that were actively reforested with non-native timber trees in the early 20th century (Figure 12).

Figure 38 Honua'ula FR Draft Management Guidelines (continued from previous page)



5.3 Management Priorities

Broad management priorities for each forest reserve were derived from the mandates that regulate DOFAW activities, including the Draft Management Guidelines and Administrative Rules, as well as input from district staff. These management priorities were divided into six categories and shall be used to guide management activities within the forest reserve. Based on the natural and cultural resources and public use opportunities of Honua'ula FR, each category has been ranked on a qualitative scale of 1 to 6 with 1 as higher priority and 6 as lower priority, ranked and defined below:

- 1) Watershed Values: aquifer recharge and erosion control
- 2) Resource Protection: fire prevention, insect and disease management, invasive species control
- 3) Native Ecosystems: landscape level protection of native ecosystems
- 4) Access, Trails, Hunting, and Other Public Uses: Access to reserve, public uses such as recreation, public hunting, cultural activities, personal gathering, educational or research activities, and events among others
- 5) Threatened and Endangered Species Management: Protection of federally listed, state listed, and other rare plants and animals
- 6) Commercial Activity: Sustainable income generating activities such as timber, other forest products, carbon sequestration, or commercial tour activities.

Table 10. expands on these management priority categories, listing general management actions to address the objectives, along with tactical goals, action items, and estimated cost associated with these actions.

Table 10 Honua‘ula Management Priorities

Watershed Values Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Cost
Cattle control	Removal of all cattle from the forest reserve	Conduct cattle removal through trapping, fences, aerial pushing, and staff shooting in Tract II.	\$70K/year + Staff & mgmt. costs
		Issue SUP for cattle removal from Tract III once fencing is complete	Staff & mgmt. costs
		Transition out of SUP for grazing in Kealakehe Tract once area is ready to manage for reforestation	Staff & mgmt. costs
	Fence construction & maintenance	Construction of fenceline along makai border of Tract III & creation of paddock in Kealakehe tract	\$740K
		Continued maintenance of existing fencelines	\$25K/year
Reforestation	Re-establishment of appropriate vegetative cover	Facilitate passive regeneration of native trees after cattle removal	Staff & mgmt. costs
		Reforest areas in upper sections (Tract II & Tract I) with koa, mamane, and ‘iliahi after cattle removal as needed	\$10K/year + staff costs
	Control ungulate populations at levels consistent with watershed protection needs	Encourage public hunting through outreach	Staff & mgmt. costs
		Based on monitoring, identify sensitive areas suitable for natural resource protection through ungulate exclusion fencing projects	Staff & mgmt. costs
Forest Monitoring	Determine landscape level needs and areas of reforestation & native ecosystems over time	Continue photo point monitoring in Tract II & Tract I every 3 years	\$10K/year
		Establish & implement transect monitoring in Tract III starting 2 years after cattle removal	\$35-70K/year

Watershed Values Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Cost
Maintain DOFAW's role in Three Mountains Alliance (TMA)	Improve communication and coordination between agencies	Establish regular communications, schedules, and protocols with TMA	Staff & mgmt. costs
		Participate in TMA's quarterly meetings	Staff & mgmt. costs
Climate change adaptation	Keep current on the latest climate change, information modeling and adaptation	Participate in climate change seminars, meetings and workshops	Staff & mgmt. costs
Erosion control	Decrease erosion and sediment delivery to improve water quality and protect municipal water supplies	Design and construct roads to minimize erosion and sediment production.	Staff & mgmt. costs

Resource Protection Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
Fire Management	Fire pre-suppression	Development of fire management plan	\$50K
		Create a road map and on the ground signs for management and fire personnel	\$20K
		Establish an agreement with neighboring landowners for access to water use in case of fire	Staff & mgmt. costs
	Fire prevention	Maintain existing roads to act as fuel breaks and fire aids	\$20K/year
		Post Smokey Bear fire prevention signs at entrances/access point of Honua'ula FR	\$2K

Resource Protection Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
		Close Honua‘ula FR during extreme fire preparedness level	Staff & mgmt. costs
	Public education and outreach	Participate in specific target outreach activities as appropriate based on fire preparedness level	Staff & mgmt. costs
Forest Health	Forest health monitoring and implementation of forest management practices	Conduct quarterly forest health surveys. Compose and submit annual survey report to Forest Health Coordinator	\$10K/year
		Hire Forest Health Coordinator position for Hawai‘i Island	\$60K-100K/year
		Rapid response to mitigate forest health issue	TBD
	Rapid ‘Ōhi‘a Death (ROD) Detection and Management	Conduct aerial surveys and trail user information surveys for early detection	\$10K/year
		Document and report any sightings of dead or dying ‘ōhi‘a trees during routine field operations	\$10K/year
		Collect samples of suspected trees to test for ROD & fell infected trees where possible	\$10K/year
		Consider high value ‘ōhi‘a stands when considering further ungulate fencing areas	Staff & mgmt costs
		Collaborate with partners to secure essential technical information of ROD threats & modes of transmission	\$5K/year
		Install additional public sanitation stations	\$5K
		Include ROD sanitation and prevention procedures on all permits designated for Honua‘ula FR	Staff & mgmt. costs
	ROD public information and	Sign installation and replacement as needed	\$2K/year

Resource Protection Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
	awareness		
	Identify presence and extent of other diseases and pests	Conduct surveys for naio thrips, koa wilt & two-lined spittlebug	\$5K/year
Monitor weather conditions	Gather rain data	Install rain gauges	\$5K
	Use weather data to determine district fire preparedness levels	Implement fire preparedness level activities	Staff & mgmt. costs
	Use data to monitor environmental conditions relating to forest health	Implement appropriate forest management activities	Staff & mgmt. costs
Plant Identification	Complete a comprehensive plant list of the FR	Conduct botanical surveys in identified undersurveyed areas of the FR	\$30K*
Invasive Species Management	Invasive species monitoring and control	Collaborate and support partner research and invasive species control efforts	\$50K/year
		Continued manual, chemical and mechanical control of target species	\$50K/year
	Continue to work with cooperating agencies, including BIISC, TNC, NRCS, HDOA, UH-CTAHR, TMA, USFWS, and others	Invasive species technician and support staff to work with cooperating agencies to monitor and control invasive species in the FR	\$125K/year
	Support biological control efforts	Support applied research for potential biocontrol release and monitoring of new agents such as strawberry guava, Christmas berry, and banana poka	TBD

Resource Protection Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
	Develop a comprehensive list of invasive and incipient plant species	Conduct surveys in identified undersurveyed areas of the FR	*see cost for plant identification (\$30K)
	Long Term Planning	Develop a comprehensive weed plan	\$5K

Native Ecosystems Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
Identify areas of regenerating and potential native ecosystems	Monitor changes to native ecosystems over time as cattle are removed	Utilize photo point monitoring & veg surveys during and after cattle removal	Staff & mgmt. cost
	Determine landscape level needs	Identify areas of native ecosystem natural recovery	Staff & mgmt. costs
		Implement common native outplanting in select areas after cattle removal	\$10K/acre
Ungulate control	Remove ungulates from within ungulate proof fences designated for zero tolerance	Ground control and aerial control work as needed	TBD
	Consider areas for further ungulate proof fencing	Based on monitoring after cattle removal, identify sensitive areas suitable for natural resource protection through ungulate exclusion fencing projects	TBD

Access, Trails, Hunting & Other Public Uses Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
Public Access & Infrastructure Management	Construct and maintain Hienaloli access road and parking infrastructure	Secure funding & hire contractor for construction of access road and parking lot	\$3,200,000
	Establish new Na Ala Hele trails in Tract III	Plan and reutilize old roads for various use groups (hiking, traditional & cultural use, personal collection, equestrian, bicycle) after access is complete	\$50K
	Maintain road infrastructure	Grading and repair of roads as needed, and maintenance of other road features	\$35K/year
	Maintain trail infrastructure in accordance to NAH program standards and plans	Maintain and repair trails with partner organizations ((Maka'ula-'O'oma Tract)	\$10K
	Evaluate potential for future recreational & access enhancements	Look into potential options for extended trail networks & other public use opportunities	TBD
		Monitor addition to Forest Reserve in Tract III	Staff & mgmt. costs
Increase public information/awareness	Update and install informational signage	Sign installation and replacement as needed	\$10K/year + Staff & mgmt. costs
Enforcement	Increase enforcement of Forest Reserve Rules and applicable HAR to protect natural resources and State infrastructure	Secure additional funding for evening and night time survey and patrol.	\$30K/year
		Establish DOCARE monitoring/patrol system	Staff & mgmt. costs
Public Hunting	Track hunting use of FR	Install hunter check-in station at the Maka'ula O'oma Tract trailhead and at future parking lot in the Hienaloli Access Road	\$5K

Access, Trails, Hunting & Other Public Uses Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
	Public education	Continue hunter education program, other public outreach as required	\$2K + Staff & mgmt. costs
	Regulate hunting as per Chapter 122 and 123, HAR	Manage bird and mammal hunting seasons	Staff & mgmt. costs

Threatened & Endangered Species Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
Protection and recovery of listed rare plants and animals	Implement management and recovery of T&E species consistent with management guidelines and 2015 Hawai'i State Wildlife Action Plan (SWAP)	PEPP staff and DOFAW botanists to conduct botanical surveys	*See cost for plant identification (\$30K)
		Utilize surveys and monitoring efforts to obtain baseline data to help determine specific areas and to protect species of interest	Staff & mgmt. costs
	Cooperate with PEPP, USFWS, and other agencies to prioritize species protection	Build fences and maintain exclosures around wild populations of rare plants. Outplant T&E species in exclosures. Conduct predator and ungulate control as needed.	\$25K
		Continue ongoing monitoring, surveys for presence, and population estimates of rare animals including the Hawaiian hoary bat and <i>Drosophila heteroneura</i>	\$5K/year
	Maintain infrastructure for all plant exclosures located within the FR	Inspect and maintain fence exclosures 4x per year or as needed. Conduct predator and ungulate control as needed	\$5K + staff & mgmt. costs

Commercial Activity Management Priorities

General Management Action	Tactical Goals	Action Items	Estimated Costs
Carbon sequestration & carbon market participation	Certify areas of Honua'ula FR under the State of Hawaii forest carbon reforestation project	Identify current areas of low canopy cover	Staff & mgmt. costs
		Obtain 3 rd party certification of areas to be included within carbon project	TBD
	Increase carbon sequestration within reserve through reforestation	Promote passive reforestation with cattle removal & replanting of open areas with koa as needed	TBD / Staff & mgmt. costs
	Improve forest management to promote additional carbon sequestration	Evaluate management strategies that would increase carbon sequestration in existing forest areas	TBD
	Track carbon increases over time	Catalog areas of carbon increase in the reserve through monitoring	Staff & mgmt. costs
Exploration of other suitable commercial activities	Commercial salvaging of dead trees from along roadsides with minimal impact to the environment	Purchase equipment for salvage (islandwide)	\$200K
		Salvage work completed by DOFAW staff, potential auction of lumber afterwards	Staff & mgmt. costs
	Explore other forest products opportunities	Monitor developing forest products industries, especially for sandalwood industry & small scale koa harvest	Staff & mgmt. costs
	Determine other income possibilities – commercial tour, commercial harvest, and film permits	Determine protocol to manage fee collection	Staff & mgmt. costs

5.4 Overall Measures of Success

Measures of success for individual forest reserve management plans can be derived from the State of Hawai‘i annual variance reports. Initial measures of success applicable to Honua‘ula include:

- Miles of fence constructed
- Miles of fence maintained
- Number of feral cattle removed
- Forest monitoring schedule met
- Acres of fire protection area
- Number of signs replaced
- Acres of invasive plants controlled
- Acres of native forest restored
- Acres of native forest maintained
- Number of rare, threatened, or endangered plant/animal species protected/outplanted
- Acres of exclosure developed
- Acres of exclosure maintained
- Number of botanical surveys completed
- Number of cultural resources protected
- Miles of road maintenance
- Miles of access roads constructed
- Number of forest users
- Number of game species harvested (game birds, game mammals)
- Number of commercial leases/licenses/permits issued
- Revenue generated from sale of carbon offset credits

5.5 Past & Related Plans

Plans that contain relevant information to the management of Honua‘ula FR are listed below.

- Big Island Invasive Species Committee Strategic Plan
- DOFAW Forest Action Plan
- DOFAW Draft Management Guidelines
- Hawaiian Islands Climate Vulnerability and Adaptation Synthesis
- Hawaii’s State Wildlife Action Plan
- Hawai‘i County Department of Water Supply (prepared by University of Hawaii Economic Research Organization) report Identifying Priority Watershed Areas for Groundwater Recharge Protection on Hawai‘i Island
- Honua‘ula Forest Reserve Restoration Project Final Environmental Assessment (2007)
- Kona Open Space Network Subcommittee Report
- Rapid ‘Ōhi‘a Death Strategic Response Plan 2020-2024
- Three Mountain Alliance Management Plan
- USFWS Endangered Species Recovery Plans

6. FUTURE RECOMMENDATIONS

6.1 Desired Outcome for the Forest Reserves

- Protection and enhancement of watershed quality and quantity.
- Reforestation of former forest land (existing pasturelands) into native forest.
- Maintain and improve rare plant exclosures.
- Removal of incipient invasive species.
- Stable populations of threatened and endangered species and native ecosystems.
- Protection of cultural resources.
- Increase and enhance sustainable public access, activities, and recreational experience.
- Removal of all feral cattle.
- Provide quality opportunities for hunting of game birds and mammals.

6.2 Future Management Recommendations

- Pursue land acquisitions or easements to increase and secure staff and public access, watershed protection, and natural resource conservation.
- Further protection of high value native habitat based on post-cattle removal monitoring.
- Integrate Hawai'i Outdoor Developed Area Accessibility Guidelines standards to meet established ADA requirements.
- Develop alternative funding opportunities that support forest management and sustainable use, such as carbon offset credits or other ecosystem benefit markets.
- Enhance district forestry program capacity, personnel and equipment resources to ensure successful implementation of management plans.
- Support enforcement personnel for improved resource protection and public safety.
- Secure funds to enhance watershed values and preserve water supply

7. REFERENCES

Asghar, M., Hasselquist, D., Hansson, B., Zehtindjiev, P., Westerdahl, H., Bensch, S. 2015. Hidden costs of infection: Chronic malaria accelerates telomere degradation and senescence in wild birds. *Science* 23, p 436-438.

County of Hawai'i. Kīlauea Eruption Recovery [Internet]. Accessed 17 March 2020.
<www.recovery.hawaiicounty.gov/hazards >

County of Hawaii, Department of Research and Development 2011. Resident Population, By Census Designated Places (CDP's) and District, Hawai'i County.
<<http://records.hawaiicounty.gov/Weblink/1/edoc/95335/Resident%20Population%20by%20Census%20Designated%20Places%20and%20Districts.pdf> >

Culliney, James 2006. *Islands in a Far Sea*. University of Hawaii Press

Decker, Robert W., Wright, Thomas L., and Stauffer, Peter H. 1987. *Volcanism in Hawai'i*. Volume 1. U.S. Geological Survey Professional Paper 1350. 584 pp. Accessed 25 March 2020.
<<https://pubs.usgs.gov/pp/1350/report.pdf> >

Ellis, W. 1825. *Journal of William Ellis*, p. 139.

Elison Timm O, Giambelluca TW, Diaz HF. 2015. Statistical downscaling of rainfall changes in Hawai'i based on the CMIP5 global model projections. *Journal of Geophysical Research: Atmospheres* 120:2014JD022059.

Federal Register. 2007. Department of the Interior. Fish and Wildlife Service. Endangered and Threatened Wildlife and Plants; Revised Proposed Designation of Critical Habitat for 12 Species of Picture-Wing Flies From the Hawaiian Islands; Proposed Rule, Part III. Vol. 72, No. 228, 67441 pp.

Frazier AG, Giambelluca TW. 2017. Spatial trend analysis of Hawaiian rainfall from 1920 to 2012. *International Journal of Climatology* 37: p 2522–2531.

Givnish TJ, Millam KC, Mast AR, et al. Origin, adaptive radiation and diversification of the Hawaiian lobeliads (Asterales: Campanulaceae). *Proc Biol Sci*. 2009
<<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2664350/> >

Gregg, R.M., editor. 2018. *Hawaiian Islands Climate Vulnerability and Adaptation Synthesis*. EcoAdapt, Bainbridge Island, WA.

Handy, E. S. Craighill, Elizabeth Green Handy, Mary Pukui Kawena. 1991. *Native Planters in Old Hawaii*. Honolulu: Bishop Museum Press, p 522-527.

Hawai'i Biodiversity and Mapping Program. 2008. *Natural Diversity Database*. Center for Conservation Research and Training. University of Hawai'i at Mānoa.

Hawai'i Gap Analysis Program. 2005. Honolulu. University of Hawai'i at Mānoa. Research Corporation of the University of Hawai'i.

Hawai'i Wildfire Management Organization. 2013. Hawai'i State Wildfire History Data Set. Accessed 30 January 2020. < www.gis.ctahr.hawaii.edu >

Hawaiian Volcano Observatory 2017. Hualālai. United States Geological Survey [Internet]. Accessed 20 March 2020. < <https://volcanoes.usgs.gov/volcanoes/hualalai> >

Hosmer, Ralph S. 1906. Reports of the Superintendent of Forestry Upon the Proposed Honuauia Forest Reserve, North Kona, Hawaii. In: Blackman, Leopold G., editor. The Hawaiian Forester and Agriculturalist Vol. III, No. 3. Honolulu: Hawaiian Gazette Co., Ltd., Publishers, p 105-110.

Jacobi, J.D., Price, J.P., Fortini, L.B., Gon III, S.M., and Berkowitz, Paul, 2017, Hawaii Land Cover and Habitat Status: U.S. Geological Survey data release, <www.doi.org/10.5066/F7DB80B9>

Judd, Charles S. 1921. Honuauia Forest Reserve: Report of the Territorial of Forester. In: Dwight, J.L., editor. The Hawaiian Forester and Agriculturalist Vol. XVIII, No. 9. Honolulu: Advertiser Publishing Co., Ltd., p. 203

Judd, Charles S. 1926. Honuauia Forest Reserve: Report of the Territorial of Forester. In: Dwight, J.L., editor. The Hawaiian Forester and Agriculturalist Vol. XVIII, No. 4. Honolulu: Advertiser Publishing Co., Ltd., p 136, 173.

Juvik, Sonia P. and Juvik, James O., editors. 1998. Atlas of Hawai'i. 3rd ed. Honolulu: University of Hawai'i Press. pp. 72

Ka Hoku o Hawai'i 1927. Volume XX, Number 48, May 3 1927 Hilo, Kalana o Hawaii, T.H. : Ka Hui Pa'i Palapala ka Hoku o Hawaii

Keener, V.W., Marra, J.J., Finucane M.L., Spooner, D., & Smith, M.H. (Eds.). 2012. Climate Change and Pacific Islands: Indicators and Impacts. Report for the 2012 Pacific Islands Regional Climate Assessment (PIRCA). Washington, D.C.: Island Press.

Klingensmith, J. 1967. Hawaii Forest Plantation: Kailua Quadrangle, Island of Hawai'i [mylar overlay]. 1:24,000. 7.5" Series. Honolulu, HI: U.S. Department of Agriculture (Forest Service, Pacific Southwest Forest and Range Experimental Station) and State of Hawai'i (Department of Land and Natural Resources, Division of Forestry and Wildlife).

Merlin, M., D. VanRavenswaay. 1990. The History of Human Impact on the Genus *Santalum* in Hawai'i. USDA Forest Service Gen. Tech. Rep. PSW-122. p 46-60.

Smithsonian Institute, 2013. Global Volcanism Project, Hualalai [Internet] Accessed April 14, 2020. < <https://volcano.si.edu/volcano.cfm?vn=332040> >

State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife. 2005. Field Faunal Survey Report.

State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife. 1999. Field Vegetation Survey Report.

State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife. 2010. Hawai‘i Statewide Assessment of Forest Conditions and Trends.

State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife. 2019. Honua‘ula Forest Reserve Forest Bird Surveys.

State of Hawai‘i, Department of Land and Natural Resources, Division of Forestry and Wildlife. 2005. Roger’s Trail Road (Honua‘ula Cabin Road) Alignment Survey Vegetation Report.

State of Hawai‘i, Department of Land and Natural Resources, Division of State Parks. 1991. Archeological Reconnaissance Survey: Hienaloli 1st, North Kona, Island of Hawaii (TMK: 7-5-13: 13 and 22).

Trauernicht, Clay. 2014. Wildfire in Hawaii. Honolulu, HI: Pacific Fire Exchange Fact Sheet Number 1.

Trauernicht, Clay, and Elizabeth Pickett. 2016. Pre-Fire Planning Guide for Resource Managers and Landowners in Hawai‘i and Pacific Islands. University of Hawai‘i at Mānoa. College of Tropical Agriculture and Human Resource. Forest and Natural Resource Management Publication RM-20.

United States Department of the Interior. 1940. Annual Report of the Governor of Hawaii to the Secretary of the Interior for the Fiscal Year Ended June 30 1940. Washington: U.S. G.P.O., 55 pp. Original from University of Massachusetts Amherst. Digitized by Internet Archive. Accessed 25 March 2020. <<https://hdl.handle.net/2027/uma.ark:/13960/t1qf9960w>>

United States Fish and Wildlife Service. Endangered Species [Internet]. Accessed 16 October 2018. <www.fws.gov/endangered>

United States Geological Society (USGS) 2007. Geologic Map of the State of Hawai‘i [Internet]. Accessed 15 July 2020. <<https://pubs.usgs.gov/of/2007/1089/>>

University of Hawai‘i at Hilo 2020. Understanding Rift Zones [Internet]. Accessed 16 July 2020. <<https://hilo.hawaii.edu/natural-hazards/volcanoes/riftzones.php>>

Woodcock, Deborah. 2003. To restore the watersheds: Early 20th Century tree planting in Hawaii. Annals of the Association of American Geographers, Vol 93, p 625-629.

Urban, Kathryn Ladoulis and Solamillo, Stanley. 2011. Civilian Conservation Corps In Hawai‘i: Oral Histories of the Haleakala Camp, Maui. Prepared for Haleakala National Park by K Design

Group. Accessed 13 November 2019. <www.nps.gov/hale/learn/historyculture/upload/CCC-Oral-Histories-of-Haleakala-Camp.pdf>

Place names according to:

Pukui, Mary Kawena, Elbert, Samuel H., and Mookini, Esther T. 1974. Place Names of Hawai'i. University of Hawai'i Press.

8. APPENDICES

Appendix A: Honua'ula Forest Reserve Working Plant List	69
Appendix B: Honua'ula Forest Reserve Forest Bird Surveys 2019	78
Appendix C: Hawai'i Invasive Species Council Plant Species Profiles	92
Appendix D: Honua'ula Forest Reserve Public Use Study	102
Appendix E: Rare Plants Considered for Outplanting within Honua'ula Forest Reserve	103
Appendix F: DOFAW Management Guideline Classification Definitions	104

Appendix A: Honua‘ula Forest Reserve Current Plant List

Tract I, II, III & Hienaloli Section Plant List

Sources: Honua'ula Tract II Survey 1999; Roger's Trail Road Alignment Survey January 11, 2005; Tract III and Hienaloli Proposed Road Corridor March 20 and 23, 2007

Taxon Name	Common Name	Status	Fed Status	Tract I	Tract II	Tract III/ Hienaloli
<i>Acacia koa</i> A. Gray	koa	Endemic		X	X	
<i>Adiantum hispidulum</i>	rough maidenhair fern	Introduced			X	
<i>Ageratina riparia</i>	Hāmākua pāmakani	Introduced			X	
<i>Andropogon virginicus</i>	broomsedge	Introduced				X
<i>Ardisia crenata</i>	Hilo holly	Introduced				X
<i>Arthrostemum ciliatum</i>	no common name	Introduced				X
<i>Asclepias physocarpa</i> (E. Mey.) Schltr.	balloon plant	Introduced		X	X	X
<i>Asplenium contiguum</i>	no common name	Endemic			X	
<i>Astelia menziesiana</i>	pa‘iniu	Endemic			X	
<i>Athyrium microphyllum</i> (J. Sm.) Alston	‘ākōlea	Endemic			X	
<i>Avena fatua</i>	wild oat	Introduced			X	X
<i>Bambusa</i> sp.	bamboo	Introduced				X
<i>Blechnum appendiculatum</i>	no common name	Introduced				X
<i>Buddleia asiatica</i>	dog's tail	Introduced		X	X	
<i>Caesalpinia decapetala</i>	cat's claw	Introduced				X
<i>Carex alligata</i>	no common name	Endemic			X	
<i>Chamaecrista nictitans</i>	partridge pea	Introduced				X
<i>Cheirodendron trigynum</i>	‘ōlapa	Endemic			X	
<i>Christella dentata</i>	downy woodfern	Introduced				X
<i>Christella parasitica</i>	woodfern	Introduced				X
<i>Cibotium glaucum</i>	hāpu‘u pulu, treefern	Endemic			X	X
<i>Cibotium menziesii</i>	hāpu‘u ‘i‘i, treefern	Endemic			X	X
<i>Cirsium vulgare</i> (Savi) Ten.	bull thistle	Introduced			X	
<i>Clermontia clermontioides</i>	‘ōhā, ‘ōhāwai	Endemic		X	X	
<i>Clidemia hirta</i>	Koster's curse	Introduced				X
<i>Cocculus trilobus</i>	huehue	Indigenous				X
<i>Commelina difusa</i>	honohono	Introduced				X
<i>Conyza bonariensis</i>	hairy horseweed	Introduced			X	X

Taxon Name	Common Name	Status	Fed Status	Tract I	Tract II	Tract III/ Hienaloli
<i>Coprosma ernodeoides</i>	kūkaenēnē	Endemic			X	X
<i>Coprosma rhynchocarpa</i>	pilo	Endemic			X	
<i>Cordyline fruticosa</i>	tī, kī	Introduced				X
<i>Crotalaria incanum</i>	rattlepod	Introduced				X
<i>Cryptomaria japonica</i>	tsugi	Introduced			X	
<i>Cuphea carthaginensis</i>	tarweed	Introduced			X	X
<i>Cupressus macrocarpa</i>	Monterey Cypress	Introduced		X		
<i>Cyanea hamitoflora</i> ssp. <i>Hamatiflora</i>	hāhā	Endemic	Endangered	X	X	
<i>Cyrtomium falcatum</i>	holly fern	Introduced			X	
<i>Dactylis glomerata</i>	orchard grass	Introduced		X	X	
<i>Delairia odorata</i>	German ivy	Introduced			X	
<i>Deschampsia nubigena</i>	no common name	Endemic		X	X	
<i>Desmodium intortum</i>	beggarweed	Introduced				X
<i>Dianella sandwicensis</i>	‘uki	Endemic			X	
<i>Dianthus armeria</i>	deptford pink	Introduced			X	X
<i>Dicranopteris linearis</i>	uluhe	Indigenous				X
<i>Diplazium sandwichianum</i>	hō‘i‘o, pohole	Endemic			X	X
<i>Dodonaea viscosa</i>	‘a‘ali‘i	Endemic		X	X	
<i>Dryopteris wallichiana</i>	Wallich's oak fem	Endemic		X	X	
<i>Dubautia ciliolata</i>	na‘ena‘e, kūpaoa	Endemic		X	X	
<i>Dubautia plantaginea</i> subsp. <i>plantaginea</i>	na‘ena‘e, kūpaoa	Endemic			X	
<i>Ehrharta stipoides</i>	meadow rice grass	Introduced			X	
<i>Elaphoglossum hirtum</i>	‘ēkaha	Endemic			X	
<i>Eriobotrya japonica</i>	loquat	Introduced				X
<i>Fragaria chiloensis</i> ssp. <i>sandwicensis</i>	ōhelo papa	Endemic		X		
<i>Geranium cuneatum</i>	nohoanu	Endemic			X	
<i>Gnaphalium japonicum</i>	cudweed	Introduced			X	
<i>Grevillea robusta</i>	silk oak	Introduced			X	X
<i>Hedychium coronarium</i>	white ginger	Introduced				X
<i>Hedychium gardnerianum</i>	Himalayan ginger	Introduced				X
<i>Hedyotis hillebrandii</i>	manono	Endemic			X	
<i>Helichrysum foetidum</i>	stinking everlasting	Introduced			X	
<i>Holcus lanatus</i>	velvet grass	Introduced			X	
<i>Hypericum mutilum</i>	St. John's wort	Introduced				X
<i>Hypochoeris radicata</i>	gosmore	Introduced			X	

Taxon Name	Common Name	Status	Fed Status	Tract I	Tract II	Tract III/ Hienaloli
<i>Hyptis pectinata</i>	comb hyptis	Introduced				X
<i>Ilex anomala</i>	kāwa'u	Endemic			X	
<i>Indigofera suffruticosa</i>	indigo	Introduced				X
<i>Ixora</i> sp.	Maltese cross	Introduced				X
<i>Jacaranda mimosifolia</i>	jacaranda	Introduced				X
<i>Juncus planifolius</i>	bog rush	Introduced			X	
<i>Kalanchoe pinnata</i>	air plant	Introduced				X
<i>Lonicera japonica</i>	Japanese honeysuckle	Introduced			X	
<i>Lycopodiella cernua</i>	waiwae'iole	Indigenous				X
<i>Lythrum maritimum</i>	pūkāmole	Endemic			X	
<i>Malvaviscus arboreus</i>	Turk's cap	Introduced				X
<i>Melicope volcanica</i>	'alani	Endemic			X	
<i>Melinis minutiflora</i>	molasses grass	Introduced				X
<i>Metrosideros polymorpha</i>	'ōhi'a, 'ōhi'a lehua, lehua	Endemic			X	
<i>Microlepia strigosa</i>	palapalai	Endemic		X	X	X
<i>Myoporum sandwicense</i>	naio	Endemic		X	X	X
<i>Myrsine lessertiana</i>	kōlea	Endemic		X	X	
<i>Nephrolepis exaltata</i>	sword fern	Endemic				X
<i>Nephrolepis multiflora</i>	hairy swordfern	Introduced				X
<i>Oplismenus hirtellus</i>	basket grass	Introduced				X
<i>Panicum maximum</i>	Guinea grass	Introduced				X
<i>Panicum repens</i>	Wainaku grass	Introduced				X
<i>Passiflora edulis</i>	passion fruit	Introduced				X
<i>Passiflora mollissima</i>	banana poka	Introduced			X	
<i>Pennisetum clandestinum</i>	kikuyu grass	Introduced			X	X
<i>Pennisetum purpureum</i>	elephant grass	Introduced				X
<i>Pennisetum setaceum</i>	fountain grass	Introduced				X
<i>Peperomia cookiana</i>	ala'ala wai nui	Endemic		X	X	
<i>Perrottetia sandwicensis</i>	olomea	Endemic			X	
<i>Persea americana</i>	avocado	Introduced				X
<i>Phaius tankervilleae</i>	Chinese ground orchid	Introduced				X
<i>Physalis peruviana</i>	cape gooseberry, poha	Introduced			X	
<i>Phytolacca sandwicensis</i>	pōpolo kū mai	Endemic			X	
<i>Pinus patula</i>	jelecote pine	Introduced		X	X	
<i>Pinus</i> sp.	no common name	Introduced		X		
<i>Pipturus albidus</i>	māmaki	Endemic			X	
<i>Pittosporum hosmeri</i>	hō'awa	Endemic			X	

Taxon Name	Common Name	Status	Fed Status	Tract I	Tract II	Tract III/ Hienaloli
<i>Pluchea symphitifolia</i>	sourbush	Introduced				X
<i>Pneumatopteris sandwicensis</i>	hō'i'o kula	Endemic			X	
<i>Polygonum punctatum</i>	water smartweed	Introduced			X	
<i>Prunella vulgaris</i> L.	self-heal	Introduced			X	
<i>Psidium cattleianum</i>	strawberry guava	Introduced				X
<i>Psilotum nudum</i>	moa	Indigenous				X
<i>Pteridium aquilinum</i> ssp. <i>decompositum</i>	kīlau	Endemic			X	
<i>Pteris cretica</i>	waimakanui	Endemic		X	X	
<i>Pteris excelsa</i>	'ōwali'i	Endemic			X	
<i>Pycneus polystachyos</i>	no common name	Indigenous				X
<i>Ranunculus plebeius</i>	Australian buttercup	Introduced			X	
<i>Rhus sandwicensis</i>	neneleau	Endemic				X
<i>Rubus argutus</i>	prickly Florida blackberry	Introduced			X	X
<i>Rubus hawaiiensis</i>	'ākala	Endemic			X	
<i>Rubus rosifolius</i>	thimbleberry	Introduced		X	X	
<i>Rumex acetosella</i>	dock	Introduced			X	
<i>Sacciolepis indica</i>	Glenwood grass	Introduced				X
<i>Schinus terebinthifolius</i>	Christmas berry	Introduced				X
<i>Schizachyrium condensatum</i>	beardgrass	Introduced				X
<i>Senecio madagascariensis</i>	fireweed	Introduced				X
<i>Senna septemtrionalis</i>	kolomana	Indigenous				X
<i>Sequoia sempervirens</i>	coast redwood	Introduced		X		
<i>Setaria gracilis</i>	yellow foxtail	Introduced				X
<i>Sida acuta</i>	no common name	Introduced				X
<i>Sigesbeckia orientalis</i>	small yellow-crown beard	Introduced				X
<i>Sonchus oleraceus</i>	pualele	Introduced			X	
<i>Sophora chrysophylla</i>	māmane	Endemic			X	
<i>Spathodea campanulata</i>	African tulip	Introduced				X
<i>Spathoglottis plicata</i>	Philippine ground orchid	Introduced				X
<i>Sphenomeris chinensis</i>	pala'ā	Indigenous				X
<i>Sporobolus africanus</i>	African dropseed; smutgrass	Introduced			X	X
<i>Stachytarpheta dichotoma</i>	owi, oi	Introduced				X
<i>Styphelia tameiameia</i>	pūkiawe	Endemic			X	X

Taxon Name	Common Name	Status	Fed Status	Tract I	Tract II	Tract III/ Hienaloli
<i>Terminalia myriocarpa</i>	jhalna	Introduced				X
<i>Tibouchina herbacea</i>	cane tibouchina	Introduced				X
<i>Trifolium repens</i>	white clover	Introduced				X
<i>Vaccinium calycinum</i>	‘ōhelo	Endemic		X	X	
<i>Verbascum thapsus</i>	mullein	Introduced			X	
<i>Veronica plebia</i>	common speedwell	Introduced			X	

Maka‘ula-‘O‘oma Tract Current Plant List

Source: Hawaii Natural Heritage Program, The Nature Conservancy. 1994. Biological Inventory of the Makaula Ooma Tract Island of Hawaii, Prepared for DLNR DOFAW

Taxon Name	Common Name	Status	FedStatus
<i>Adiantum hispidulum</i>	Rough maidenhair	Introduced	
<i>Adiantum raddianum</i>	maidenhair fern	Introduced	
<i>Ageratina riparia</i>	Hāmākua pāmakani	Introduced	
<i>Ageratum conyzoides</i>	maile hohono	Introduced	
<i>Aleurites moluccana</i>	candlenut, kukui	Introduced	
<i>Alyxia oliviformis</i>	maile	Endemic	
<i>Annona cherimola</i>	cherimoya, momona	Introduced	
<i>Antidesma platyphyllum</i> var. <i>platyphyllum</i>	hame, mehame	Endemic	
<i>Axonopus fissifolius</i>	narrow-leaved carpet grass	Introduced	
<i>Blechnum occidentale</i>	no common name	Introduced	
<i>Boehmeria nivea</i>	ramie	Introduced	
<i>Broussaisia arguta</i>	kanawao, pū‘ahanui	Endemic	
<i>Buddleia asiatica</i>	dogtail	Introduced	
<i>Caesalpinia bonduc</i>	kākalaioa	Indigenous	
<i>Canthium odoratum</i>	alahe‘e	Indigenous	
<i>Charpentiera obovata</i>	pāpala	Endemic	
<i>Cibotium glaucum</i>	hāpu‘u pulu, treefern	Endemic	
<i>Cibotium menziesii</i>	hāpu‘u ‘i‘i, treefern	Endemic	
<i>Cirsium vulgare</i>	bull thistle	Introduced	
<i>Citrus</i> sp.	no common name	Introduced	
<i>Claoxylon sandwicense</i>	po‘olā	Endemic	
<i>Clermontia clermontioides</i>	‘ōhā, ‘ōhāwai	Endemic	
<i>Cocculus trilobus</i>	huehue	Indigenous	
<i>Coffea arabica</i>	Arabian coffee	Introduced	
<i>Commelina diffusa</i>	honohono	Introduced	
<i>Conyza bonariensis</i>	hairy horseweed, ilioha	Introduced	
<i>Conyza canadensis</i>	horseweed	Introduced	
<i>Coprosma menziesii</i>	pilo	Endemic	

Taxon Name	Common Name	Status	FedStatus
<i>Coprosma rhynchoscarpa</i>	pilo	Endemic	
<i>Cordyline fruticosa</i>	tī, kī	Introduced	
<i>Crassocephalum crepidioides</i>	no common name	Introduced	
<i>Cuphea carthagenensis</i>	tarweed, Columbian cuphea	Introduced	
<i>Cyrtandra menziesii</i>	ha'iwale, kanawao ke'oke'o	Endemic	
<i>Cyrtomium caryotideum</i>	kā'ape'ape	Indigenous	
<i>Cyrtomium falcatum</i>	holly fern	Introduced	
<i>Deparia petersenii</i>	no common name	Introduced	
<i>Desmodium intortum</i>	no common name	Introduced	
<i>Desmodium sandwicense</i>	Spanish clover, pua pilipili	Introduced	
<i>Digitaria pentzii</i>	pangola grass	Introduced	
<i>Diospyros sandwicensis</i>	lama, ēlama	Endemic	
<i>Diplazium sandwichianum</i>	hō'i'o, pohole	Endemic	
<i>Dodonaea viscosa</i>	'a'ali'i	Indigenous	
<i>Doodia kunthiana</i>	'ōkupukupu lau'i'i	Endemic	
<i>Drymaria cordata</i> var. <i>pacifica</i>	pipili, pilipili	Introduced	
<i>Dryopteris acutidens</i>	'akole	Endemic	
<i>Dryopteris fusco-atra</i>	'i'i	Endemic	
<i>Dryopteris wallichiana</i>	i'o nui, laukahi	Endemic	
<i>Ehrharta stipoides</i>	meadow ricegrass	Introduced	
<i>Elaphoglossum paleaceum</i> ssp. <i>micans</i>	māku'e	Indigenous	
<i>Embelia pacifica</i>	kilioe	Endemic	
<i>Epilobium billardierianum</i> ssp. <i>cinereum</i>	willow herb	Introduced	
<i>Erechtites valerianifolia</i>	fireweed	Introduced	
<i>Euphorbia peplus</i>	petty surge	Introduced	
<i>Flueggea neowawraea</i>	mēhamehame	Endemic	Endangered
<i>Fragaria vesca</i>	European strawberry	Introduced	
<i>Freycinetia arborea</i>	'ie'ie	Indigenous	
<i>Geranium homeanum</i>	no common name	Introduced	
<i>Gnaphalium sandwicense</i>	'ena'ena	Endemic	
<i>Grevillea robusta</i>	silk oak	Introduced	
<i>Hedychium gardnerianum</i>	Himalayan ginger	Introduced	
<i>Hedyotis terminalis</i>	manono	Endemic	
<i>Holcus lanatus</i>	common velvet grass	Introduced	
<i>Hydrocotyle bowlesioides</i>	marsh pennywort	Introduced	
<i>Hypochoeris radicata</i>	hairy cat's ear, gosmore	Introduced	
<i>Hyptis pectinata</i>	comb hyptis	Introduced	
<i>Ilex anomala</i>	kāwa'u	Endemic	
<i>Jacaranda mimosifolia</i>	jacaranda	Introduced	
<i>Kalanchoe pinnata</i>	Air plant, 'oliwa kū kahakai	Introduced	
<i>Kyllinga brevifolia</i>	kili'o'opu	Introduced	
<i>Lantana camara</i>	lantana	Introduced	

Taxon Name	Common Name	Status	FedStatus
<i>Liparis hawaiiensis</i>	awapuhi-a-kanaloa, twayblade	Endemic	
<i>Lophospermum erubescens</i>	larger roving sailor, creeping gloxinia	Introduced	
<i>Ipomoea indica</i>	koali 'awa, koali 'awahia	Indigenous	
<i>Lythrum maritimum</i>	pūkāmole	Indigenous?	
<i>Macrothelypteris torresiana</i>	no common name	Introduced	
<i>Mangifera indica</i>	mango	Introduced	
<i>Mariscus meyenianus</i>	no common name	Introduced	
<i>Melicope hawaiiensis</i>	alani	Endemic	
<i>Melicope radiata</i>	alani	Endemic	
<i>Melinis minutiflora</i>	molasses grass	Introduced	
<i>Metrosideros polymorpha</i> var. <i>incana</i>	'ōhi'a, 'ōhi'a lehua, lehua	Endemic	
<i>Microlepia strigosa</i>	palapalai	Indigenous	
<i>Morus alba</i>	white mulberry, kilika	Introduced	
<i>Myrsine lanaiensis</i>	kōlea	Endemic	
<i>Myrsine lessertiana</i>	kōlea	Endemic	
<i>Nephrolepis cordifolia</i>	kupukupu, ni'ani'au	Indigenous	
<i>Nephrolepis exaltata</i> var. <i>hawaiiensis</i>	kupukupu, ni'ani'au	Endemic	
<i>Nephrolepis multiflora</i>	kupukupu, ni'ani'au	Introduced	
<i>Nestegis sandwicensis</i>	olopua, pua	Endemic	
<i>Oplismenus hirtellus</i>	basketgrass, honohono kukui	Introduced	
<i>Oxalis corniculata</i>	yellow wood sorrel, 'ihi mākole	Introduced?	
<i>Paspalum conjugatum</i>	Hilo grass	Introduced	
<i>Paspalum urvillei</i>	vasey grass	Introduced	
<i>Passiflora edulis</i>	passion fruit, liliko'i	Introduced	
<i>Passiflora ligularis</i>	sweet granadilla, lemi wai	Introduced	
<i>Passiflora mollissima</i>	banana poka	Introduced	
<i>Pennisetum clandestinum</i>	kikuyu grass	Introduced	
<i>Pennisetum setaceum</i>	fountain grass	Introduced	
<i>Peperomia cookiana</i>	'ala'ala wai nui	Endemic	
<i>Peperomia macraeana</i>	'ala'ala wai nui	Endemic	
<i>Peperomia remyi</i>	'ala'ala wai nui	Endemic	
<i>Perrottetia sandwicensis</i>	olomea	Endemic	
<i>Persea americana</i>	avocado	Introduced	
<i>Phaius tankarvilleae</i>	Chinese ground orchid	Introduced	
<i>Physalis peruviana</i>	cape gooseberry, poha	Introduced	
<i>Picris hieracioides</i>	hawkweed	Introduced	
<i>Pipturus albidus</i>	māmaki	Endemic	
<i>Pisonia sandwicensis</i>	pāpala kēpau, āulu	Endemic	
<i>Pittosporum hosmeri</i>	hō'awa	Endemic	
<i>Plantago major</i>	broad-leaved plantain, laukahi	Introduced	

Taxon Name	Common Name	Status	FedStatus
<i>Pluchea symphytifolia</i>	sourbush	Introduced	
<i>Polygala paniculata</i>	milkwort	Introduced	
<i>Pouteria sandwicensis</i>	‘a‘ala	Endemic	
<i>Psidium cattleianum</i>	strawberry guava, waiawi	Introduced	
<i>Psidium guajava</i>	guava, kūawa	Introduced	
<i>Psilotum complanatum</i>	moa	Indigenous	
<i>Psilotum nudum</i>	moa	Indigenous	
<i>Psychotria hawaiiensis</i> var. <i>hawaiiensis</i>	kōpiko, ‘ōpiko	Endemic	
<i>Psychotria hawaiiensis</i> var. <i>hillebrandii</i>	kōpiko, ‘ōpiko	Endemic	
<i>Pteris cretica</i>	‘ōali	Indigenous	
<i>Pteris excelsa</i>	waimakanui	Indigenous	
<i>Pteris x hillebrandii</i>	no common name	Endemic	
<i>Pycreus polystachyos</i>	no common name	Indigenous	
<i>Rubus rosifolius</i>	thimbleberry	Introduced	
<i>Sacciolepis indica</i>	Glenwood grass	Introduced	
<i>Sadleria cyatheoides</i>	‘ama‘u, ma‘u	Endemic	
<i>Schinus terebinthifolius</i>	Christmas berry, wilelaiki	Introduced	
<i>Selaginella arbuscula</i>	lepelepe-a-moa	Endemic	
<i>Senecio mikanioides</i>	German ivy, Italian ivy	Introduced	
<i>Senna pendula</i> var. <i>advena</i>	no common name	Introduced	
<i>Senna septemtrionalis</i>	kolomona	Introduced	
<i>Setaria gracilis</i>	yellow foxtail	Introduced	
<i>Sida acuta</i> ssp. <i>carpinifolia</i>	no common name	Introduced	
<i>Solanum capsicoides</i>	cockroach berry, kīkānia lei	Introduced	
<i>Spathodea campanulata</i>	African tulip tree	Introduced	
<i>Spermacoce assurgens</i>	buttonweed	Introduced	
<i>Sporobolus indicus</i>	smutgrass, West Indian dropseed	Introduced	
<i>Stachytarpheta dichotoma</i>	owi, oi	Introduced	
<i>Stenogyne scrophularioides</i>	mōhihi	Endemic	
<i>Streblus pendulinus</i>	a‘ia‘i	Indigenous	
<i>Syzygium cumini</i>	java plum	Introduced	
<i>Tectaria cicutaria</i> ssp. <i>gaudichaudii</i>	‘iwa‘iwa lau nui	Endemic	
<i>Thelypteris cyatheoides</i>	kikawaiō	Endemic	
<i>Thelypteris dentata</i>	downy woodfern	Introduced	
<i>Thelypteris parasitica</i>	woodfern	Introduced	
<i>Thelypteris sandwicensis</i>	hō‘i‘o kula	Endemic	
<i>Triumfetta semitriloba</i>	Sacramento bur	Introduced	
<i>Uncinia uncinata</i>	no common name	Indigenous	
<i>Vandenboschia davallioides</i>	palai hihi	Endemic	
<i>Verbena litoralis</i>	ha‘uoi, oi	Introduced	

Taxon Name	Common Name	Status	FedStatus
<i>Veronica plebeia</i>	trailing speedwell, common speedwell	Introduced	
<i>Veronica serpyllifolia</i>	thyme-leaved speedwell	Introduced	
<i>Wahlenbergia gracilis</i>	no common name	Introduced	
<i>Wikstroemia sandwicensis</i>	‘ākia	Endemic	
<i>Xylosma hawaiiense</i>	maua	Endemic	
<i>Youngia japonica</i>	Oriental hawksbeard	Introduced	

Appendix B

Honua‘ula Forest Reserve Forest Bird Surveys 2019

Compiled by:

Jackie Gaudioso-Levita, Lainie Berry, and Alex Wang

Hawaii Department of Lands and Natural Resources, Division of Forestry and Wildlife

August 5th, 2019

Reserve Location and Forest Types

The Honua‘ula Forest Reserve, located on the slopes of Hualālai volcano on Hawai‘i Island, comprises 8,489 acres across 6 tracts: Makaula-O‘oma, Kealakehe, Honua‘ula, Hienaloli, Tract II and Tract III (**Figure 1**). The Makaula-O‘oma tract is an ōhi‘a and hāpu‘u tree fern -dominated forest located adjacent to a residential area within the Kaloko sub-division of the North Kona District (**Figure 2**). The remaining five contiguous tracts consist of grazed grasslands with remnant native forest consisting of ōhi‘a, māmane, and koa (**Figure 3**).

Tract II and many of the surrounding properties were and are currently under active grazing. As a result of the almost continuous presence of domestic and feral cattle populations, native forest composition and structure have been heavily altered (DOFAW 2007). Tract II is mostly characterized as an open koa/‘ōhiā (*Acacia koa*, *Metrosideros polymorpha*) montane mesic forest, with little developed understory. The boundary between Tracts II and III is characterized as the best quality native forest in Tract II with an intact understory of native vegetation (DOFAW 2007). The vegetation in the Honua‘ula Tract of the forest reserve is dominated by open koa/mamane (*Acacia koa*, *Sophora chrysophylla*) forest (with mixed grasses and native shrubs), native dominated mamane/naio (*Sophora chrysophylla*, *Myoporum sandwicense*) forest, uncharacterized open-sparse vegetation, native shrubland with sparse ‘ōhiā, and alien forest and grassland in the mauka sections. The Tract III section of the forest reserve is largely dominated by open and closed ‘ōhiā forest. The Hienaloli section is mostly closed ‘ōhiā forest, but non-native species are dominant (**Figure 4**).

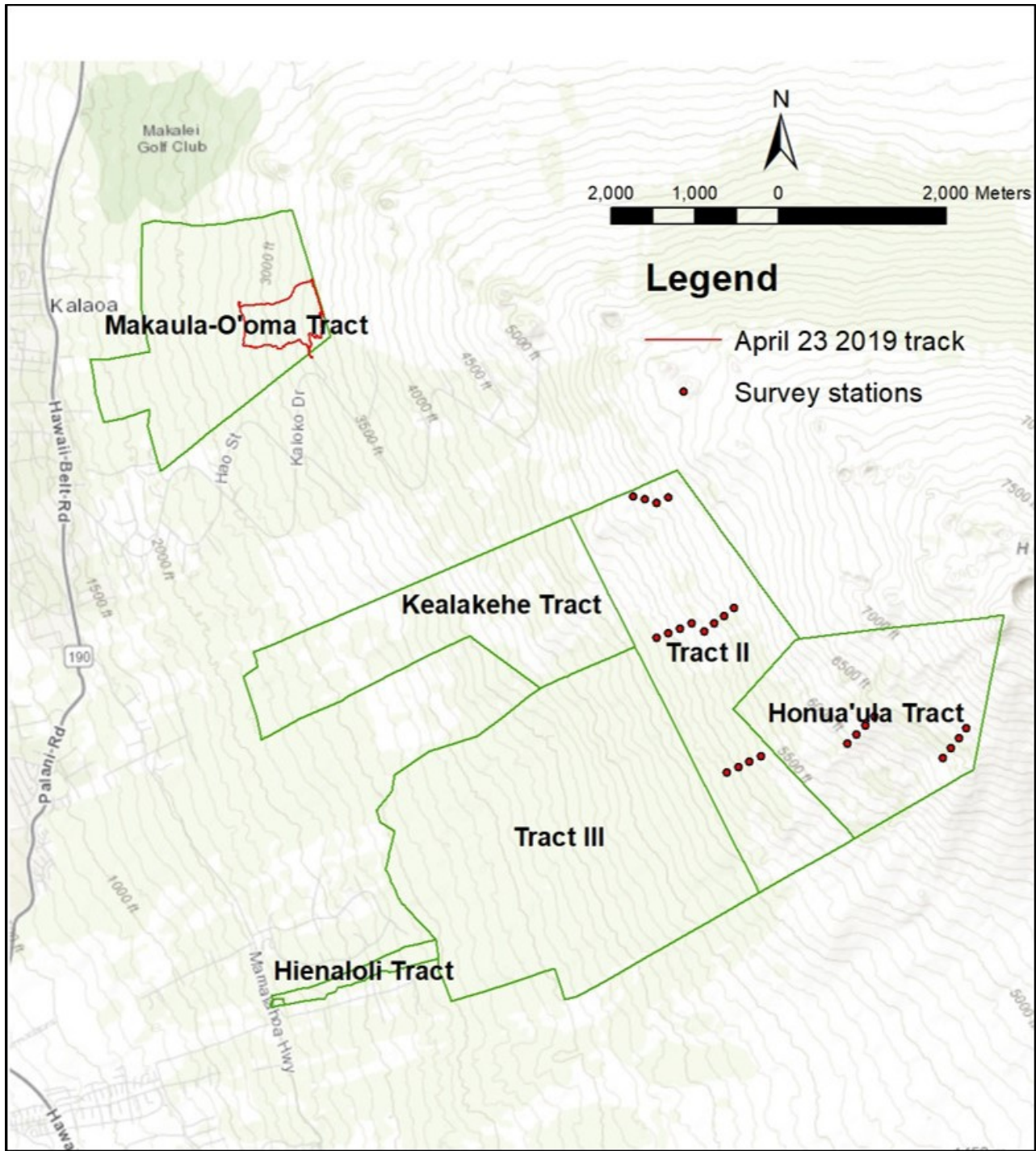


Figure 1. Map showing the Makaula-O'oma tract with presence/absence survey route walked (red lines) on April 23, 2019 and the other 5 contiguous tracts of the reserve, with the VCP (variable circular plot) survey stations shown (red dots) surveyed on April 24, 2019 within the Honua'ula Tract and Tract II.



Figure 2. Photo of forested trail in the Makaula-O'oma tract.



Figure 3. Photos of Honua'ula Tract and Tract II forest from one of the interior roads.

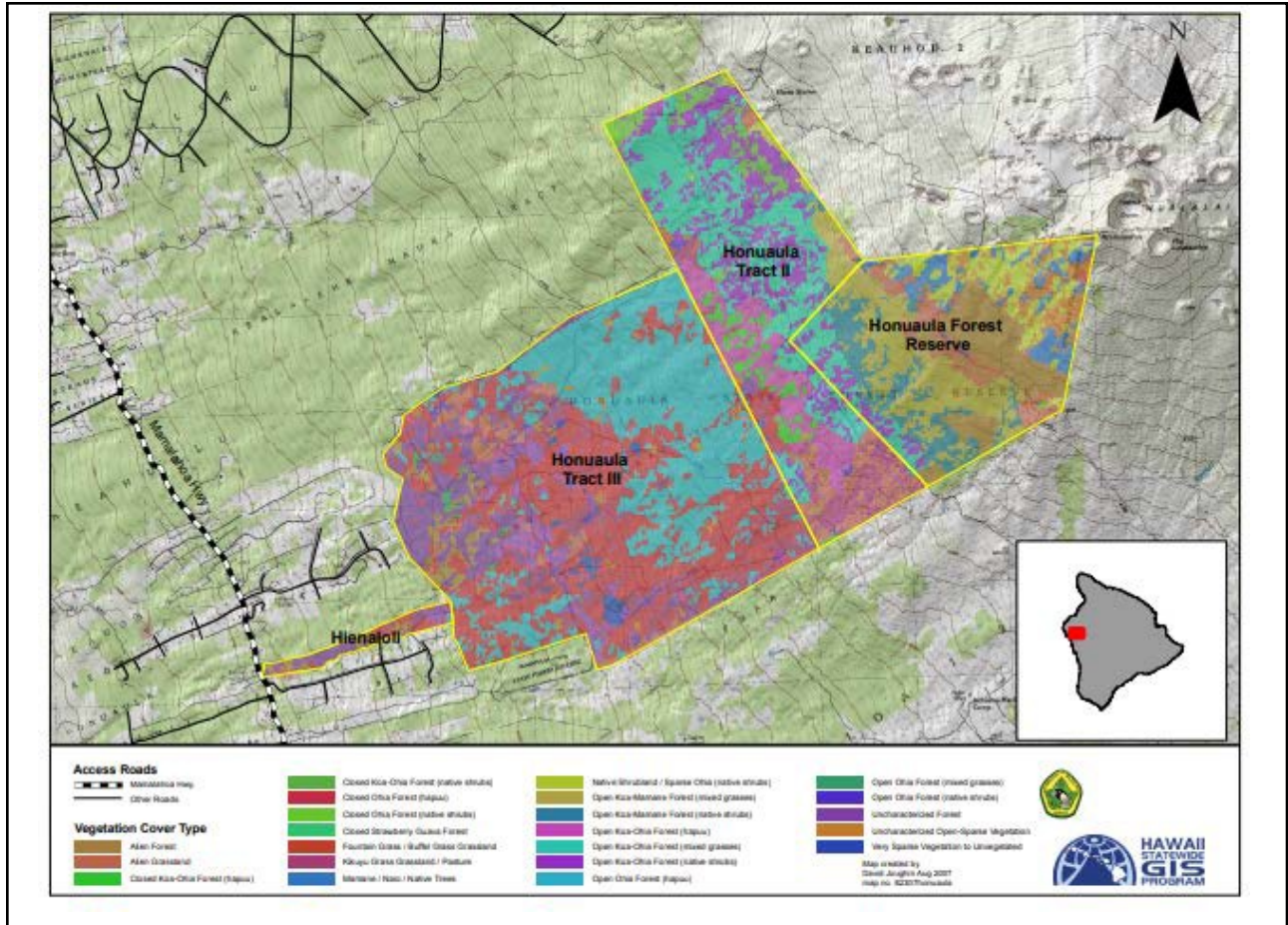


Figure 4. Map showing vegetation classes of Honua'ula Forest Reserve (taken from DOFAW 2007).

Background: Forest Bird Composition

Over four decades ago, Honua'ula Forest Reserve harbored endangered forest birds species, including 'Alalā (*Corvus hawaiiensis*), 'Alawī (*Loxops mana*) and 'Akepa (*Loxops coccineus*), which have not been detected in the reserve since 1986, 1996, and 1985, respectively (**Table 1; Figure 5**).

Table 1. Most recent observations of listed forest birds within Honua'ula Forest Reserve from DOFAW's rare species database 2008

	Makaula-O'oma	Kealakehe	Honua'ula	Tract II	Tract III
'Alalā	1975	1978	1986	1986	
'Alawī			1978		1996
'Akepa				1985	
'Io	1994	1974	1978		1978

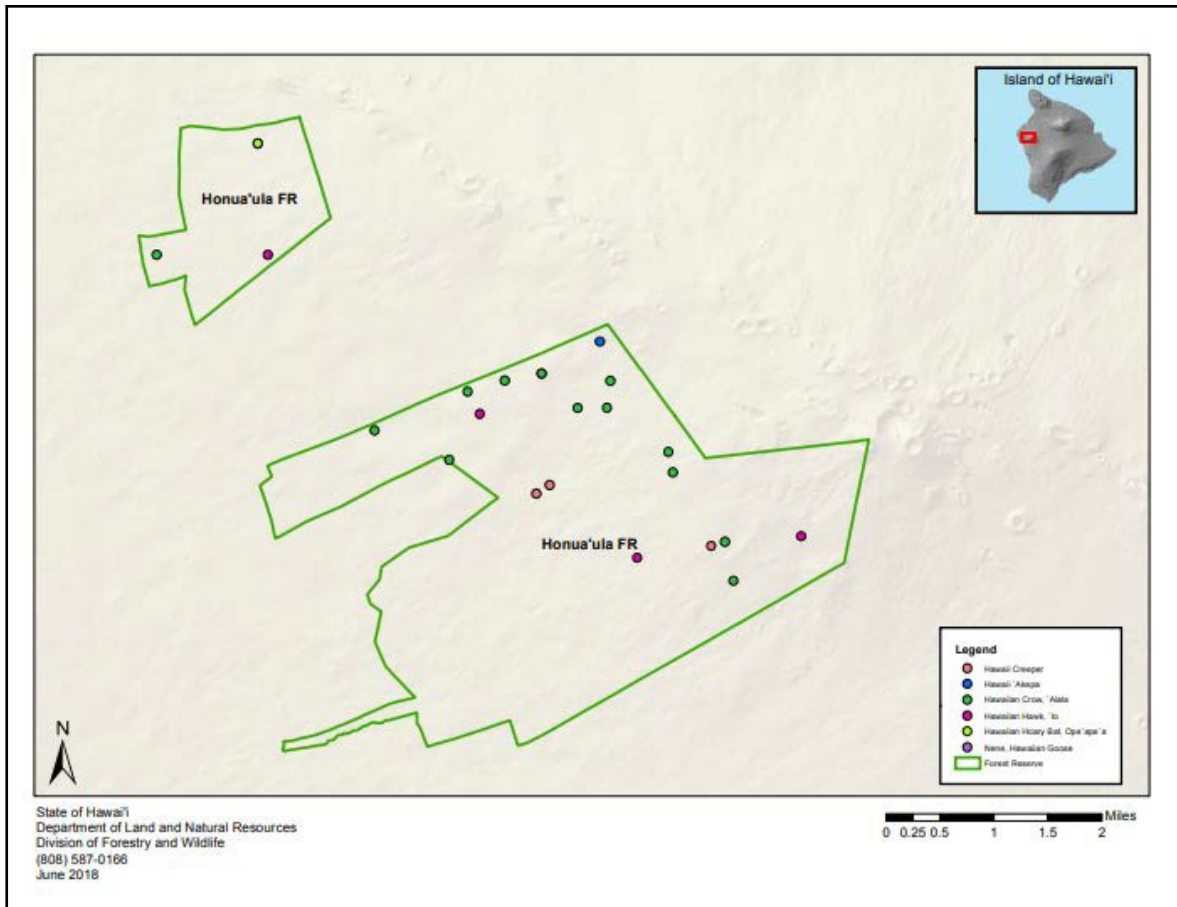


Figure 5. Map of endangered forest bird species detected previously at Honua'ula Forest Reserve, following Table 1.

A natural resources survey was conducted within Tract III by The Nature Conservancy's Hawaii Natural Heritage Program in June 1996. Although forest birds were not the focus of the survey, the following birds were incidentally observed: 'Apapane (*Himatione sanguinea*), Hawaii 'Amakihi (*Chlorodrepanis virens*), 'I'iwi (*Drepanis coccinea*) and Hawai'i 'Elepaio (*Chasiempis sandwichensis*). Additionally, 'Alawī and 'Io (*Buteo solitarius*) were observed by DOFAW staff in the northern part of Tract III.

Tract II was surveyed for forest birds by the West Hawai'i Branch of the Hawai'i Division of Forestry and Wildlife in May 2005 along a transect following the road traversing north-south through the tract, and another road along the east boundary of the tract. A total of 11 species were recorded: three native forest birds ('Apapane, Hawaii 'Amakihi, 'I'iwi), five non-native passerines (Northern Cardinal (*Cardinalis cardinalis*), Japanese White-eye (*Zosterops japonicus*), Red-billed Leiothrix (*Leiothrix lutea*), House Finch (*Haemorhous mexicanus*), and Yellow-fronted Canary (*Serinus mozambicus*)), and three non-native game birds (Wild Turkey (*Meleagris gallopavo*), Erckel's Francolin (*Pternistis erckelii*), and Kalij Pheasant (*Lophura leucomelanos*)). No Hawai'i 'Elepaio were detected despite the use of playback. The forest

reserve has not been surveyed using transect-based methods by trained observers since the 2005 survey, until this most recent April 2019 survey.

Field Methods

In April 2019, staff from the Hawai‘i DLNR-Division of Forestry and Wildlife conducted forest bird surveys within Honua‘ula Forest Reserve. The goal of these surveys was to provide current species lists and distribution maps for native forest birds within the surveyed tracts.

On April 23, 2019 two groups of seven DOFAW staff (one group of four observers and one group of three observers) followed existing trails (**Figure 1**), covering 3.8 km within the Makaula-O‘oma tract and noted all bird species observed by presence-absence census methods over a 80-minute period. On April 24, 2019 the same seven DOFAW staff separated into groups of 1-2 observers and conducted 8-minute variable circular plot (VCP) surveys along six transects, each with four stations spaced 150 m apart, measuring 450m in length, within Honua‘ula Tract and Tract II (**Figure 1**). Counts began at 0620 HST and stopped at approximately 0945 HST. During each count, the trained and calibrated observers recorded the forest bird species, detection type (seen, heard or both), and distance of each bird from the survey station center. Times of sampling, weather conditions and any reason for postponement of counting (high winds, heavy rain, or ambient noise) were recorded.

The vegetation type description was recorded in the comments by a rapid habitat assessment method, which included categories for tree crown cover, tree height, tree species composition, and ground cover or understory type (see Jacobi 1989). These notes on vegetation are not presented in this report, and the Hilo DOFAW Forestry staff plans to conduct in-depth vegetation plots along these transects.

Results

In the Makaula-O‘oma tract, we observed 2 native bird species and 11 non-native bird species (**Table 2**). Of note, additional bird species have been detected at this tract by resident bird watchers in 2019, but we did not detect these bird species during the time period we conducted the presence/absence census.

Within the Honua‘ula Tract and Tract II, we detected a total of 601 birds over 24 stations. We detected a total of 3 native bird species and 10 non-native bird species (**Tables 3 and 4**). The most frequently detected native bird was Hawai‘i ‘Amakihi followed by ‘Apapane. The most frequently detected non-native bird species was Japanese White-eye, followed by Northern Cardinal and Red-billed Leothrix (**Figures 7 and 8**). Of note, the percent occurrence across the 24 survey stations of all three native forest birds detected was very high, 100% for ‘I‘iwi and Hawai‘i ‘Amakihi and 79% for ‘Apapane (**Table 4**).

Table 2. List of species observed on April 23, 2019 in Makaula-O‘oma Tract by seven observers. Note additional species have been recently (in 2019) detected previously than those listed below, such as ‘Io, Indian Peafowl, Saffron Finch, Wild Turkey, Black Francolin, and Eurasian Skylark.

Common Name	Scientific Name
'Apapane	<i>Himatione sanguinea</i>
Common Myna	<i>Acridotheres tristis</i>
Common Waxbill	<i>Estrilda caerulescens</i>
Hawaii 'Amakihi	<i>Chlorodrepanis virens</i>
House Finch	<i>Haemorhous mexicanus</i>
Japanese White-eye	<i>Zosterops japonicus</i>
Kalij Pheasant	<i>Lophura leucomelanos</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
Red-billed Leiothrix	<i>Leiothrix lutea</i>
Red-masked Parakeet	<i>Psittacara erythrogenys</i>
Scaly-breasted Munia	<i>Lonchura punctulata</i>
Yellow-billed Cardinal	<i>Paroaria capitata</i>
Yellow-fronted Canary	<i>Serinus mozambicus</i>

Common Name	Scientific Name
'Apapane	<i>Himatione sanguinea</i>
Erckel's Francolin	<i>Pternistis erckelii</i>
Hawaii 'Amakihi	<i>Chlorodrepanis virens</i>
House Finch	<i>Haemorhous mexicanus</i>
'I'iwi	<i>Drepanis coccinea</i>
Japanese Bush Warbler	<i>Horornis diphone</i>
Japanese White-eye	<i>Zosterops japonicus</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
Red-billed Leothrix	<i>Leiothrix lutea</i>
Wild Turkey	<i>Meleagris gallopavo</i>

and birds per station by species for Honua'ula Tract and Tract II.

Species Common Name	Number of Stations Occupied	Number of Detections	% Occurrence	Birds per Station
'Apapane	19	140	79.17	5.83
Erckel's Francolin	11	16	45.83	0.67
Hawai'i 'Amakihi	24	206	100.00	8.58
House Finch	3	4	12.50	0.17
'Tiwi	24	82	100.00	3.42
Japanese Bush-Warbler	12	19	50.00	0.79
Japanese White-eye	20	56	83.33	2.33
Kalij Pheasant	2	2	8.33	0.08
Northern Cardinal	17	27	70.83	1.13
Red-billed Leothrix	12	21	50.00	0.88
Red-masked Parakeet	5	11	20.83	0.46
Wild Turkey	3	3	12.50	0.13
Yellow-fronted Canary	4	14	16.67	0.58

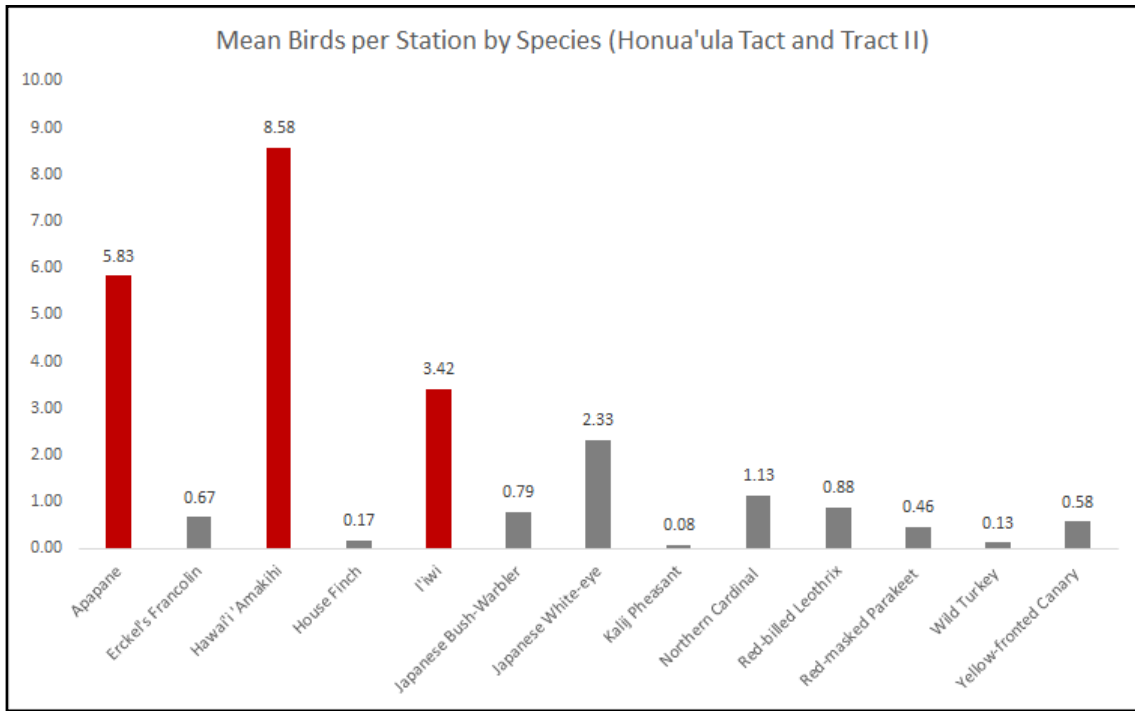


Figure 6. Mean birds per station by species for Honua'ula Tract and Tract II. Red bars denote native forest bird species, while grey bars denote non-native forest bird species.

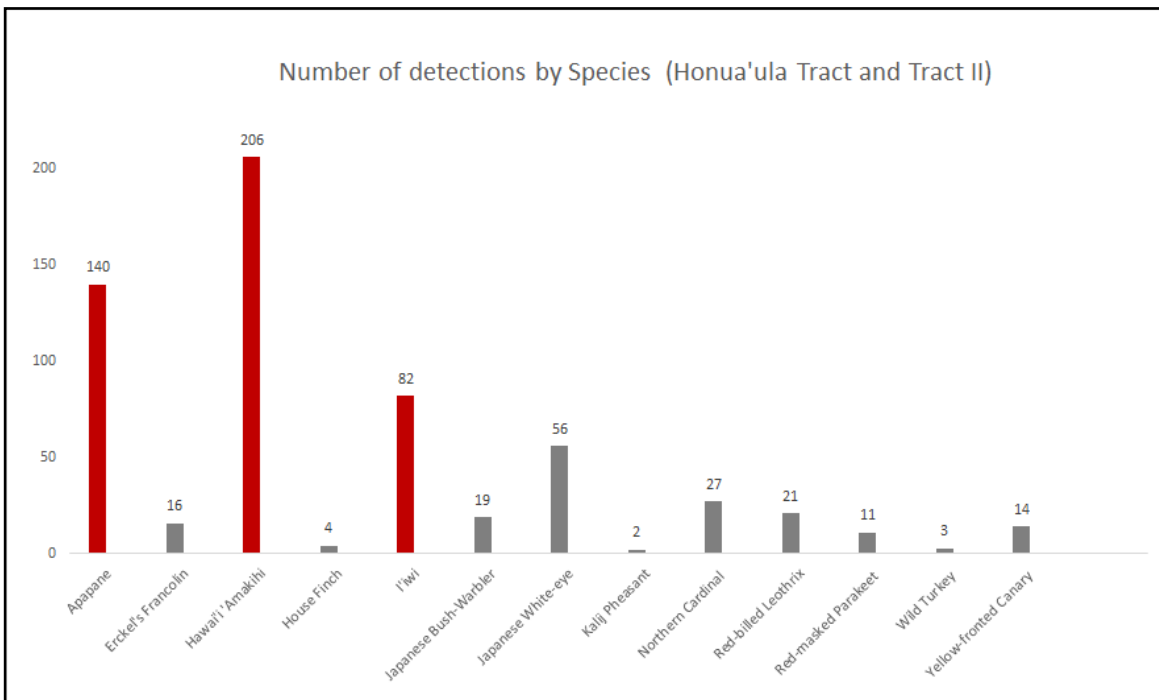


Figure 7. Total Number of detections by species for Tracts I and II. Red bars denote native forest bird species, while grey bars denote non-native forest bird species.

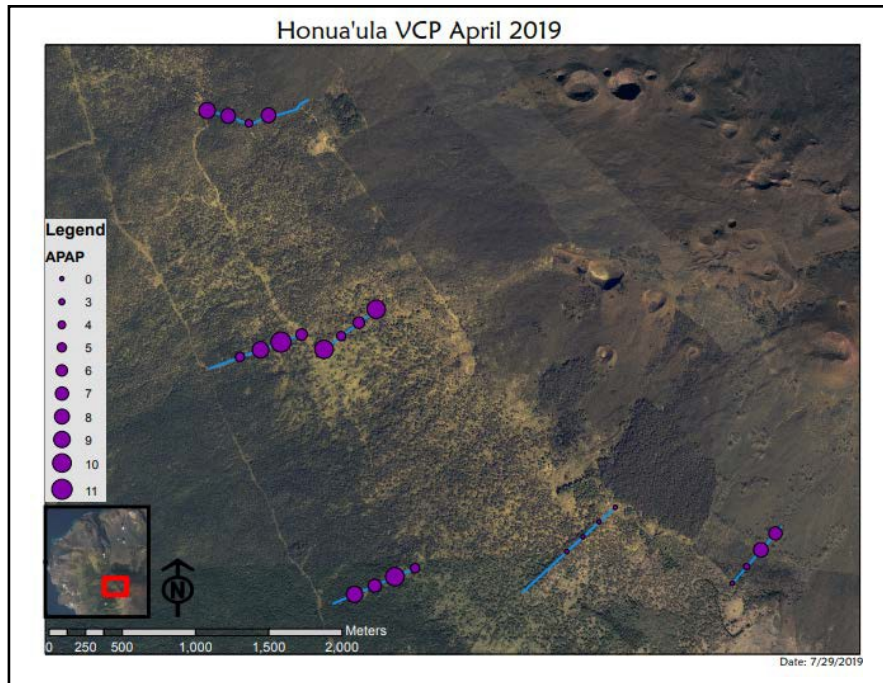


Figure 8. Detection map showing number of detections per station of 'Apapane (weighted purple dots) across the Honua'ula Tract and Tract II during the April 24, 2019 VCP forest bird survey. Note, none detected on Transect 4.

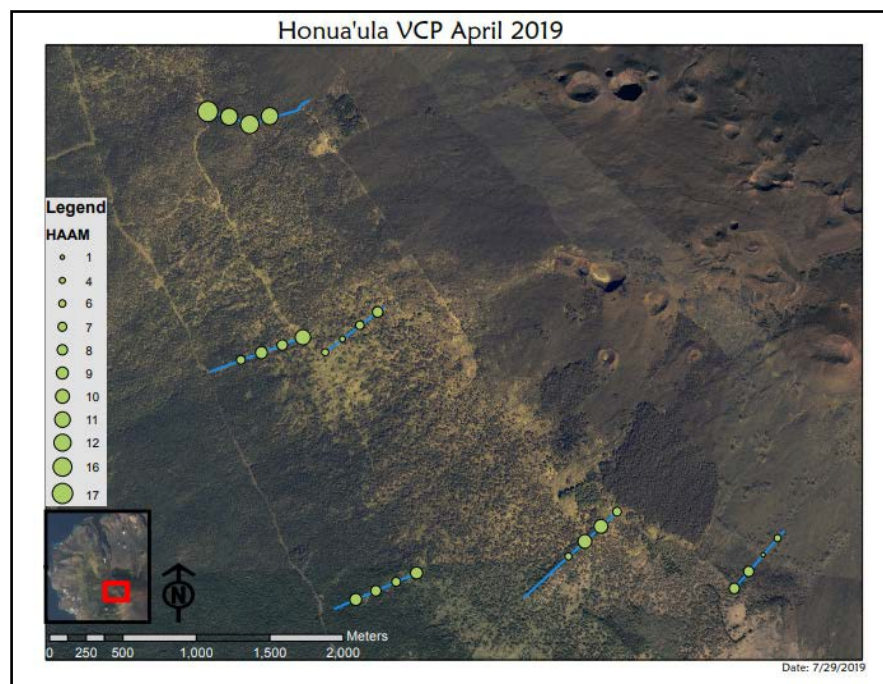


Figure 9. Detection map showing number of detections per station of Hawai'i 'Amakihi (weighted green dots) across the Honua'ula Tract and Tract II during the April 24, 2019 VCP forest bird survey.

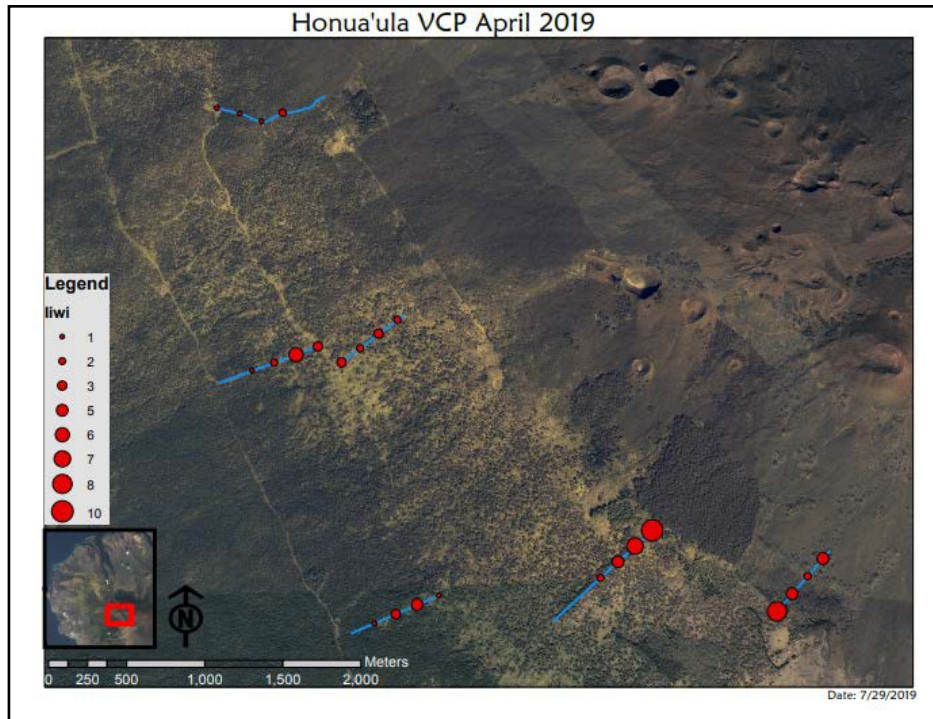


Figure 10. Detection map showing number of detections per station of 'I'iwi across Honua'ula Tract and Tract II during the April 24, 2019 VCP forest bird survey.

Recommendations Based on Survey Results

- Additional and longer length VCP forest bird surveys are needed to determine the distribution and estimate densities of forest bird species in Honua'ula Forest Reserve. The Honua'ula Forest Reserve will be included in the Kona 2021 Hawai'i Forest Bird Survey and it's recommended transects be extended along a full elevational gradient to see where 'I'iwi ,specifically, drop out (relevant to avian disease and habitat fragmentation). 'I'iwi is the most susceptible to avian malaria of the three native forest bird species detected during our 2019 survey (Atkinson et al. 1995) so it is a good indicator species of avian malarial distribution and transmission and can inform managers where the most beneficial region of the reserve is to create fence units to reduce avian malaria transmission. Further, with expected increase in avian malaria transmission with climate change (Fortini et al. 2015), it is advisable to evaluate the current distribution of 'I'iwi and plan actions to mitigate disease transmission based on a comprehensive survey of occurrence, distribution and estimated densities.
- Create smaller fenced units in which ungulate removal is conducted within higher priority forest bird habitat (e.g. where threatened forest bird species, I'iwi are found in Tract II but not as common as in Honua'ula Tract). We found the percent occurrence of the three native forest bird species to be high within the Honua'ula Tract and Tract II, despite altered forest due to grazing. However, fencing and ungulate removal would likely result in greater plant recruitment and longer-term restoration of forest bird habitat. Restoration

of habitat will further bolster the native forest birds present and may create a disease-free refugia for additional native forest bird species which may naturally re-colonize the area or be reintroduced to the area in the future. Further, according to the DOFAW Final Environmental Assessment on the Honua‘ula Forest Reserve Restoration Project (DOFAW 2007), Tract II contains a large number of mature koa trees, but is limited in koa seedling regeneration which is believed to be inhibited in part by the presence of a thick carpet of Kikuyu grass (*Pennisetum clandestinum*) which inhibits seed germination and feral cattle browsing which inhibits seedling establishment.

- Conduct outplanting of nesting and food resource plant species to facilitate building corridors of habitat for forest birds, similar to management activities done within the fragmented sections of Hakalau Forest National Wildlife Refuge (Paxton et al. 2018; Pejchar et al. 2005).
- Implement a small mammal predator control program to reduce depredation of native forest birds, their eggs and nestlings within units that have been fenced and where ungulates have been removed (Three Mountain Alliance-West or DOFAW staff could operate this program). This is a second priority action, subsequent to the recommended wider-scale management actions mentioned above.

References Cited

Atkinson, C. T., K. L. Woods, R. J. Dusek, L. S. Sileo, And W. M. Iko. 1995. Wildlife disease and conservation in Hawaii: pathogenicity of avian malaria (*Plasmodium relictum*) in experimentally infected ‘I‘iwi (*Vestiaria coccinea*). *Parasitology* 111: S59–S69

Division of Forestry and Wildlife. 2007. Final Environmental Assessment. Honua‘ula Forest Reserve Restoration Project. September 2007. Available here:

http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2007-12-08-HA-FEA-Honuaula-Reforestation.PDF

Fortini LB, Vorsino AE, Amidon FA, Paxton EH, Jacobi JD (2015) Large-Scale Range Collapse of Hawaiian Forest Birds under Climate Change and the Need 21st Century Conservation Options. *PLoS ONE* 10(10).

Hawai‘i National Heritage Program. 1996. Natural Resource Management Assessment Honuaula Tract III, Kona, Hawaii. Hawaii Natural Heritage Program, The Nature Conservancy.

Jacobi, J.D. 1989. Vegetation maps of the upland plant communities on the Islands of Hawai‘i, Maui, Molokai, and Lana‘i. Technical Report 68. Cooperative National Park Resources Studies Unit, University of Hawai‘i at Manoa, Department of Botany, HI, U.S.A.

Paxton, E. H., S. G. Yelenik, T. E. Borneman, E. T. Rose, R. J. Camp, and S. J. Kendall. 2018. Rapid colonization of a Hawaiian restoration forest by a diverse avian community. *Restoration Ecology* 26:165–173.

Pejchar, L., K. D. Holl, & J. L. Lockwood. 2005. Hawaiian honeycreeper home range size varies with habitat: Implications for native *Acacia koa* forestry. *Ecological Applications* 15(3):1053- 1061.

Polhemus, J. 2006. Forest Bird Survey of Honua‘ula Tract 2. May 3-5, 2005. West Hawai‘i Wildlife Branch, Hawai‘i DLNR-Division of Forestry and Wildlife.

Appendix C. Hawai'i Invasive Species Council Plant Species Profiles

BANANA POKA (PASSIFLORA TARMINIANA)

SYNONYM: *P. MOLLISSIMA*

Hawaii Pacific Weed Risk Assessment: **24 High Risk**

Regulatory Status: **Hawaii Noxious Weed List**

Prevention and Control Category: **none**

Description

Fast growing climbing vine. Large showy pink flowers. Produces many elongated fruit that are yellow in color when ripe. Fruit contain an orange pulp with hundreds of seeds. Leaves are dark green and have three distinct lobes.



Impacts

Found in disturbed areas, open fields and around freshwater habitats. *P. tarminiana* will readily climb and smother trees. Fruit provides a food source for non-native animals. Seeds are dispersed by birds and feral pigs. Dense curtains of the vine can extend to the ground from canopy branches, sometimes causing branches to break and toppling trees during storms. Where the canopy has been opened, dense mats of vines also cover the understory trees and shrubs and inhibit regeneration of the native trees (Mueller-Dombois et al. 1980).



Distribution

**Kauai: Widespread in the Koke'e area
Maui: Currently restricted to the Kula area
Big Island: Widespread**

FOUNTAIN GRASS (*PENNISETUM SETACEUM*)

Hawai'i-Pacific Weed Risk Assessment Score: **26 High Risk**. Visit <http://www.hpwra.org> for more info
Regulatory Status: **Hawaii Noxious Weed (HAR68)**
Prevention and Control Categories: **KISC EDRR Species. OISC Target Species. MISC Target Species.**
Report this species if seen on Kauai, Oahu, Maui, or Molokai

Description

Fountain grass is a perennial, clumping grass that can grow in a variety of habitats, from bare lava, to rangeland, to urban roadsides in drier areas of the Hawaiian islands (<127 cm rain/yr). It can reach a height of 0.2-1 m (0.5-3 ft) with bristly, cylindrical shaped purple or rose-colored flower head (100-250 mm or 4-10 in long).



Impacts

Originally introduced as an ornamental plant, fountain grass has become an aggressive habitat-invader. It degrades the quality of pasture lands, particularly in drier areas. Fountain grass is also fire-adapted and can sustain fires that spread quickly into adjacent areas. Its dried leaves increase the intensity of wildfires. After a fire it sprouts faster than native plants.



Distribution

On Kaua'i, there is only one known population in sub-optimal habitat above Hanapēpē. On O'ahu, fountain grass is established and widespread in Lanikai and Diamond Head, and encroaching on the Wai'anae mountains. Lana'i and Kaho'olawe have several limited populations of fountain grass, while Maui and Moloka'i have eradicated any known populations. On Big Island, the site of the original widespread plantings, over 200,000 acres

are infested on the Kona side of the island.

Look-alike Species

Red fountain grass (*Pennisetum macrostachyum*): Red fountain grass has similar nodding, long seed heads to fountain grass, but can be differentiated by red or purple tinted foliage and seed heads. Red fountain grass also grows much taller (1.8-2.4 m or 6-8 ft). THIS PLANT IS ALSO A PEST!

Feathertop grass (*Pennisetum villosum*): Feathertop is another perennial, clumping grass that is grown in gardens with a similar growth structure and leaves to fountain grass. Feathertop produces distinctive feathery seed heads that can grow up to 90 cm (35 in) in length. THIS PLANT IS ALSO A PEST!

FLORIDA BLACKBERRY (*RUBUS ARGUTUS*)

Hawaii Pacific Weed Risk Assessment: **21.5 HIGH RISK**

Regulatory Status: **none**

Prevention and Control Category: **none**

Description

Erect or arching thorny shrub. Stiff stems usually stand upright in open areas. Hooked or straight prickles up to 6mm in length. Leaves are compound and have three or five leaflets. Flowers are white in color with five petals. Fruit are black when ripe.



Impacts

Forms dense, impenetrable thickets that exclude other native plant species. Seeds are spread by fruit-eating birds and mammals, also spreads vegetatively. Thickets also make access difficult for hunters, hikers and other visitors to forest. Can infest a variety of sites including grasslands, forest edges, stream banks, and boggy areas



Photo Credit: Forest & Kim Starr

Distribution

Present on Hawaii, Maui, Molokai, Oahu, and Kauai

Lanai: presence/absence unknown

MYSORE RASPBERRY (*RUBUS NIVEUS*) SYNONYMS: CEYLON RASPBERRY, HILL RASPBERRY, SNOWPEAKS RASPBERRY

Hawaii Pacific Weed Risk

Assessment: **19 HIGH RISK**

Regulatory Status: **Hawaii Noxious
Weed List**

Prevention and Control

Category: **none**

Description

Spiny, woody bramble that grows as a sprawling bush, but may reach heights of 4 m (13 ft). White flowers that become shiny black fruit when ripe. Native to South-eastern United States, introduced to Hawaii as an ornamental and backyard food crop

Impacts

Forms dense, impenetrable thickets that exclude other native plant species. Seeds are spread by fruit-eating birds and mammals, also spreads vegetatively. Thickets also make access difficult for hunters, hikers and other visitors to forest
Infestations can produce 7,000-13,000 seeds per square meter, which can remain dormant in the soil for several years



Distribution

Kauai: Form A is found on Kauai

Maui: On Maui, there are two forms known, form a, which is likely the form Wagner et al. (1999) were referring to, and form b, first discussed in Gerrish et al. (1992). *Rubus niveus* form b is well established in disturbed urban areas of Kula as well as in a variety of habitats in Polipoli, including native



and non-native mesic forests, alpine shrubland, degraded pastures, and along trails and roads, at elevations from 3,000-6,500 ft (914-1,981 m).

Big Island: Form A is found on Hawaii Island



Cabinet-level direction on invasive species issues
Hawaii Invasive Species Council

FIREWEED (*SENECIO MADAGASCARIENSIS*)



Hawai'i-Pacific Weed Risk Assessment Score: 23, High Risk. Visit <http://www.hpwra.org> for more info

Regulatory Status: Hawaii Noxious Weed List (HAR 68)

Prevention and Control Category: KISC Target Species. OISC Target Species. MoMISC Target Species.

Report this species if seen on Kauai, Oahu, or Molokai

Description

Fireweed is already widespread on the islands of Maui, Oahu, Lanai, and Hawaii, but can be prevented from invading Kauai. Fireweed is a daisy-like herb that grows up to 2' high. The stem is upright and slender with bright green leaves. The leaves are smooth, very narrow (only 1/4" wide), have serrated edges, and they reach about 5" long. The small yellow flowers have 13 petals and are about the size of a nickel. The mature flowers turn into white thistle-like downy seed balls.



Impacts

Fireweed invades pastures, disturbed areas, and roadsides. It is very toxic to cattle, horses and other livestock. When ingested it causes illness, slow overall growth, liver-malfunction and even death in severe cases. In Australia, fireweed costs over \$2 million per year in losses and control.

Distribution

Fireweed is native to Madagascar and South Africa. Fireweed was first discovered on the Big Island in the 1900's and is now too widespread for control there. This pest can also be found on Maui and Lana'i. On Kaua'i, known infestations from hydro-mulched areas near Halfway Bridge and in Kalihiwai were controlled by KISC and HDOA. Kaua'i, O'ahu, and Moloka'i continue to be monitored for new infestation areas. The preferred habitat for this weed is disturbed grasslands, abandoned pastures and roadsides. Fireweed grows on a wide range of soils in sub-humid to humid subtropical woodland.

Look-alike Species

Spanish needle (*Bidens pilosa*): Spanish needle is a widespread invasive herb on Kaua'i. It has tiny yellow flower clusters unlike fireweed's daisy-like flowers. Spanish needle also grows much taller; up to 6 feet. THIS LOOK-ALIKE IS ALSO A PEST!

Wedelia (*Sphagneticola trilobata*): Wedelia is another widespread invasive herb that is commonly planted as an ornamental groundcover. It can be distinguished from fireweed by its larger yellow flowers which grow 1-2" wide. It also has a variable amount of pedals, unlike fireweed's constant 13. THIS LOOK-ALIKE IS ALSO A PEST!



Cabinet-level direction on invasive species issues
Hawaii Invasive Species Council

CANE TIBOUCHINA (*TIBOUCHINA HERBACEA*)

Hawai'i-Pacific Weed Risk

Assessment Score:

24. Visit <http://www.hpwra.org> for more info

Regulatory Status: Hawaii Noxious Weed List (HAR 68)

Prevention and Control Category: OISC Target Species

Report this species if seen on Oahu

Description

This shrub is semi woody and can grow up to 9' tall. The young stems are angled and hairy. The leaves are opposite, 3" long by 1.4" wide, hairy, and have 5-7 prominent veins. The flowers are pink and have 4 petals with bright yellow anthers. The fruit is cup-like and extremely small. The seeds are very small and numerous.

Impacts

This plant is a prolific seeder and spread by birds. It forms dense stands in pastures and can also invade disturbed forest areas, displacing native species.

Distribution

This shrub is native to southern Brazil, Uruguay, and Paraguay. Cane tibouchina has heavy infestations on Maui and Big Island. It occurs in the northern Ko'olau range on O'ahu, as well as on Moloka'i and Lana'i, and in Hilo, including lower Saddle Road on Hawai'i. This pest is not known to be on Kauai. Please



report any new sighting of this pest!

What you can do

If you see this species, call 643-PEST or visit www.reportapest.org to find out if this plant is controlled on your island.

Look-alike Species

Glorybush (*Tibouchina urvilleana*): Also called princess flower, this is another Melastome species that can be very invasive. It has larger, purple flowers with five petals and can grow up to 12' tall. The anthers of this plant are purple, unlike the yellow anthers of cane tibouchina. This plant can be seen in Koke'e, naturalized along the roadside. THIS LOOK- ALIKE IS ALSO A PEST!

Asian melastome (*Melastoma candidum*, *M. septemnerium*): This is a spreading shrub that forms tangled brush between 5' to 15' tall. Each flower usually contains five to six petals, averaging 1" long. This plant is widespread across Kaua'i. THIS LOOK-ALIKE IS ALSO A PEST!

Appendix D Honua‘ula Forest Reserve Public Use Study

Due to the length of the Honu‘ula Forest Reserve Public Use Survey, the entire document has been uploaded and made available at the address below:

<https://dlnr.hawaii.gov/forestry/files/2021/02/Honuaula-Forest-Reserve-Public-Use-Study-Final-Report.pdf>

Appendix E Rare Plant Species Considered for Outplanting within Honua‘ula Forest Reserve

<u>Species</u>	<u>Status</u>	<u>Hawai‘i Island Endemic</u>	<u>PEPP Species</u>	<u>Currently Outplanted in Honua‘ula FR</u>
<i>Bidens campylotheca</i> ssp. <i>campulotheca</i>	None	no	no	no
<i>Bidens menziesii</i> ssp. <i>filiformis</i>	None	yes	no	no
<i>Chrysodracon hawaiiensis</i>	Endangered	yes	no	yes
<i>Colubrina oppositifolia</i>	Endangered	no	no	yes
<i>Cyanea hamatiflora</i> ssp. <i>carlsonii</i>	Endangered	yes	yes	no
<i>Cyanea marksii</i>	Endangered	yes	yes	no
<i>Cyanea strictophylla</i>	Endangered	yes	yes	no
<i>Cyrtandra menziesii</i>	None	yes	no	no
<i>Festuca hawaiiensis</i>	Endangered	no	no	no
<i>Fragardia chiloensis</i> var. <i>sandwicensis</i>	None	no	no	no
<i>Delissea argutidentata</i>	Endangered	yes	yes	yes
<i>Hibscadelphus hualalaiensis</i>	Endangered	yes	yes	yes
<i>Kokia drynarioides</i>	Endangered	yes	yes	yes
<i>Mezoneuron kavaiensis</i>	Endangered	no	yes	yes
<i>Nothocestrum breviflorum</i>	Endangered	yes	no	no
<i>Phyllostegia floribunda</i>	Endangered	yes	yes	no
<i>Phyllostegia racemosa</i>	Endangered	yes	yes	no
<i>Phyllostegia stachyoides</i>	Endangered	yes	yes	no
<i>Phyllostegia velutina</i>	Endangered	yes	yes	no
<i>Phyllostegia warshaueri</i>	Endangered	yes	yes	no
<i>Pittosporum hawaiiense</i>	Endangered	yes	no	no
<i>Ranunculus mauensis</i>	Endangered	no	no	no
<i>Plantago hawaiiensis</i>	Endangered	yes	yes	no
<i>Sicyos macrophyllus</i>	Endangered	yes	yes	no
<i>Sisyrinchium acre</i>	None	no	no	no
<i>Spermolepis hawaiiensis</i>	Endangered	no	no	no
<i>Stenogyne angustifolia</i>	Endangered	no	no	no
<i>Vicia menziesii</i>	Endangered	yes	yes	no
<i>Zanthoxylum hawaiiense</i>	Endangered	no	no	no
<i>Zanthoxylum kauaense</i>	None	no	no	no

Appendix F Division of Forestry and Wildlife Management Guidelines

Forest Products Management – LNR 172		
Management of sustainable forest product opportunities.		
Class Name	Class Definition	Management Strategies
F-1: Large Scale Commercial	<ul style="list-style-type: none"> • Forest products are a primary objective, and large scale sustainable commercial timber harvesting or salvage is allowed; • Permits, licenses and environmental compliance are required; • Harvesting of non-timber forest products is allowed. 	<ul style="list-style-type: none"> • Produce a sustainable timber supply in balance with other resource management objectives; • Activities may include site preparation, tree-planting, thinning operations, forest stand improvement and large-scale timber harvest; • Timber management plans are required to mitigate non-timber resource impacts, and assure sustainable yield and positive impact forestry.
F-2: Small Scale Commercial	<ul style="list-style-type: none"> • Areas where limited commercial timber harvesting or salvage is allowed in balance with other land uses; • Required permits, licenses and environmental compliance depend on scope and scale of operations; • Harvesting of non-timber forest products may be allowed. 	<ul style="list-style-type: none"> • To produce a sustainable supply of forest products while minimizing other resource impacts; • Activities may include site preparation, tree-planting, thinning operations, forest stand improvement and small-scale timber harvest; • Impacts of harvesting distributed over the resource area through controlled seasons and harvest; • Timber management plans are required to mitigate non-timber resource impacts, and assure sustainable yield and positive impact forestry; • Forest management activities performed in coordination with other resource management activities.
F-3: Personal Use	<ul style="list-style-type: none"> • Areas where selective non-commercial timber harvesting and targeted commercial timber salvage is allowed in balance with other land use objectives; • Permits for harvest of non-timber products issued on a case by case basis. 	<ul style="list-style-type: none"> • Limited timber harvest performed as appropriate to bring materials to local market, and produce other positive resource outcomes; • Minimize human impacts to native species and native ecosystems; • Accommodate harvest of forest products for sustainable personal use.
F-4: Restricted	<ul style="list-style-type: none"> • Harvesting of timber only considered if activity improves other priority resource outcomes; • Permits for harvest of non-timber forest products will be considered on a case by case basis for research and education, improving forest 	<ul style="list-style-type: none"> • Resource protection is the top priority; • Prioritize protection of native species and native ecosystems; • Permitted activities in these areas are minimally

	science and health, watershed protection, traditional and customary practices, and conservation efforts.	disruptive, and focused on improving forest and watershed health, native ecosystems, and other conservation efforts.
--	--	--

Conservation Resources - Native Species Habitat, Water Resources – LNR 402/407		
Class Name	Class Definition: May have one, all, or a combination of conservation values	Management Strategy
C-1: High Conservation Resources	<ul style="list-style-type: none"> • High level of native biological resources, native ecosystem intactness, and/or recovery potential; • Essential to the conservation and/or recovery of native species; • Important restoration areas, such as rare ecosystem remnants, native wildlife habitat, wetlands, and offshore islands; • High degree of conservation related regulatory encumbrances - critical habitat, restricted watershed, conservation easements and/or zoning; • High watershed conservation value per CWRM, USGS, BWS, and/or DOFAW. 	<ul style="list-style-type: none"> • Intensive management applied, as necessary, to protect watershed values, and native species and ecosystems, as resources permit; • Management may include animal exclusion fencing, predator control, vegetation/weed control; • Work may include out-planting of native vegetation and reintroduction of native wildlife, as needed.
C-2: Medium Conservation Resources	<ul style="list-style-type: none"> • Moderate level of native biological diversity and/or native ecosystem intactness; • Contributes to the conservation and/or recovery of native species (i.e. T&E / native species habitat, water resources); • Medium degree of conservation related regulatory encumbrances; • Medium watershed conservation value. 	<ul style="list-style-type: none"> • Management activities to control priority threats and improve watershed, native species or ecosystem outcomes; • Work may include out-planting of native vegetation and reintroduction of native wildlife, as needed. • Other uses may include forest products gathering, hiking, and liberal hunting.
C-3: Low Conservation Resources	<ul style="list-style-type: none"> • Low level of native biological diversity and/or native ecosystem intactness; • Low conservation and/or recovery of native species but may contribute to conservation (i.e. individual or small clusters of rare plants; genetic collection); • Low degree of conservation related regulatory encumbrances; • May have low watershed conservation value. 	<ul style="list-style-type: none"> • Native species management occurs mostly in remnant patches and fenced units; • Mixed use area with forest products gathering, hunting and non-hunting recreation, as appropriate.
C-4: Little to No Conservation Resources	<ul style="list-style-type: none"> • Little to no native biological diversity and/or native ecosystems highly degraded or absent; • Little to no contribution to the conservation and/or recovery of 	<ul style="list-style-type: none"> • Area managed for a variety of uses not appropriate for more pristine environments, including timber harvest, regulated hunting and more intensive non-hunting recreation (hiking, equestrian and/or off-road vehicles).

	native species; <ul style="list-style-type: none"> • Very little or no conservation related regulatory encumbrances; • May have low watershed conservation value. 	
--	--	--

Conservation Management - Native Species Habitat, Water Resources – LNR 402/407

Class Name	Class Definition	Management Strategy
Intensively Managed Areas	<ul style="list-style-type: none"> • High degree of watershed, native species and/or biodiversity conservation management is underway. 	<ul style="list-style-type: none"> • Conservation of watersheds and/or native species and biodiversity is a higher priority than all other uses; • Management focus is on protection, restoration and maintenance of native ecosystems and species; • Employ strategies to reduce the threat of alien species or other factors to the greatest extent possible - fencing, intensive animal and/or weed control; • Maintain & improve native ecosystem processes; • Collect genetic material, reintroduce species, work to recover threatened and endangered species, protect areas from degradation, restore damaged resources as needed;

Vegetation Resources – LNR 402/407

Class Name	Class Definition
V-1: Highest Quality Native Vegetation	These areas consist of the highest quality native ecosystems and communities. They have minimal disturbance, with low levels (less than 10%) of non-native plants in any vegetative layer (91-100% native plant cover).
V-2: Predominantly Native Areas:	Areas in which native plants predominate in communities that are relatively intact, and are minimally disturbed. They have a significant component of non-native plants (51-90% native plant cover).
V-3: Considerably Degraded Native Vegetation Cover:	Areas have a considerable amount of disturbance to native vegetation. Non-native plants may predominate, however there may be pockets of remaining native plant communities (11-50% native plant cover).
V-4: Heavily Degraded Areas:	Areas where the native vegetation is severely degraded or highly altered from its natural state. There may be areas of severe erosion, former pasture or crop lands, forest plantations, areas of non-native grass or brush resulting from fires or intensive grazing. (0-10% native plant cover).

Hunting Management – LNR 804

Management for public recreation, subsistence hunting and animal damage control.

Class Name	Class Definition	Management Strategy
H-1: Active Hunting Management:	<ul style="list-style-type: none"> • Public hunting is a high priority land use; • Area is suitable for a high degree of active management for public hunting; • Management of the area is designed to provide maximum sustained yield of game animals. 	<ul style="list-style-type: none"> • Hunting regulations for the area are designed to provide maximum sustained yield while minimizing environmental impacts; • High degree of management to maintain or improve hunting program infrastructure; • Habitat is managed to maintain or increase game animal carrying capacity, while maintaining healthy vegetative cover for proper range management and erosion control.
H-2: Moderate Hunting Management:	<ul style="list-style-type: none"> • Area is suitable for a moderate degree of active management for animal enhancement and habitat management to increase animal productivity for public hunting; • Public hunting opportunities may be improved or maximized; • Public hunting is balanced with other objectives. 	<ul style="list-style-type: none"> • Hunting regulations established to manage animal harvest; • Moderate degree of infrastructure for animal management; • Habitat modification for game animal production as appropriate for the area; • Balance animal impacts with other resources.
H-3: Low Intensity Hunting Management:	<ul style="list-style-type: none"> • Area not suitable for game enhancement and habitat management to increase animal densities - hunters play an important role in limiting animal impacts; • Minimal public hunting restrictions provide maximum public hunting opportunity; • Public hunting management includes maintaining access and monitoring hunter effort and success. 	<ul style="list-style-type: none"> • Hunting seasons, bag limits and other hunting regulations liberalized to maximize hunting opportunity; • Hunting opportunities may include permitted hunts if needed to improve access; • No habitat modification for production and/or enhancement of game animals.
H-4: No Hunting Management:	<ul style="list-style-type: none"> • Area is not suitable for open public hunting due to environmental sensitivity, access, or safety; • No active management for public hunting; public hunting may be used for animal damage control on a permit basis; • Public hunting is not a primary land management objective. 	<ul style="list-style-type: none"> • Area not open to regular public hunting seasons for either management, access or safety reasons; • Animal control to be conducted by staff, permitted and/or guided hunters, and other cooperators as appropriate.

Recreation Management – LNR 804

Class Name	Class Definition	Management Strategy
R-1: High Recreation Management:	<ul style="list-style-type: none"> • Areas where outdoor recreation is a primary objective; • High level of visitor use is received and accommodated; • May include recreation, transit and/or urban elements; • Approximate average daily use: 100 - 1000+ users. 	<ul style="list-style-type: none"> • Area can sustain heavy recreational use; recreation plays a major role in use of the area; • Trails maintained to sustain heavy use which may include hiking, mountain bike riding, equestrian and/or off-road vehicle use; • Improvements commensurate with use.
R-2: Medium Recreation Management:	<ul style="list-style-type: none"> • Areas where outdoor recreation is of moderate intensity, and may be integrated with other uses; • Includes a wide range of trails and roads requiring a moderate level of management and maintenance to meet user needs and balance other land use objectives; • Approximate average daily use: 0 – 500 (+/-) users. 	<ul style="list-style-type: none"> • Area can sustain moderate recreational use; recreation integrated with other management programs; • Roads and trails maintained to sustain moderate use which may include hiking, mountain bike riding, equestrian, and/or off-road vehicle improvements; • Improvements commensurate with use.
R-3: Low Recreation Management:	<ul style="list-style-type: none"> • Areas where outdoor recreation is of low intensity, and is integrated with other uses; • Trails and roads that receive limited use, or whose character and terrain require little maintenance relative to the usage; • Approximate average daily use: 0 – 100 (+/-). 	<ul style="list-style-type: none"> • Areas may be inaccessible or remote; facilities and improvements are limited, in keeping with the level of use; • Areas may be managed for multiple uses including forest protection, conservation, hunting, and hiking, or protected and managed to preserve natural conditions; activities may include hiking, biking, equestrian and/or off-road vehicles; • To protect both the trail environment and experience, improvements are typically minimal, and designed to fit the setting and need.
R-4: Recreation Management (Restricted access):	<ul style="list-style-type: none"> • Areas where outdoor recreation is restricted or controlled; • Areas sensitive to human disturbance due to natural, cultural or archaeological features; • Access primarily for management purposes, and/or limited or programmatic recreational or educational uses. 	<ul style="list-style-type: none"> • Areas may be classified “restricted” due to hazardous conditions, watershed protection, sensitive wildlife, fragile ecosystems, cultural resources, limited accessibility, or management practices incompatible with recreational activities; • Managed to limit impacts from human activities; • Facilities and improvements are very limited and generally associated resource management; • Trails will not feature extensive recreational amenities and will generally incorporate only facilities necessary to protect and manage the resource; • Access may be controlled via permits, group number limitations, or other restrictions as appropriate for the area.

--	--	--