STATE OF HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife
Honolulu, Hawai'i 96813

October 13, 2017

Chairperson and Members
Board of Land and Natural Resources
State of Hawai'i
Honolulu, Hawai'i

Land Board Members:

SUBJECT: REQUEST FOR APPROVAL OF A FOREST RESERVE MANAGEMENT PLAN FOR PŪPŪKEA FOREST RESERVE, TAX MAP KEYS (1) 5-9-006:026 AND (1) 5-9-006:006, PŪPŪKEA, KO'OLAULOA, O'AHU.

REQUEST FOR APPROVAL OF A FOREST RESERVE MANAGEMENT PLAN FOR KULA FOREST RESERVE AND THE PAPA'ANUI TRACT OF KAHIKINUI FOREST RESERVE, TAX MAP KEYS (2) 2-2-007:001 (PORTION) AND 003, KULA, MAKAWAO, MAUI.

REQUEST APPROVAL OF DECLARATION OF EXEMPTION TO CHAPTER 343, HRS, ENVIRONMENTAL COMPLIANCE REQUIREMENTS FOR APPLICABLE MANAGEMENT ACTIVITIES DESCRIBED IN THE MANAGEMENT PLANS FOR PŪPŪKEA FOREST RESERVE, AND KULA FOREST RESERVE AND THE PAPA'ANUI TRACT OF KAHIKINUI FOREST RESERVE.

SUMMARY:

This submittal requests Board approval for the Division of Forestry and Wildlife (DOFAW) Pūpūkea Forest Reserve Management Plan (Exhibit A) and the Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve (Papa'anui) Management Plan (Exhibit B). The Pūpūkea Forest Reserve consists of approximately 782 acres of public land located on the north shore of O'ahu. Kula Forest Reserve is comprised of approximately 4,931 acres of public land located on the leeward slopes of Haleakalā. Papa'anui is comprised of approximately 714 acres of public land located on the ridge top adjacent to Kula Forest Reserve. These plans are part of a series of site-specific plans prepared by DOFAW for individual forest reserves in the State of Hawai'i. These plans present a brief history of the specific forest reserves, a description of cultural and natural resources, and current and future management actions for the area.

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Further, the submittal requests approval of a declaration of exemption for Chapter 343, Hawai'i Revised Statutes (HRS) for applicable management activities described in the management plans for Pūpūkea Forest Reserve, Kula Forest Reserve and Papa'anui.

BACKGROUND:

The Hawai'i Forest Reserve System was created by the Territorial Government of Hawai'i on April 25, 1903. Forest reserves were intended to protect mauka forests and watersheds to guarantee an ample supply of water to developing agricultural interests, which in turn would ensure the prosperity and welfare of the Territory. The Forest Reserve System is one of the oldest structures for land conservation in Hawai'i. Today, DOFAW manages 54 forest reserves across the state, encompassing over 650,000 acres of public land. The Forest Reserve System provides essential benefits to the residents of Hawai'i, including fresh water supply and many other conservation, cultural and recreational values.

Intermittently throughout the twentieth century, forestry staff developed management plans for a variety of forest reserves; however, this practice was discontinued during the 1970s for undocumented reasons. DOFAW believes that management plans for forest reserves provide important information both to land managers and the public about the natural and cultural resources as well the intent and purpose of management actions in those areas. Thus, DOFAW is conducting on-going planning efforts to develop and update management plans for all of the forest reserves in Hawai'i. These plans vary in detail depending on a number of factors, but all represent an important foundation for reforestation, conservation and forest product development in the future. These efforts are intended to be consistent across the state and serve to organize field management, assist in budgeting and funding concerns, and to provide the public and partner organizations a process for providing input to and viewing the resulting management plans.

These plans will also contribute towards fulfillment of recommendations made in the Hawai'i Tropical Forest Recovery Action Plan - a result of the 1992 Federal Hawai'i Tropical Forest Recovery Act. Specific recommendations addressed by these management plans include:

- Recommendation 1: Using a partnership-based, ecosystem management approach, develop a comprehensive management, protection, and utilization strategy for the forest resources of Hawai'i;
- Recommendation 6: Protect and restore native forest ecosystems through adequate support of existing state, federal, and private organizations' natural resource programs in an effort to contribute to healthy forest ecosystems and the recovery of plant and animal species listed as threatened and endangered;
- Recommendation 7: Expand research and support for comprehensive game management efforts to enhance hunting opportunities;
- Recommendation 8: Establish koa and other hardwood reforestation projects on formerly forested lands to restore a full range of values and purposes, from commercial forests to natural ecosystems;
- Recommendation 10: Utilize existing fire management expertise in a coordinated effort to share knowledge and resources for prevention, presuppression and suppression, and vegetation management activities. Enhance existing fire suppression capabilities,

including private sector resources; and
- Recommendation 19: Update or complete and implement management plans for all publicly owned and managed forests.

Pūpūkea Forest Reserve

Pūpūkea Forest Reserve (FR) was established by Governor's Proclamation in 1910 to conserve and protect the remaining forest and increase local water supply. The reserve consists of approximately 782 acres of state land located on the northwestern portion of the Ko'olau Mountain Range in the Ko'olauloa District on O'ahu. Vegetation is dominated by non-native forest, but some 'ōhi'a forest, open koa 'ōhi'a forest, and scattered native shrublands still exist in the southeast portion of the reserve. There are several plantation stands composed of non-native commercial timber species that were planted as part of a reforestation effort that happened in the early 1900's.

Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve

According to a report by the Territorial Forester Ralph S. Hosmer, prior to the late 1800's "there was a belt of heavy forest with dense undergrowth," in the Kula district. By 1912, the effects of grazing resulted in the conversion of the forest to open grass land with the exception of scattered groves of māmane (*Sophora chrysophylla*) and steep sided gulches that provided protection to pockets of forest from cattle. Kula Forest Reserve was established by Governor's Proclamation on September 11, 1912, with a purpose different from most other forest reserves. The reserve was established with the intent to reforest the area that was converted to pasture after 20 years of grazing. Establishing forest cover around Polipoli Spring, which at the time was considered the only permanent source of water on the southern end of Haleakalā, was one of the underlying reasons for creating Kula Forest Reserve.

The Kahikinui Forest Reserve was established by Governor's Proclamation on December 22, 1928. In the report that preceded the establishment of Kahikinui FR, the Territorial Forester described how the majority of the boundary was already protected by existing fence lines constructed on neighboring leased and private lands that were being managed by cattle ranchers, and also by natural barriers that limited the ingress of ungulates. He further describes the significant number of goats and the few cattle that were in Kahikinui at the time. The intention was to remove the wild goats and cattle and "give the extensive existing grove of koa (*Acacia koa*) trees on Nakula and Nuu a chance to expand," (Judd 1928). There were also stands of māmane that they hoped would expand through natural recruitment. The overarching goal for Kahikinui FR was to improve the vegetative cover in the area to "prevent excessive runoff and make available for use in the intervening dry periods water on the lower lands, where it is almost always at a premium," (Judd 1928).

DISCUSSION:

The Pūpūkea FR and the Kula FR and Papa'anui management plans were developed using a variety of methods. Initial development consisted of reviewing and analyzing DOFAW historic and current files (at the Administrative, O'ahu Branch, and Maui Branch offices) and documents

obtained from other state agencies including the Department of Land and Natural Resources Land Division and Bureau of Conveyances, the Department of Accounting and General Services Survey Division, as well as the State Archives. State of Hawai'i Geographic Information Systems (GIS) map layers relating to biological, historical, and environmental resources were referenced extensively to develop this plan. Additional resources utilized for the development of these plans which includes other plans that identified the Forest Reserves or the general area, were the Hawaiian Forester and Agriculturalist, the Hawai'i Biodiversity and Mapping Program, Hawai'i Forest Action Plan, Hawai'i Comprehensive Wildlife Conservation Strategy, and U.S. Fish and Wildlife Service Recovery Plans, among others.

The plans then evolved into their final iteration through discussions with DOFAW staff from all program areas, both at the branch and administrative offices, other divisions and state agencies, DOFAW partners, and the public.

Development Process & Timeline for the Pūpūkea Forest Reserve, O'ahu

Stage of Development	Date Achieved	Comments
Branch review	August 2015	Incorporated
DOFAW review	October 2016	Incorporated
Partner agency consultation	March 2017	Nine responses received from partners and government agencies
Public consultation	August 2017	• Posted on DOFAW website July 1, 2017 – July 31, 2017 • Press release July 1, 2017 • No comments received

Development Process & Timeline for the Kula Forest Reserve and Papa'anui, Maui

Stage of Development	Date Achieved	Comments
Branch review	May 2015	Incorporated
DOFAW review	August 2016	Incorporated
Partner agency consultation	March 2017	Nine responses received from partners and government agencies and relevant comments were incorporated.
Public consultation	August 2017	• Posted on DOFAW website July 1, 2017 – July 31, 2017 • Press release July 1, 2017 • Eight responses were received from members of the public and relevant comments were incorporated.

SUMMARY OF COMMENTS AND RESPONSES:

Pūpūkea Forest Reserve

DOFAW received nine responses on the Pūpūkea Forest Reserve Management Plan during the partner agency consultation period, and no written comments on the plan during the public

consultation period. A summary of the major comments received and the responses that were provided has been attached as Exhibit C.

Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve

DOFAW received nine responses on the Kula Forest Reserve and Papa'anui Management Plan during the partner agency consultation period, and eight comments during the public consultation period. A summary of the major comments received and the responses that were provided has been attached as Exhibit D.

Board approval of the subject forest reserve management plans is intended to trigger some or all of the following actions:

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, which may require future Board review and approval, as necessary.

DOFAW has completed and approved the following management plans and submits it for your review:

1. Pūpūkea Forest Reserve Management Plan (Exhibit A)
2. Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve Management Plan (Exhibit B).

CHAPTER 343 – ENVIRONMENTAL ASSESSMENT:

In accordance with Hawai'i Administrative Rules Sections 11-200-8(a) (1) and (4) and the Exemption List for the Department of Land and Natural Resources approved by the Environmental Council and dated June 5, 2015, many of the day-to-day management activities described in the Pūpūkea Forest Reserve Management Plan and the Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve (Papa'anui) Management Plan are exempt from the preparation of an environmental assessment pursuant to Exemption Classes list in the attached Exemption Notification (Exhibit E).

All other projects outlined in the Forest Reserve Management Plans that do not qualify under the Departmental Exemption list will follow all Chapter 343, Hawai'i Revised Statutes, compliance regulations prior to implementation.

Exemption consultation

Agency	Comment
DLNR, Land Division	No response by suspense date
DLNR, State Parks	No comments
DLNR, Commission on Water Resources Management	No response by suspense date
County of Honolulu – Department of Planning and Permitting (Pūpūkea Management Plan only)	No objections
Honolulu Board of Water Supply (Pūpūkea Management Plan only)	No response by suspense date
County of Maui – Planning Department (Kula and Papa‘anui Management Plan only)	No comments
County of Maui – Department of Water Supply (Kula and Papa‘anui Management Plan only)	No response by suspense date

RECOMMENDATIONS:

That the Board of Land and Natural Resources:

1. Approve the Pūpūkea Forest Reserve Management Plan as a guiding document for the management of the subject reserve.
2. Approve the Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve Management Plan as a guiding document for the management of the subject reserves.
3. Declare that, after considering the potential effects of the applicable management activities described in both the Pūpūkea Forest Reserve Management Plan and the Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve Management Plan, as provided by Chapter 343, HRS, and Chapter 11-200, HAR, these management activities will probably have minimal or no significant effect on the environment and are therefore exempt from the preparation of an environmental assessment.

Respectfully submitted,

DAVID G. SMITH, Administrator
Division of Forestry and Wildlife

APPROVED FOR SUBMITTAL:

SUZANNE D. CASE, Chairperson
Board of Land and Natural Resources

Exhibit C

Summary of Comments Received and Responses Provided for the Pūpūkea Forest Reserve Management Plan

Comment: To minimize impacts to the endangered Hawaiian hoary bat, it was recommended that woody plants greater than 15 feet tall should not be disturbed, removed, or trimmed during the bat birthing and pup rearing season (June 1 through September 15).
Response: DOFAW is aware of the tree felling concerns during Hawaiian hoary bat birth and pup rearing season. There are established procedures already in place for avoiding impacts to rare and endangered species, and they will be followed by DOFAW during any management activities.

Comment: To minimize adverse effects to listed plants, it was recommended that a botanical survey be conducted in areas where management activities will be done outside existing disturbed sites, listed plants within the disturbance site be flagged, and disturbance within 200 of listed plants be avoided.
Response: Should any proposed activities occur outside existing disturbed areas, the following potential actions will be considered: a botanical survey within and extending 200 feet beyond the proposed activity area, flagging of all listed plants within the survey area, and avoidance of cutting or removing vegetation within 200 feet of listed plants.

Comment: It is not indicated in the plan that the forest reserve abuts the Pūpūkea-Paumalū State Park Reserve. The Girl Scouts of Hawai'i camp is also adjacent to the forest reserve and should be included in DOFAW's consultations.
Response: The Park Reserve will be identified as adjacent to the forest reserve in the management plan. A draft of the plan was sent to the Girl Scouts of Hawai'i.

Comment: As recently as September 2016, 3 individuals of devil weed (*Chromolaena odorata*) were found within the forest reserve. Devil weed is highly invasive and can spread via recreational activities increasing the risk of it spreading in the future. Recommendations to limit spread included installing education signs to encourage cleaning of gear.
Response: DOFAW recognizes that devil weed has a high potential to spread in the forest reserve via different recreational activities. DOFAW has included invasive species prevention as a tactical goal and will encourage the cleaning of gear via informational signage and boot brushes at the trailhead.

Comment: A Memorandum of Agreement (MOA) with the Boy and Girl Scout camps to have them assist with trail maintenance as an annual service project should be incorporated.
Response: DOFAW will look into establishing a partnership with the Boy and Girls Scouts at a future time.

Comment: Research and discussions on carrying capacity of the Pūpūkea Forest Reserve for recreational, hunting, collecting and harvesting activities should be initiated.
Response: DOFAW will investigate the potential in doing this type of research at a future time.

Comment: Four partner agencies supported the plan and/or had no objections.

Exhibit D

Summary of Comments Received and Responses Provided for the Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve Management Plan

Partner Comments:

Comment received from the Division of Aquatic Resources
Theme: Clarify and identify suitable commercial activities.
Response: The only commercial activity occurring in Kula FR are commercial hiking tours. Detailed information on the management of this commercial activity has been inserted into section "G" of the plan in response to this comment.

Comment received from the Office of Conservation and Coastal Lands (OCCL)
Comment: DOFAW must consult with OCCL before pursuing actions listed under Commercial Activity Management to determine if any permits are necessary, or if there are any questions whether other activities qualify as a nonconforming use that are not covered under DOFAW's Programmatic Site Plan Approval.
Response: DOFAW will consult with OCCL on any planned activities that qualifies as a nonconforming use that are not covered under the Programmatic Site Plan Approval.

Comments received from the Office of Hawaiian Affairs (OHA)
Comment: The plan lacks an understanding of known cultural practices in the area that would ensure the cultural gathering rights of Native Hawaiians are protected and minimally impacted by proposed activities.
Response: The Kula FR and Papa'anui Management Plan is primarily a natural resource management plan. We do include information that we have available to us from cultural site inventories and existing cultural assessments for the area. Beyond this we lack the expertise to delve into the primary resources that contain information recorded in Hawaiian language documents and oral histories. Any information for Kula FR and Papa'anui that OHA can share with us would be appreciated, and we would gladly partner with OHA to further explore how we can appropriately incorporate Hawaiian culture and history into our management plans.

Comment: The plan should integrate a Cultural Impact Assessment (CIA) study or cultural and educational significance of the area by integrating Hawaiian mo'olelo or oral histories about the area.
Response: DOFAW does not anticipate that any of our current management activities will require us to conduct an Environmental Assessment (EA). If any future projects require us to complete an EA we will also conduct a CIA at that time.

Comment: Protocols should be put in place to ensure Section 6E, HRS, compliance should there be any inadvertent discoveries of historic properties or human remains.
Response: DOFAW recognizes that traditional and customary rights of the native Hawaiian people are protected under Hawai'i law. In the Constitution of the State of Hawai'i, Article XII, Section 7, "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." We have decided to include this recognition, and our protocol for inadvertent discovery of historic properties or human remains in section "J" of the

management plan.

Comment received from the State Historic Preservation Division (SHPD)
Comment: There are no documented archaeological sites in Kula FR and Papa'anui. There are rock walls built by cattle ranchers and remains of boundary walls built by the forest ranger. These structures are greater than fifty years old and meet the definition of "historic property" in Section 6E-2, HRS. Any State projects that could potentially affect these structures are subject to review by SHPD. Specific language was provided, for inclusion into the management plan that define procedures to ensure protection of historical and archaeological resources. The plan would be considered "accepted" by SHPD if the provided language is incorporated.
Response: DOFAW included the following into section "I" of the management plan as was requested by SHPD: "There are some rock walls that were built by cattle ranchers more than 50 years ago that are located within the forest reserve. Some of the walls were also built by the forest ranger along the boundary in the early 1920's to keep cattle out of the forest reserve. These structures meet the definition of "historic property" as defined in Section 6E-2, HRS, and 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.

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 [AMP] or a preservation plan [PP]) 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."

Comments received from the U.S. Forest Service State and Private Forestry
Comment: The plan is largely silent on how the state plans to manage the stands of non-native trees present in Kula FR. This should be clearly discussed, and the impacts (good and bad) of these non-native stands on other values or uses should be clearly stated.
Response: In terms of the future management of the non-native trees, barring another major wildfire, DOFAW has no plans to implement any large-scale species replacement at this time. In an effort to contain the impacts of invasive species present in Kula FR, the plan does include goals and action items to create a weed free buffer between Kula and adjacent watershed areas.

Comment: The plan states there is critical habitat for two species of forest birds in the area, but there are no management actions tied to this designation.
Response: There is currently critical habitat for two species of forest birds, the 'ākohekohe (*Palmeria dolei)* and the kiwikiu (*Pseudonestor xanthophrys*) in Kula FR and Papa'anui. 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." These two species are not present in either Kula FR or Papa'anui, and the area lacks suitable habitat for these endangered forest birds. DOFAW is conducting landscape scale restoration efforts on the south facing slopes of Leeward Haleākala,

which will create much more suitable for future reintroductions of these endangered species.

Comment: In many places in the western US, there are recurring conflicts between hikers and mountain bikers using the same trail system (also with equestrian users). Is this an issue in the planning area? If so, how should it be reduced? If it is not currently an issue, should it be anticipated?
Response: There are currently no reported conflicts occurring between the different user groups of Kula FR and Papa'anui. As described in the management plan, trails are designated for specific uses. This was done to minimize user conflicts. If incidents increase and are reported to DOFAW, staff will re-evaluate current policies and make necessary changes as appropriate.

Comment: The plan should discuss what impacts invasive species are having, especially in terms of fire risk and water quality/quantity. Indicate which invasive plants and animal species are currently under management and what the objective is (eradication, control, containment).
Response: DOFAW revised the management plan to include invasive plant management objectives (control, containment, or eradication) in the threats sections of the plan. An appendix with a brief description of each invasive plant species, their distribution and their impacts was also inserted.

Comments received from Starr Environmental
Comment: The endangered Hawaiian petrel or 'ua'u (*Pterodroma sandwichensis*) are likely present in the higher elevations areas of Kula FR and Papa'anui, as there are burrows on adjacent similar lands. Surveys for this species is needed, and if detected predator control and/or predator proof fencing was recommended.
Response: Information on the endangered Hawaiian petrel was included into section "F" of the management plan in response to this comment. Continuation of ongoing surveys for presence, location, and population estimates of rare seabirds (Hawaiian petrel) is an identified management objective in the plan.

Comment: A list of additional birds that have been observed in Papa'anui was provided.
Response: Any species not already included in Table 9 of the management plan were inserted.

Comment: Kula FR is home to a few species of native Tephritid flies (Tephritidae: *Trupanea* spp.). Polipoli is a refugia for this genus of native flies.
Response: With their permission, information provided by Starr Environmental on the presence of native *Trupanea* fruit flies found in Kula FR has been included in section "F" of the management plan.

Comments received during public consultation period

Theme: Recreation, Trails and Access
Comment: Do not pave the Polipoli Access Road any further. Increasing access will result in increased disrespect of the area with rubbish, etc.
Response: DOFAW has no intention at this time of paving the Polipoli Access Road (Waipoli Access Road) any further. Current management objectives are to maintain the existing road infrastructure, repairing and grading the road when needed.

Comment: Keeping the road in a condition that allows non-four-wheel drive vehicles to reach the trailheads is critical for access by a diverse group of hikers.
Response: Road and trail maintenance are identified action items in Table 13 of the draft management plan. DOFAW will continue to maintain the roads and trails to the level that they are currently being managed.

Comment: Boundary trail slants downwards strongly towards the lower ditch area, and accidents have recently occurred there and are likely to occur again without some improvement.
Response: The Nā Ala Hele program has improved several trails in Kula FR increasing safety, decreasing erosion and improving trail experience. An Environmental Assessment is being drafted for the proposed redesign of Lower Waiohuli Trail, which is the next project to be initiated once environmental compliance has been completed.

Comment: Install single-track trails designed specifically for mountain biking. There a very few options on Maui for mountain biking.
Response: In June 2015, the Division's Nā Ala Hele program in partnership with the mountain biking community on Maui, opened a new trail system located within Makawao Forest Reserve. The Kahakapao Recreational Area features miles of professionally designed and designated mountain biking trails that contain a variety of features for riders of all skill levels and ages. DOFAW currently has no plans to create additional mountain bike trails, but the Nā Ala Hele Advisory Council and DOFAW management staff continue to look for and evaluate new opportunities.

Comment: Feral ungulate populations should be eliminated because of the negative affect they have on trails. Trail damage should be included as a threat caused by feral pigs.
Response: Kula FR is designated as Public Hunting Area Unit C. Elimination of game species which includes the feral pig population, is not a stated objective in the draft management plan. Our management goal is to allow for multiple uses to occur, maintaining compatibility between all user groups. If you experience any conflicts with other user groups of the forest reserve, please contact the Maui Forestry Manager. We have also included trail damage as an impact due to feral pig activity in section "K" of the management plan.

Comment: The "Number of recreational users" and the "Diversity of the recreational visitor population" should be added as overall measures of success in the management plan.
Response: The "Number of visitors" has been added as an overall measure of success in section "E" of the management plan. An automated vehicle counter has already been installed along the access road. In terms of diversity, the DOFAW does not have the resources to do an analysis of the types of visitors utilizing Kula Forest Reserve.

Comment: The area being managed by the Kahikinui Hunter's Club should be added to the Forest Reserve and open to the general public.
Response: DOFAW has no jurisdiction over those lands leased to the Kahikinui Game and Land Management 'Ohana. That area is managed by the Department of Hawaiian Home Lands (DHHL). Please contact the DHHL Maui office at (808) 760-5120 with any concerns regarding these lands in Kahikinui.

Theme: Invasive Species
Comment: Get rid of banana poka from the forest reserve.
Response: Banana poka has been recognized as an invasive species in Table 11 of the draft management plan, and "eradication" is the stated objective for this species. DOFAW at one time had a crew dedicated to banana poka removal that were successful in removing banana poka from several areas. The funding for this dedicated crew lasted for several years before it was expended. Currently, DOFAW continues to control incipient banana poka populations to prevent new populations from becoming established. Unfortunately, the populations in Kula FR has been difficult to eradicate because they are located in the canopy of 100ft tall stands of *Eucalyptus*. DOFAW is currently exploring how to expand application of a fungal biocontrol agent (*Septoria passiflorae*) which has been successful in reducing banana poka population by 90-95% in some areas.

Comment: Explore what can be done to control the fireweed that came in after the wildfire.
Response: Fireweed (*Senecio madagascariensis*) has also been recognized as an invasive species in Table 11 of the draft management plan and "control" is the state objective for this species. This species is too widespread in Kula FR to control mechanically. DOFAW is monitoring biocontrol efforts on neighboring properties, and depending on how successful these efforts are, will consider their release in the FR.

Comment: Glycine seems to be spreading unchecked and is overtaking non-developed areas. This species should be listed as an invasive species in the management plan.
Response: Based on the plant species inventory done for the management plan, glycine (*Neonotonia wightii*) has not been located within the boundary of Kula FR or Papa'anui. If you are aware of any glycine populations located within the FR please contact our Maui Forestry Manager with that information.

Theme: Fire and Post-fire reforestation
Comment: There needs to be increase enforcement in Kula FR. There are open fire pits and illegal camping occurring in the forest reserve.
Response: DOFAW is aware of the numerous unattended fires left along the Polipoli Access Road. The Division of Conservation and Resource Enforcement (DOCARE) patrols Kula FR every week for illegal activity and has been regularly issuing citations. During months when there are high fire hazard conditions, DOFAW staff conduct fire patrols on a weekly basis. They extinguish smoldering pits and remove excess wooden pallets that are commonly used as fuel for this activity. We recognize the need to increase patrols, especially at night, and securing funding for additional night patrols is a stated objective in the draft management plan.

Comment: The next fire in Kula FR will be worse due to the amount of fuel the Monterey pines are producing.
Response: The majority of wildfires ignitions in Hawai'i are human related. Numerous unattended fires are left along the Polipoli Access Road. DOCARE patrols Kula FR every week for illegal activity, and during high fire hazard conditions DOFAW staff will conduct weekly fire patrols. Other fire presuppression activities identified in the management plan include researching the feasibility of using a cable yarder to reduce forest fuel loads, and development of a fire

management and fuel load reduction plan.

Comment: The replanting of natives after the 2007 wildfire was unsuccessful due to the size of the planting and lack of maintenance. Native plants need help in the first few years, so they don't get overtaken by invasive plants.
Response: After the 2007 wildfire, DOFAW outplanted 780 acres with native trees and shrubs. Native plants were not planted into existing pine stands as they would not be able to compete with the faster growth rates of these species. Previously open shrub and grassy areas were the preferred outplanting sites for native plants. Of the species planted, koa (*Acacia koa*) did the best, and there are several large stands of koa that are now over 30 feet tall with the FR. As these tree reach maturity, they will hopefully create a sufficient canopy to shade out other less desirable species. DOFAW did attempt to use herbicide and manual removal techniques to control the regenerating pine stands. Due to the immediate and rapid regrowth after these control efforts, such methods were deemed financially unsustainable.

Comment: Divide the area into manageable reforestation sectors with firebreaks. All firebreaks should be planted with redwoods which would create a natural firebreak.
Response: Redwoods are known to have fire resistant characteristic, but to be an effective greenbreak, corridors 100 – 200 feet wide would have to be established. DOFAW does not currently have the manpower to maintain such an undertaking. Redwood outplanting in such a manner would exceed what DOFAW can do successfully. DOFAW has instead identified implementing a firebreak along access corridors as an objective in the management plan.

Theme: Forest Cover
Comment: Consider planting sterile Leucaena hybrids in Kula FR, as a short-rotation timber species.
Response: DOFAW currently does not have any plans for large scale timber harvesting in Kula FR.

Comment: The park is shrinking due to the overgrowth of vegetation.
Response: Forestry and Wildlife staff are currently cutting back pines between forest #5 and the southern portion of the FR. This is a management objective for the Kaonoulu Cooperative Game Management Area, which is maintained as a game bird hunting area. The last pine control effort happened in May 2017. In terms of forest cover, DOFAW has no intention of removing forest cover over any other portion of the reserve as the highest management priority for Kula FR is Watershed Value. Forest thinning activities may be considered in the future as needed to benefit the forested watershed.

DAVID Y. IGE
GOVERNOR OF HAWAII

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EXEMPTION NOTIFICATION
Regarding the preparation of an environmental assessment pursuant to Chapter 343, Hawaii Revised Statutes and Chapter 11-200, Hawai'i Administrative Rules.

Project Title:	Pūpūkea Forest Reserve Management Plan, Tax Map Keys (1) 5-9-006:026, (1) 5-9-006:006, Pūpūkea, Ko'olauloa, O'ahu. AND Kula Forest Reserve and the Papa'anui tract of Kahikinui Forest Reserve Management Plan, Tax Map Keys (2) 2-2-007: portion of 001 and (2) 2-2-007:003, Kula, Makawao, Maui.
Project Number:	N/A
Project Description:	The Division of Forestry and Wildlife's Pūpūkea Forest Reserve (FR) Management Plan and the Kula FR and the Papa'anui Tract of Kahikinui FR (Papa'anui) Management Plan present a brief history of the specific forest reserves, a description of cultural and natural resources, and the current and proposed management actions for the area. A more detailed description of these management activities can be found in Table 9 of the Pūpūkea FR Management Plan, and in Table 13 of the Kula FR and Papa'anui Management Plan.
Chapter 343 Trigger:	Use of State Land and Funds
Exemption Class No.:	In accordance with Hawai'i Administrative Rules Sections 11-200-8(a)(1) and (4) and the Exemption List for the Department of Land and Natural Resources approved by the Environmental Council and dated June 5, 2015, the subject request is exempt from the preparation of an environmental assessment pursuant to: Exemption Class No. 1, Item 1, "Mitigation of any hazardous conditions that present imminent danger as determined by the Department Director and that are necessary to protect public health, safety, welfare, or public trust resources." Exemption Class No. 1, Item 2, "Upon determination by the Department Director that an emergency exists, emergency mitigation and restoration work to prevent

Exhibit E

	damage from continuing to occur and to restore the topographical features and biological resources." Exemption Class No. 1, Item 3, "Removal of boulders, rocks, hazardous trees, marine debris, and other similar hazards necessary to maintain state lands and waters in a safe condition." Exemption Class No. 1, Item 4, "Fire management activities, including prevention and restoration measures, when conducted in accordance with Departmental and Division procedures." Exemption Class No. 1, Item 5, "Rescue of threatened or endangered species." Exemption Class No. 1, Item 7, "Operation, repair and maintenance, of existing Department structures and facilities, including baseyards, offices, cabins, sheds, and fencing." Exemption Class No. 1, Item 13, "Operation, repair and maintenance of existing recreational facilities, such as campsites, cabins, shelters, and other similar structures, and the appurtenant support facilities and structures." Exemption Class No. 1, Item 14, Operation, repair or maintenance of existing fire tool caches, fuel breaks, and helispots. Exemption Class No. 1, Item 19, "Repairs to existing ground water, surface water, or climatological monitoring equipment, and other similar monitoring and data collection equipment, and the structures that house or protect them." Exemption Class No. 1, Item 23, "Repair and maintenance of existing water tanks, water catchment basins, water units, pumps and controls, pipes, channels, dikes, and moats." Exemption Class No. 1, Item 28, "Repair and maintenance of historic and archaeological sites to maintain the integrity of historic structures, archaeological features and sites." Exemption Class No. 1, Item 29, "Maintenance of existing boardwalks, trails and unpaved roads." Exemption Class No. 1, Item 30, "Maintenance of state-owned right-of-way other than public right-of-ways." Exemption Class No. 1, Item 31, "Repair and maintenance of existing roadways, roadway shoulders, road structures and signage, parking areas, walkways,

	bikeways, multi-use pathways, driveways, and boat launch ramps (includes grading, resurfacing, infilling, sealing, grooving, cleaning, chipping, painting and patching)." Exemption Class No. 1, Item 32, "Maintenance of existing landscaping, including planting, trimming, mowing, and irrigation. Exemption Class No. 1, Item 33, "Maintenance of state lands and waters to remove weeds, brushes, grass and other unwanted vegetation." Exemption Class No. 1, Item 34, "Routine pruning, trimming, thinning, and removal of trees, excluding commercial logging. Exemption Class No. 1, Item 35, "Termite and pest control treatment using Environmental Protection Agency and State Department of Agriculture approved pesticides under the supervision of certified applicators provided that treatment is limited to existing structures, facilities, or equipment. Exemption Class No. 1, Item 36, "Repair and maintenance of existing machinery, equipment, vessels, and vehicles used to support Departmental operations. Exemption Class No. 1, Item 37, "Clearing, grading, and grubbing, for which grading permits are not required. Exemption Class No. 1, Item 38, "Removal and disposal of rubbish and debris from state lands and waters. Exemption Class No. 1, Item 41, "Storage of construction equipment and materials for a limited period of time as necessary to support planned or existing construction or repair. Exemption Class No. 1, Item 42, "Actions that are intended to maintain or support the sustainability of those natural resources under the jurisdiction of the Department, including law enforcement, regulation compliance, resources and environmental monitoring, debris or property removal, and other administrative and management measures. Exemption Class No. 1, Item 51, "Permits, licenses, registrations, and rights-of-entry issued by the Department that are routine in nature, involving negligible impacts beyond that previously existing." Exemption Class No. 1, Item 52, "Use of state lands and waters by those exercising traditional and customary practices for minor non-commercial purposes or for the gaining of traditional ecological knowledge."

	Exemption Class No. 1, Item 53, "Granting to a person the privilege to conduct operations involving the provision of goods, wares, merchandise, or services to the general public including, but not limited to, tours, food and beverage operations, retail operations, rental operations, or communications and telecommunications services in or on an existing building, facility, or area." Exemption Class No. 2, Item 1, "Replacement or reconstruction of existing Department structures and facilities, including baseyards, offices, cabins, sheds, and fencing." Exemption Class No. 2, Item 2, "Replacement or reconstruction of existing signs, markers, buoys, or aids to navigation." Exemption Class No. 2, Item 7, "Replacement or reconstruction of existing recreational facilities, such as campsites, cabins, shelters, and other similar structures, and the appurtenant support facilities and structures." Exemption Class No. 2, Item 9, "Minor upgrades or replacement of existing utilities and drainage systems on state lands. Drainage improvements will generally consist of the installation of culverts, pipes, and construction of gutters or other similar infrastructure where minor flooding occurs." Exemption Class No. 2, Item 12, "Replacement or reconstruction of existing ground water, surface water, or climatological monitoring equipment, and other similar monitoring and data collection equipment, and the structures that house or protect them." Exemption Class No. 2, Item 13, "Replacement or reconstruction of existing electrical, telemetry, or communications systems and the structures that house or protect them." Exemption Class No. 2, Item 16, "Replacement or reconstruction of existing water tanks, water catchment basins, water units, pumps and controls, pipes, channels, dikes, and moats, in a size commensurate with existing system and source capacities and requirements to provide service in existing water systems." Exemption Class No. 2, Item 19, "Rehabilitation and restoration of existing structures and features at historic and archaeological sites." Exemption Class No. 2, Item 20, "Replacement or reconstruction of existing boardwalks, trails, and unpaved roads." Exemption Class No. 2, Item 21, "Replacement or reconstruction of existing

	roadways, roadway shoulders, road structures and signage, parking areas, walkways, bikeways, multi-use pathways, driveways, and boat launch ramps." Exemption Class No. 2, Item 22, "Replacement or renovation of existing landscaping or vegetation." Exemption Class No. 2, Item 23, "Re-vegetate burned or eroded areas to encourage the succession of selected plant species to prevent soil erosion and promote the goals of the Department." Exemption Class No. 2, Item 24, "Replacement or reconstruction of existing machinery, equipment, vessels, or vehicles used to support Departmental operations." Exemption Class No. 3, Item 1, "Fences around or to manage rare, threatened or endangered plants, covered or open areas for endangered species, game birds and mammals, auxiliary buildings for food or equipment storage, incubators and brooders, open-top breeding and release pens, field aviaries, and hacking boxes, and for watershed and native forest management and restoration. Fences shall contain step-overs or other features that permit pedestrian access for cultural and recreational use." Exemption Class No. 3, Item 2, "Construction and location of new, small facilities or structures necessary to support or enhance natural resource management actions on state lands and waters that the Department declares are designed specifically to monitor, conserve, or enhance native species or native species' habitat, such as nurseries, helispots, and other similar structures." Exemption Class No. 3, Item 3, "Construction and location of new, small facilities or structures necessary to support or enhance safe and effective management of state lands and waters, such as baseyards, caretaker's residences, work cabins and shelters, utility sheds, storage buildings, sanitation facilities, plant nurseries, trash containers, fire caches, radio repeaters, tollbooths, gates, installation of signage, safety enhancements (e.g., handrails, lighting), and other similar structures." Exemption Class No. 3, Item 4, "Construction and location of new, small facilities or structures necessary to support or enhance public recreational use of state lands and waters, such as comfort stations and related individual wastewater disposal systems, sanitation facilities, outdoor showers, signage, interpretive kiosks, viewing platforms, pavilions, shelters, tables, grills, cabins, campgrounds, lifeguard stations, improvements necessary for compliance with the Americans with Disabilities Act, and other similar structures."

	Exemption Class No. 3, Item 5, "Construction on state lands of roadways with distances less than 1,000 yards (excluding access roads) and walkways." Exemption Class No. 3, Item 6, "Construction of off-street parking facilities having capacities of up to 25 passenger vehicle stalls, on state lands." Exemption Class No. 3, Item 7, "Improvement of existing trails and construction or improvement of boardwalks on existing trails for recreation, education, and management." Exemption Class No. 3, Item 8, "Water catchment systems with less than 20,000 gallon capacity and above ground, nondestructive irrigation systems." Exemption Class No. 3, Item 9, "Construction of security features, including fencing, gates, cameras, lighting, and other similar items." Exemption Class No. 3, Item 10, "Installation of weatherports and radio repeaters and other similar communications equipment and related infrastructure for natural resource management purposes or for emergency response." Exemption Class No. 3, Item 13, "Installation of new, small groundwater, surface water, or climatological monitoring and data collection equipment, structures that house or protect this equipment, and installation of electrical, telemetry, or communications systems to service this equipment." Exemption Class No. 3, Item 14, "Construction of drainage swales and structures and other similar surface runoff management techniques with minimal or no effect on the environment." Exemption Class No. 4, Item 1, "Upon determination by the Department Director that an emergency exists, emergency mitigation and restoration work to prevent further damage from occurring and to restore the topographical features and biological resources." Exemption Class No. 4, Item 2, "Construction of walkways and pathways and installation of guard rails, handrails, ramps, and other similar items." Exemption Class No. 4, Item 3, "Improvement of existing trails and construction or improvement of boardwalks on existing trails for recreation, education, and management." Exemption Class No. 4, Item 4, "Improvements of previously existing graded parking and storage yard areas, including paving, infilling, grading and compacting."

	Exemption Class No. 4, Item 5, "Establishment of helispots for fire control, natural resource management, and rescue." Exemption Class No. 4, Item 6, "Minor vegetation clearing and management, including mowing, pruning, trimming, and application of federal and state approved herbicides in conformance with label instructions." Exemption Class No. 4, Item 7, "Clearing of fuel breaks and other similar fire pre-suppression actions to reduce fire potential and minimize fire severity." Exemption Class No. 4, Item 8, "Removal of invasive vegetation utilizing cutting, mowing, application of federal and state approved herbicides in conformance with label instructions, distribution of biocontrol agents approved by the State of Hawaii and other approved methods." Exemption Class No. 4, Item 9, "Vegetation clearing and removal work on or near the embankment, spillway, or outlet works of a dam facility of vegetation that could pose a threat to the embankment or impede inspection of the facility." Exemption Class No. 4, Item 10, "Vegetation clearing and grading work to stabilize existing slopes and mitigate rockfall, including work required to mobilize equipment." Exemption Class No. 4, Item 11, "Controlled burning of vegetation less than ten (10) acres in size to improve wildlife habitat where non-native vegetative cover constitutes greater than 75% of the area." Exemption Class No. 4, Item 12, "Establish temporary or permanent vegetative cover including trees, shrubs, grasses, and sod for landscaping, reforestation, soil stabilization, watershed protection, native wildlife habitat, native ecosystem restoration, and rare plant preservation; provided, however, that this exemption shall not apply to vegetation that is likely to be invasive or for tree plantings for which harvesting is planned or is reasonably foreseeable." Exemption Class No. 4, Item 13, "Gathering plant seed, cuttings, or other vegetative matter for propagation." Exemption Class No. 4, Item 14, "Minor ground adjustments (e.g., grading, grubbing, cutting, or filling) that do not require grading permits." Exemption Class No. 4, Item 15, "Minor alterations in state waters, including restoration of native species and control of invasive weeds, algae, invertebrates, fishes or other invasive aquatic organisms."

	Exemption Class No. 4, Item 16, "Control of pests utilizing federal and state approved pesticides, herbicides, fungicides, and toxicants in conformance with label instructions; traps, snares, lures, and repellents; distribution of biocontrol agents approved by the state of Hawaii; and other approved methods." Exemption Class No. 4, Item 17, "Management of surface water runoff, including installation of minor drainage ditches and implementation of other stormwater best management practices and low impact development techniques (e.g., bioretention areas, permeable pavers, etc.)." Exemption Class No. 4, Item 18, "Minor alteration of retaining walls." Exemption Class No. 4, Item 22, "Natural resource management actions that the Department declares are designed specifically to monitor, conserve, or enhance the status of native species or native species' habitats, such as removal of introduced vegetation, reintroduction of native species into their historic range, or construction of fencing. This exemption would not apply to biocontrol of invasive species or commercial logging." Exemption Class No. 5, Item 1, "Conduct surveys or collect data on existing environmental conditions (e.g, noise, air quality, water flow, water quality, etc.)." Exemption Class No. 5, Item 2, "Non-destructive data collection and inventory, including field, aerial and satellite surveying and mapping." Exemption Class No. 5, Item 3, "Conduct topographic, sounding, wave, littoral transport, bathymetric, and location surveys." Exemption Class No. 5, Item 5, "Installation of climatological stations and equipment and streamflow gaging stations and equipment, and other similar equipment necessary to measure environmental factors and collect data." Exemption Class No. 5, Item 12, "Conduct terrestrial and marine archaeological surveys." Exemption Class No. 5, Item 13, "Research or experimental management actions that the Department declares are designed specifically to monitor, conserve, or enhance native species or native species' habitat." Exemption Class No. 5, Item 14, "Implanting transponders and affixing tags, transmitters, markers, or other similar devices to birds, mammals, invertebrates, or aquatic organisms to record movement, longevity, growth, distribution, behavior, and other activities; taking disease or blood samples from birds,

	mammals, invertebrates, or aquatic organisms; and placing remote monitoring devices (to determine animal movement), cameras, equipment and feeders." Exemption Class No. 5, Item 15, "Game and non-game wildlife surveys, vegetation and rare plant surveys, aquatic life surveys, inventory studies, new transect lines, photographing, recording, sampling, collection, culture, and captive propagation." Exemption Class No. 5, Item 16, "Captive propagation of birds, mammals, invertebrates, or aquatic organisms; cultivation of plants. Housing, care, feeding, veterinarian examination, breeding (pairing, hatching, brooding, fledgling, rearing), cross fostering, double clutching nests, and experimental studies of native species (including those which are rare, threatened or endangered), game birds and game mammals." Exemption Class No. 5, Item 17, "The reintroduction or supplementation (e.g., stocking) of native, formerly native, or established species into suitable habitat within their historic or established range, where no or negligible environmental disturbances are anticipated." Exemption Class No. 5, Item 18, "Research or experimental wildlife and plant management actions, including controlled grazing or burning as a management tool and outplanting." Exemption Class No. 5, Item 19, "Research or experimental management actions to identify, monitor, control, or eradicate introduced species." Exemption Class No. 5, Item 22, "Conduct planning and feasibility studies." Exemption Class No. 5, Item 23, "Permission to enter state lands for the purpose of conducting those activities listed above." Exemption Class No. 6, Item 1, "Construction, placement or installation of signage, pavement markings, buoys, or other similar structures." Exemption Class No. 6, Item 4, "Installation of glare screens, bollards, guard rails, vehicular access barriers, and other similar appurtenances designed to protect the public on state lands." Exemption Class No. 6, Item 6, "Construction or placement of lighting systems for street lights, facility lighting, and security lighting." Exemption Class No. 6, Item 7, "Alarm systems, camera systems, and similar surveillance items on state lands for security and safety purposes."

	Exemption Class No. 6, Item 8, "Construction of walls, fencing, or screens around buildings, structures, facilities, or equipment on state lands." Exemption Class No. 6, Item 9, "Construction of interior roadways, driveways, parking areas, sidewalks, pathways, aisles, curbs, gutters, and other similar items on state lands." Exemption Class No. 6, Item 10, "Water tanks with less than 20,000 gallon capacity." Exemption Class No. 6, Item 11, "Water catchment systems, lines, and faucets." Exemption Class No. 6, Item 13, "Placement or construction of accessory structures such as utility sheds, storage or maintenance sheds, office trailers, trash enclosures, comfort stations or sanitation facilities and related individual wastewater disposal systems, bus shelters, pavilions or picnic shelters, parking and fee collection facilities, checking stations, interpretive kiosks and displays, dock boxes, mooring cleats, bumpers, and mooring buoys, blocks and piles, and other similar structures accessory to existing facilities on state lands and waters" Exemption Class No. 6, Item 16, "Installation of weatherports and radio repeaters for natural resource management purposes or for emergency response." Exemption Class No. 8, Item 2, "Demolition and removal of existing structures, facilities, utilities, and other improvements on state lands, except those structures located on any historic site as designated in the National Register or Hawaii Register as provided for in the National Historic Preservation Act of 1966, 16 U.S.C §§470 et. seq., as amended, or Haw. Rev. Stat. Chapter 6E." Exemption Class No. 8, Item 3, "Demolition and removal of experimental devices or other equipment, when such devices or equipment are no longer used or needed." Exemption Class No. 8, Item 4, "Demolition and removal of abandoned private property from state lands." Exemption Class No. 8, Item 5, "Demolition and removal of unauthorized improvements from state property." Exemption Class No. 10, Item 1, "Purchase of supplies, equipment, materials, motor vehicles, boats, and services." Exemption Class No. 10, Item 2, "Contracts for small purchases, professional

	services, competitive sealed proposals, competitive sealed bidding, or purchase of goods and services which are exempt from Haw. Rev. Stat. Chapter 103D." Exemption Class No. 10, Item 3, "Requests for federal, state, county or private assistance grants to support ongoing operations or implement programs of the Department." Exemption Class No. 10, Item 4, "Personnel-related actions." Exemption Class No. 10, Item 5, "Training, environmental interpretation, public safety efforts and other educational activities."
Consulted Parties	As noted in the submittal.
Recommendation	That the Board finds this project will have minimal or no significant effect on the environment and is presumed to be exempt from the preparation of an environmental assessment.

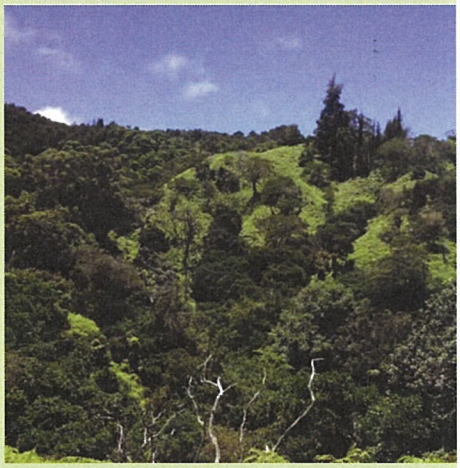
Suzanne D. Case, Chairperson

Date

EXHIBIT A

Pūpūkea Forest Reserve

Management Plan - 2017



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

Contact information:

O'ahu Branch Manager
Division of Forestry & Wildlife
2135 Makiki Hts. Drive
Honolulu, HI 96822
Phone: (808) 973-9784

EXECUTIVE SUMMARY

This management plan for Pūpūkea Forest Reserve on O'ahu is one in a series of site-specific natural resource management plans to be prepared by the Department of Land and Natural Resources (DLNR), 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 cultural and natural 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.

Pūpūkea Forest Reserve (FR) was established by Governor's Proclamation in 1910 to conserve and protect the remaining forest and increase local water supply. The reserve consists of approximately 782 acres of state land located on the northwestern portion of the Ko'olau Mountain Range in the Ko'olauloa District on O'ahu. Vegetation is dominated by non-native forest, but some 'ōhi'a forest, open koa 'ōhi'a forest, and scattered native shrublands still exist in the southeast portion of the reserve. There are several plantation stands composed of non-native commercial timber species that were planted as part of a reforestation effort that happened in the early 1900's. A previous management plan was drafted for Pūpūkea Forest Reserve in the early 1960's; this plan was never completed and much of the information it contains is now outdated.

DOFAW's current management activities within Pūpūkea FR include maintenance of infrastructure such as fences, picnic tables, gates, locks, a shelter, bridge, and one Nā Ala Hele (NAH) trail.

Forest reserve management priorities were divided into eight categories and ranked on a qualitative basis. Summaries of management priorities and goals for the Pūpūkea Forest Reserve are as follows:

1. Watershed Values - Erosion reduction and prevention; increase lands under Forest Reserve status.
2. Resource Protection - Wildfire prevention and mitigation.
3. Public Activity - Maintain and enhance public use opportunities; improve educational and informational signage.
4. Invasive Species Control - Manage incipient and established invasive plants and animals.
5. Game Animal Management - Promote public hunting through amendments to Hawai'i Administrative Rules (HAR) Chapter 122 and 123.
6. Native Ecosystems - Native ecosystem restoration; expand native forest ecosystems/cover.
7. Threatened and Endangered (T&E) Species Management - Protect occurrences of rare and endangered plants and animals.
8. Commercial Activity - Generate income from commercial use activities in the reserve; provide opportunities for sustainable commercial forest product collection.

Details of specific strategic goals and action items can be found in Table 9 on page 35 of this plan. 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 or additional objectives for Pūpūkea Forest Reserve.

TABLE OF CONTENTS

PŪPŪKEA FOREST RESERVE

MANAGEMENT PLAN SIGNATURE PAGE

O'ahu Branch certification: This plan was prepared by a team of Division of Forestry and Wildlife (DOFAW) staff to provide a management framework for Pūpūkea Forest Reserve.

_____ _____

Marigold S. Zoll, DOFAW O'ahu Branch Manager Date

DOFAW 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 Pūpūkea 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 Statues, 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 _____, 2017

DEVELOPMENT PROCESS TIMELINE

Pūpūkea Forest Reserve, O'ahu

Stage of Development	Date Achieved	Comments
Branch review	August 2015	Incorporated
DOFAW review	October 2016	Incorporated
Partner agency consultation	March 2017	Incorporated
Public consultation	June 2017	Incorporated
DOFAW approval	September 2017	None
BLNR approval		

I. INTRODUCTION

The Division of Forestry and Wildlife 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 management, assist in budgeting and funding concerns, and involve partner organizations and the public in the intended management of the forest reserve. These plans also help to fulfill certain recommendations made in the Hawai'i Tropical Forest Recovery Action Plan, including updating or completing and implementing management plans for all publicly owned and managed forests. The recovery action plan came about as a result of the 1992 Federal Hawai'i Tropical Forest Recovery Act.

Each Branch office of the Division will have a comprehensive management plan that addresses overall Forest Reserve System issues, goals and objectives for that Branch. In addition, 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 the Pūpūkea Forest Reserve, in which concerns and strategies are addressed for the public lands within the reserve.

This management plan for the Pūpūkea Forest Reserve was developed using a variety of methods. Initial development consisted of reviewing and analyzing DOFAW historic and current files (both at the administrative and O'ahu Branch office), and documents obtained from other state agencies including the Department of Land and Natural Resources Land Division and Bureau of Conveyances, the Department of Accounting and General Services Survey Division, as well as the State Archives. State of Hawai'i Geographic Information Systems (GIS) map layers 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 Reserves or the general area), were the Hawaiian Forester and Agriculturalist, Hawai'i Biodiversity and Mapping Program, Hawai'i Comprehensive Wildlife Conservation Strategy, Hawai'i Forest Action Plan, U.S. Fish and Wildlife Service Recovery Plans, biological surveys, among others. The plan evolved into its final iteration through discussions with Division staff from all program areas, both at the O'ahu Branch and administrative offices, other divisions and state agencies, DOFAW partners, and the public.

Once finalized by DOFAW, this management plan for Pūpūkea Forest Reserve 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 as necessary.

II. PŪPŪKEA FOREST RESERVE DESCRIPTION

A. Location and Description: Pūpūkea FR is located on the northern slopes of the Koʻolau Mountains on the island of Oʻahu (Figure 1) and is comprised of approximately 782 acres of public land (Table 1). Pūpūkea FR is within the ahupuaʻa of Paumalū, and is surrounded by the ahupuaʻa of Waimea to the south, Kaunala to the northeast, and Pūpūkea to the west. Principal adjacent landowners and lessees include the Boy Scouts of America (on former public FR lands) to the west, Pūpūkea Homesteads to the northwest, Girl Scouts of Hawaiʻi to the north, Pūpūkea-Paumalū State Park Reserve to the northeast, federal lands used as the Kahuku Training Area to the east, private lands owned by Dole Food Co. Inc. leased to the U.S. Military as components of the Kawailoa Training Area to the south, and Waimea Valley owned by the Office of Hawaiian Affairs to the southwest. Pūpūkea FR is dominated by non-native vegetation, with some areas of ʻōhiʻa forest, open koa ʻōhiʻa forest, and scattered native shrublands in the southeast portion of the FR.

Table 1: Government Tax Map Key (TMK) parcels currently comprising public lands of Pūpūkea Forest Reserve (Figure 1).

TMK Number	Owner	Tax Acres (entire TMK)	GIS Acres (entire TMK)	GIS Forest Reserve Acres
159006026	State of Hawaiʻi	700	720.1	720.1
159006006	State of Hawaiʻi	72.9	61.86	61.86
			TOTAL	**781.97**

B. Geographic Site Data: The island of Oʻahu is the third largest of the Hawaiian Islands. Oʻahu consists of two extinct volcanoes: Koʻolau in the east and Waiʻanae in the west. These mountains form parallel ranges which are the eroded remnants of two shelf volcanoes that erupted 1.3 and 2.2 million years ago. The broad plain that extends from Diamond Head across Pearl Harbor to ʻEwa and Barbers Point is partly the result of upward seafloor warping or tilting as caused by weight pressure from Maui and Hawaiʻi Island (Juvik and Juvik, 1998). Pūpūkea FR is a part of the Koʻolau mountain range and is the northernmost forest reserve on Oʻahu.

C. Physical Site Data: The elevation of Pūpūkea FR ranges from 500 feet along the northern boundary to 1,300 feet at the southeast corner of the reserve at a peak called Puʻu Moa. There is another peak, Puʻu Aimuʻu, located in the northern portion of the reserve. The reserve encompasses three gulches and adjacent ridge systems. Each gulch contains one perennial tributary that feed into Paumalū Stream. The stream supplies water for users downstream and is ranked as a substantial cultural and recreational resource in the Hawaiʻi Stream Assessment Report (State of Hawaiʻi and National Park Service, 1990).

Average annual rainfall ranges from 62 to 90 inches (Figure 2). The United States Department of Agriculture's Natural Resource Conservation Service has mapped Kapaʻa silty clay as the dominant soil type in Pūpūkea FR. Other soils present include Paumalū-Badland complex, Paʻaloa silty clay, and Paumalū silty clay as shown in Figure 3. This agency provides online soil maps and data at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

D. Pre-Reserve History and Forest Reserve History:

Pre-Reserve History: According to the Atlas of Hawaiʻi, 3rd Edition, the area of Pūpūkea FR was most likely mesic forest and shrubland prior to human settlement. The topography of Paumalū was not suitable for wet taro cultivation, so it is likely that the gulches and streams were never terraced or planted (Handy and Handy, 1991). Following European contact, Pūpūkea FR was primarily used for cattle grazing.

Figure 1: Current extent of public lands of Pūpūkea Forest Reserve

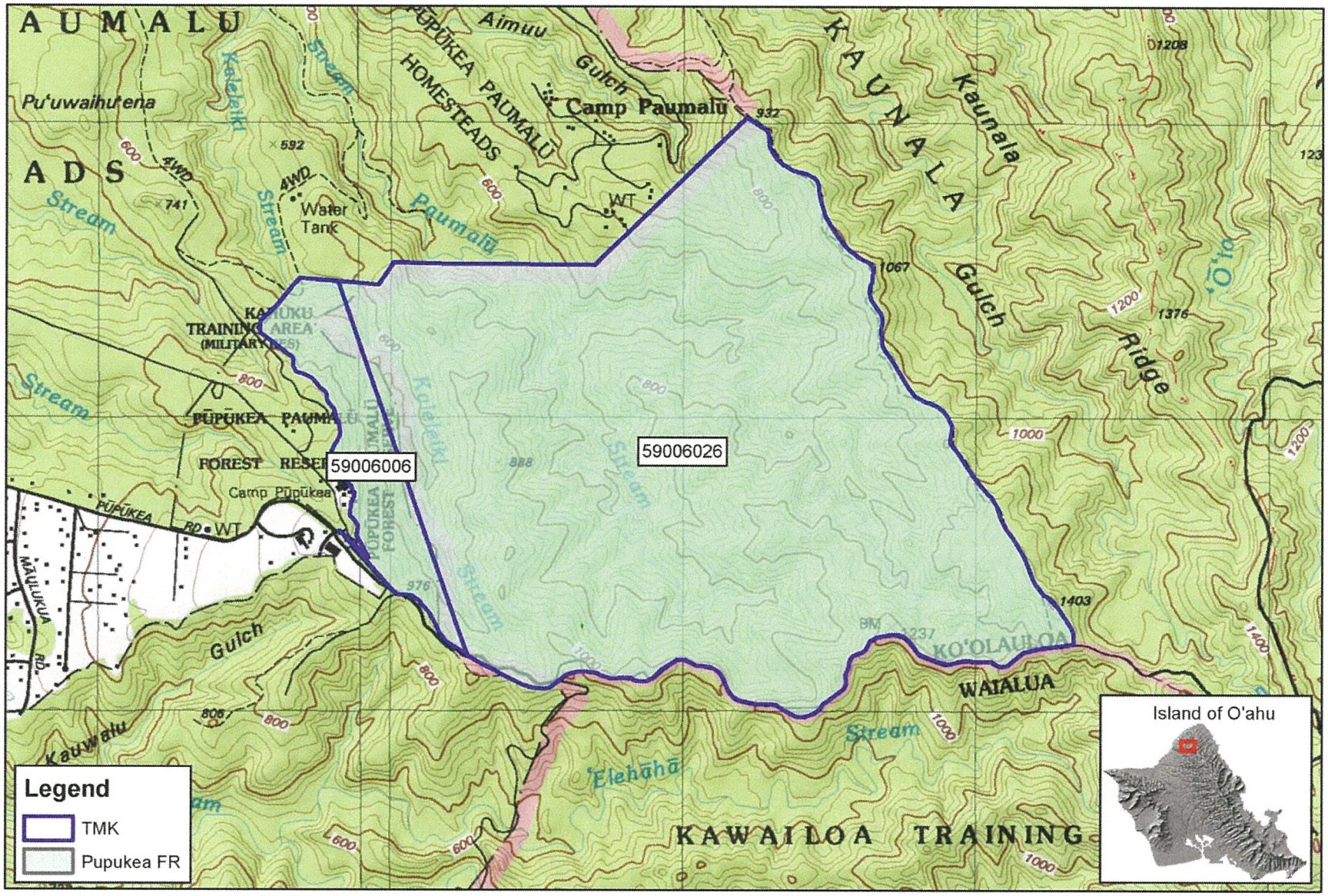


Figure 2: Hydrological features of Pūpūkea Forest Reserve

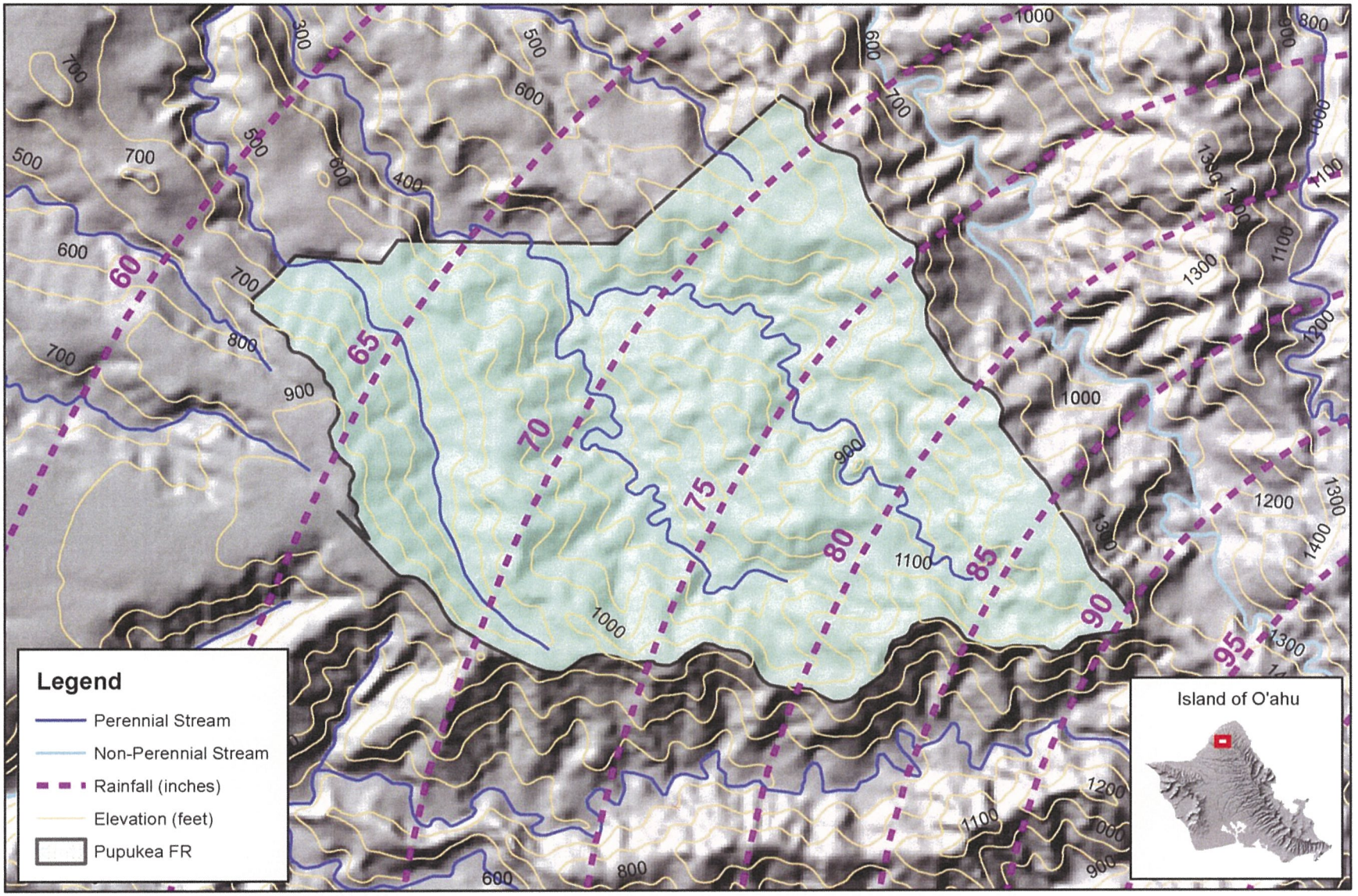
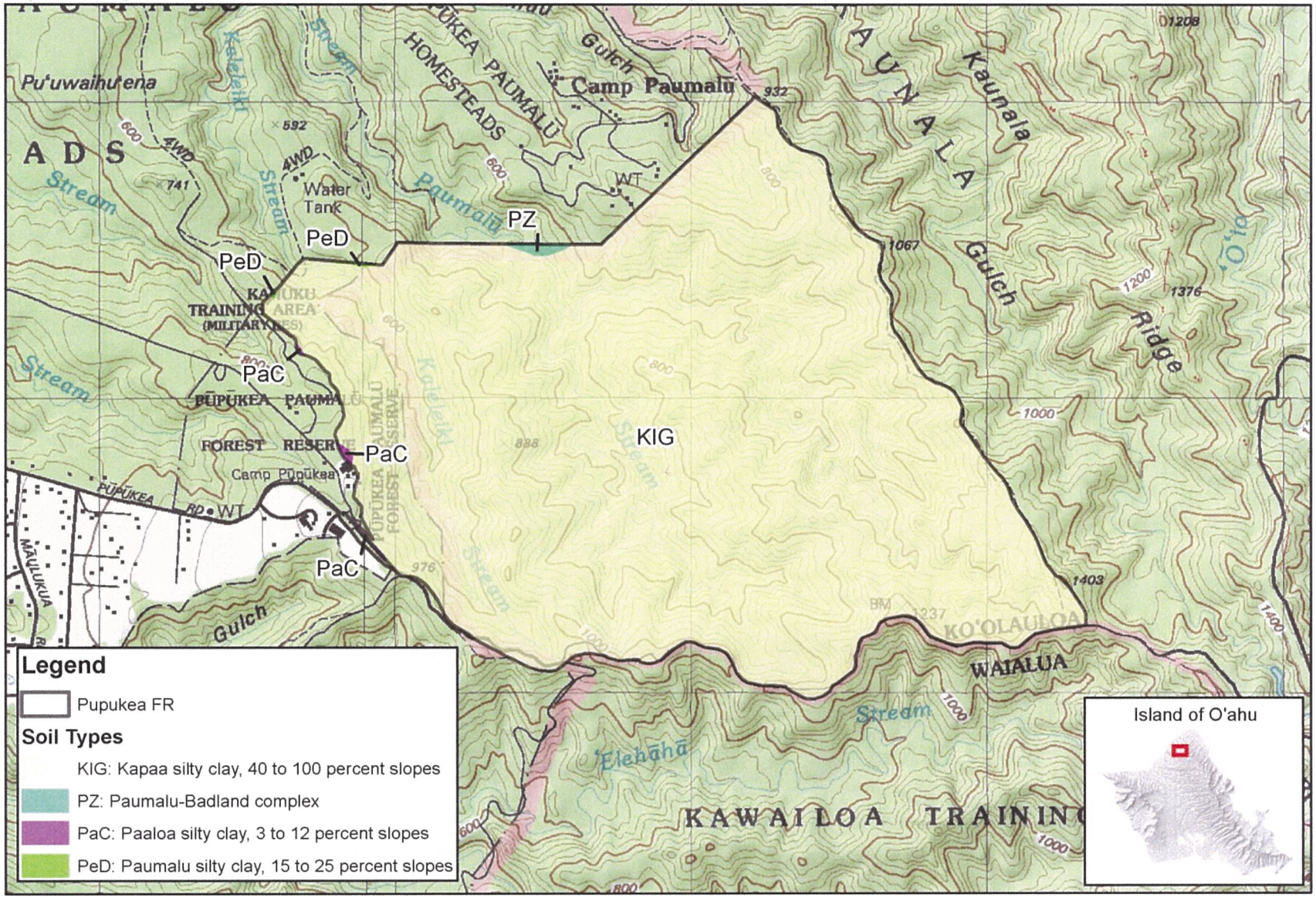


Figure 3: Pūpūkea Forest Reserve Soils (USDA, NRCS Web Soil Survey)



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Since 1903, the Division of Forestry has planted millions of trees statewide to replace forests that were lost due to fire, cattle grazing, and harvesting for fence posts and fuel wood for whaling ships and sugar mills. Non-native tree species were primarily used because early foresters concluded that they were more suitable to rapidly revegetate denuded sites than native species. Native species were also used, but in much smaller numbers (Skolmen, 1980). See Appendix B for more information on the specific plantings done in Pūpūkea FR.

Forest Reserve History: Pūpūkea FR was established by Governor's Proclamation on May 10, 1910, to protect the forest and increase the flow from several small springs and waterholes. According to a report that preceded the 1910 proclamation, the forest consisted of "ohia lehua and koa, with considerable lauhala in the lower part and a scattering of other trees, including some iliahi," (Hosmer 1910, p. 129). Pūpūkea FR was comprised of four main units: Water Reserves A (13.33 acres), Water Reserve B (13.4 acres), Water Reserve C (47.1 acres) and the main FR unit (790 acres). The water reserves were included in the forest reserve to provide additional protection to the existing water and natural resources in the area.

Water use:
Residents of the Pūpūkea-Paumalū Homestead Tract were interested in utilizing the surface water flowing from the forest reserve onto their lots. In 1910, they formed two water users associations, the Pūpūkea Water Users Association and the Paumalū Water Users Association. The Pūpūkea Water Users Association was issued a water license (GL741-A) in 1911 that allowed for utilization of 11/20ths of all natural running waters for a term of 50 years. The Paumalū Water Users Association was issued a similar license (GL1701) in 1925 for a term of 21 years. Both licenses covered the main forest reserve unit and Water Reserve C.

In 1943, the Attorney General issued an opinion stating that the license issued to the Pūpūkea Water Users Association in 1911 was nothing more than a revocable permit because it was not sold at public auction. As a result of the Attorney General's opinion, both associations were issued revocable permits (RP330 and RP338) in 1949 to continue to take water from the FR. The revocable permits were canceled in the 1960's as both associations had dissolved by this point.

In 1949, the Board of Commissioners of Agriculture and Forestry approved the removal of Water Reserves A and B from the FR. The water reserves were removed because most of the Homestead area was acquired by the Hawaiian Avocado Company, and the surrounding areas had been converted to pastureland. In 2007, both parcels were acquired by the DLNR to be set aside to the Division of State Parks for state park purposes. It was found that the parcels had not been formally withdrawn from the FR however, so EO 4437 was issued in 2013 to remove the parcels from the FR and set them aside to the Division of State Parks (Table 2). The parcels were added to the Pūpūkea-Paumalū State Park Reserve to increase public access and recreational opportunities. In 1964, a one-acre portion of Water Reserve C was withdrawn by EO 2155 for a reservoir site.

United States Army:
The United States Army (Army) has a long history of land use in Pūpūkea FR, using the area for training purposes prior to, during, and after World War II. In 1944, the Army was granted a permit that allowed them to use and occupy Water Reserve C for military purposes. The terms of the permit were retroactive and effective from December 7, 1941 to 6 months after the end of

the war. The permit allowed the Army to establish temporary structures for training purposes. In 1945, BSA expressed interest in using the buildings and camping facilities constructed by the Army in Water Reserve C for a summer camp. The Army had no objections and canceled their permit to allow BSA to obtain their own permit to use the area.

In 1964, the Army was issued General Lease No. S-3850 for military purposes in the main forest reserve area (TMK (1) 5-9-006:026). The lease is valid for a term of 65 years, and entitles entrance, construction activities, and sign posting in the FR. The Army is responsible for taking precautions to prevent forest fires and unnecessary damage to the natural resources in the reserve. Firing of weapons is allowed as long as they are not larger than .50 caliber, and 3.5-inch rockets or weapons of similar size are allowed as long as no forest fires are created. The lease also stipulates that the FR will be open to the public and under the control of the State of Hawai'i from dusk on Friday to midnight on Sunday, and from dawn to midnight on national holidays. The Army may obtain an exemption from this clause by notifying the public about training activities that must be conducted during specific weekends and holidays.

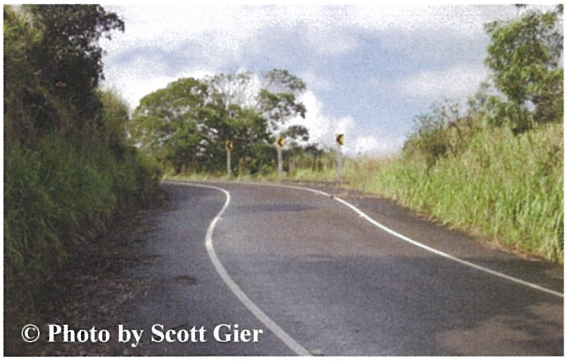


Figure 4: Drum Road in Pūpūkea FR

In 2006, the Board approved the issuance of a perpetual, non-exclusive easement to the Army for road right-of-way purposes over Drum Road in Pūpūkea FR. The U.S Army Engineer District was subsequently granted an interim construction right-of-entry onto Government lands for repairs to Drum Road while the easement documents were completed. The perpetual non-exclusive easement was never finalized.

In 2009, the Army paved the portion of Drum Road within the FR in support of Striker Brigade training. O'ahu Branch staff met with the Army to discourage the project, preferring the dirt road because it would be more manageable to maintain. The Army ultimately paved the road, classifying it as "road maintenance" which is an allowed activity under their lease agreement. In late 2014, early 2015, heavy rainfall resulted in soil erosion that undercut a portion of the paved road. The road was deemed impassable and has been closed since. DOFAW does not have the current resources to repair the road.

Boy Scouts of America:

The Boy Scouts of America also have a history of land use in Pūpūkea FR. In 1946, BSA was issued a 10-year use permit to use buildings and camping facilities built by the Army in Water Reserve C for a summer camp. Rights to the facilities and campsite were transferred to BSA from the Army. The permit allowed BSA to use the area as a campsite, occupy a portion of the main FR, perform tree planting, trail cleaning, and other maintenance work as authorized by the Board. The facility is now called Camp Pūpūkea. To secure long term interest in Camp Pūpūkea, BSA requested a long-term lease in 1964. BSA was granted a lease (S-3951) in 1966 for use of Water Reserve C for the duration of 55 years. BSA sought to acquire fee title of the two parcels that comprise Water Reserve C, so a land exchange with DLNR was executed in 2004. The parcels were formally withdrawn from the FR in 2011 by EO 4395.

Other notable items:

- 1946 - A truck from Fort Shafter was found cutting down Norfolk pines for Christmas trees without a permit.
- 1946 - Live ammunition was found along the roadsides, which was not permitted under the original lease.
- 1950 - One of the old army cabins under the Division's control was found to be used and locked by hunters. The cabins were open for use by hikers, but no exclusive use or locking was permitted.
- 1952 - The Hawaiian Electric Company was granted permission to construct a power line over a portion of the FR to serve the Mutual Telephone Company's Relay Service.
- 1952 - Harold Nakasone was issued a one-year revocable use permit to place one hundred colonies of bees in the FR for one year.
- 1953 - The Hawai'i Meat Co. and the Division of Forestry handled the repair of a deteriorated fence line discovered during an inspection as a 50-50 divide of materials and labor.
- 1954 - The Sunset Beach Community complained to the Board about a gate erected across the access road into the FR saying it limited public use. Construction of the gate was approved by the Board to stop pleasure rides and fence destruction.
- 2001 - Waimea Valley was given a key to the gate on the Pūpūkea access road to assist bikers involved in accidents related to their activities. There was one instance of misuse of that key by hunters who claimed they received the key from Waimea Valley.
- 2014 - Sunset Ranch proposed to build a parking lot on their property for the public who use the FR. Branch staff did not have any objections. To date however, construction has not begun.

Table 2: Summary of public land additions and withdrawals (A/W) for Pūpūkea Forest Reserve See Figure 6 for map descriptions. Data relating to these items are filed at the DOFAW Administrative Office and the State Survey Office.

Action	Date	A/W	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Governor's Proclamation	10-May-1910	A	Establishment of Pūpūkea Forest Reserve	864	2137	5-9-006:026, 5-9-006:007, 5-9-005:071, 5-9-:005:002
Executive Order 2155	28-Jun-1964	W	Removal of section of land within Water Reserve C for the purpose of a reservoir site	0.942	13939, 13940	5-9-005:071
Executive Order 4395	15-Dec-2011	W	Removal of lands, Parts 1 and 2 of remainder of Water Reserve C, Pūpūkea	64.80	25132	5-9-005: 002 & 077
Executive Order 4437	23-Sep-2013	W	Removal of Water Reserve A and Water Reserve B, Paumalū	27.50	25298	5-9-006: 003 & 007

Kuleana Parcels: None.

Documented Activities/Leases/Deeds/Permits: Documentation has been found for land use agreements involving lands of the Pūpūkea FR (Table 3).

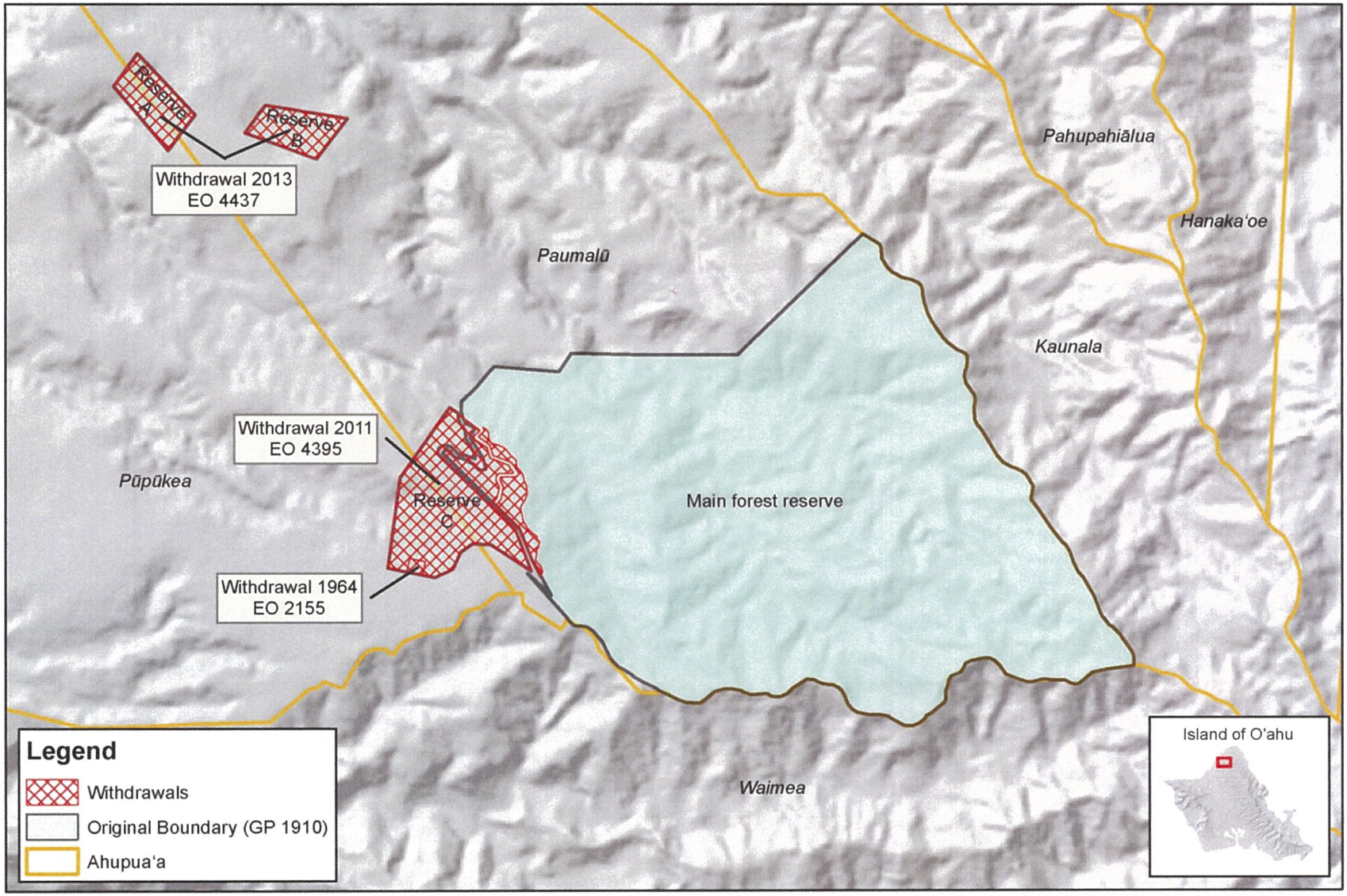
Table 3: Historical and current land use agreements in Pūpūkea Forest Reserve

Type of Action	Action Number	Duration	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Lease	GL-741A	16-Feb-1911 to 1-Feb-1961	Pūpūkea Water Users Association, Limited	837.1	n/a	Not specified
Lease	GL-1701	30-Mar-1925 to 30-Mar-1946	Paumalū Water Users Association, Limited	837.1	n/a	Not specified
Use Permit	n/a	19-Mar-1946 to 31-Dec-1956	Boy Scouts of America (BSA)	n/a	n/a	Not specified
Revocable Permit	n/a	19-Mar-1946	Boy Scouts of America (BSA) – rights transferred to BSA from Army	n/a	n/a	Not specified
Revocable Permit	328	19-Apr-1949 to Jun-1960	Paumalū Water Users Association, Limited (under terms and condition of GL-1701)	837.1	n/a	Not specified
Revocable Permit	330	6-Jun-1949 to Apr-1965	Pūpūkea Water Users Association, Limited (under terms and condition of GL741A)	837.1	n/a	Not specified
Lease	Gl3850	17-Aug-1964 to 16-Aug-2029	USA: Army Training Area	700	n/a	5-9-006:026
Lease	S-3951	11-Mar-1966 to 11-Mar-2012	Boy Scouts of America (BSA)	64.8	n/a	5-9-005: 002 & 077
Perpetual Easement	LOD 28536	28-Jun-2005	Hawaiian Electric Co, Inc.	11.02	Govt. Survey Registered Map H.S.S. Plat2034A	5-9-006:026

E. Vegetation: According to the Hawai'i Gap Analysis Program (2005), the vegetation of Pūpūkea FR is highly degraded and dominated by non-native forest cover (80% of total land cover, Figure 8). Much of this area consists of invasive species such as satin leaf (*Chrysophyllum oliviforme*), strawberry guava (*Psidium cattleianum*), and Guinea grass (*Urochloa maxima*). However, native stands of closed 'ōhi'a lehua (*Metrosideros polymorpha*) forest, open 'ōhi'a lehua/koa (Acacia koa) forest, and patches of 'uluhe (*Dicranopteris linearis*) shrubland are present in the southeast

Figure 5: Mixed native and non-native forest in Pūpūkea FR

Figure 6: Historical changes to public lands in Pūpūkea Forest Reserve. Year of addition/withdrawal and ahupua'a indicated.



portion of the FR. Other less dominant native plant species include ʻiliahi (sandalwood, *Santalum freycinetianum*), halapepe (*Chrysodracon halapepe*), (*Wikstroemia oahuensis*), and others. For a more detailed list of plant species found in the reserve, see Appendix A.

DOFAW's Draft Management Guidelines for the island of Oʻahu consist of four vegetation classifications (see Appendix D for descriptions). The vegetation in Pūpūkea FR is classified as V-3 (Considerable Disturbed Area) (Figure 9). Management objectives for V-3 areas are to prevent activities or intensities of use that result in degradation of unique native species and secondary forest resources (water supply erosion control & aesthetic values). Permitted activities may have high levels of disturbance, as long as they don't negatively impact remaining native plant populations and have an eventual net benefit to other resources. Native plant conservation may be focused at a species, rather than an ecosystem level. There are approximately 782 acres of V-3 in the reserve. DOFAW is in the process of updating its Management Guidelines.

Rare and Endangered Plants:
Rare and endangered species in Hawaiʻi are listed under the Federal Endangered Species Act (ESA) and the State Endangered Species Law, Chapter 195D, HRS. There are six plant species currently known to exist in Pūpūkea FR (Table 9, Figure **10**) that have been placed on the endangered species list. These species include nīoi (*Eugenia koolauensis),* ʻakoko *(Euphorbia rockii),* nanu (*Gardenia mannii*), ʻohe ʻohe (*Polyscias gymnocarpa*), kaulu (*Pteralyxia macrocarpa*), and pilo kea *(Platydesma cornuta var cornuta.)* Koʻokoʻolau (*Bidens campylotheca ssp. campylotheca)* is recognized as a species of concern (SOC) by DOFAW. A SOC is a species for which there is concern or uncertainty about its status. SOC are not listed under the ESA, therefore they do not afford any protections under the Act.

Pilo kea is managed by the Plant Extinction Prevention Program (PEPP) of Hawaiʻi. The mission of PEPP is to protect the rarest native Hawaiian plants from extinction. PEPP works to reverse the trend toward extinction by managing existing populations, collecting seeds and establishing new populations with a focus on species that have fewer than 50 plants remaining in the wild. Members of the Hawaiʻi Rare Plant Restoration Group, of which DOFAW is a founding member, provides oversight to PEPP and provides botanical expertise when necessary. PEPP regularly collaborates with over 60 conservation partners and landowners to protect PEPP species under their jurisdiction.

Figure 7: Rust damage on Eugenia koolauensis

The Oʻahu Army Natural Resource Program (OANRP) manages two of the endangered species in the reserve. The main goal of OANRP is to effectively balance the requirements of the U.S. Army training mission with its natural resource responsibilities. OANRP is responsible for overseeing compliance of various environmental laws, and is required to protect federally listed species that may be impacted due to the Army's training operations. OANRP maintains a rare plant exclosure fence built for the endangered *Eugenia koolauensis* by DOFAW. Given that the population of *Eugenia koolauensis* has been severely affected by *Puccinia psidii*, a pathogenic rust, OANRP's immediate strategy is to establish a living collection in their nursery by collecting cuttings. All plants within the exclosure have been

Figure 8: Vegetation cover of Pūpūkea Forest Reserve. (Hawai'i GAP Analysis Program 2005)

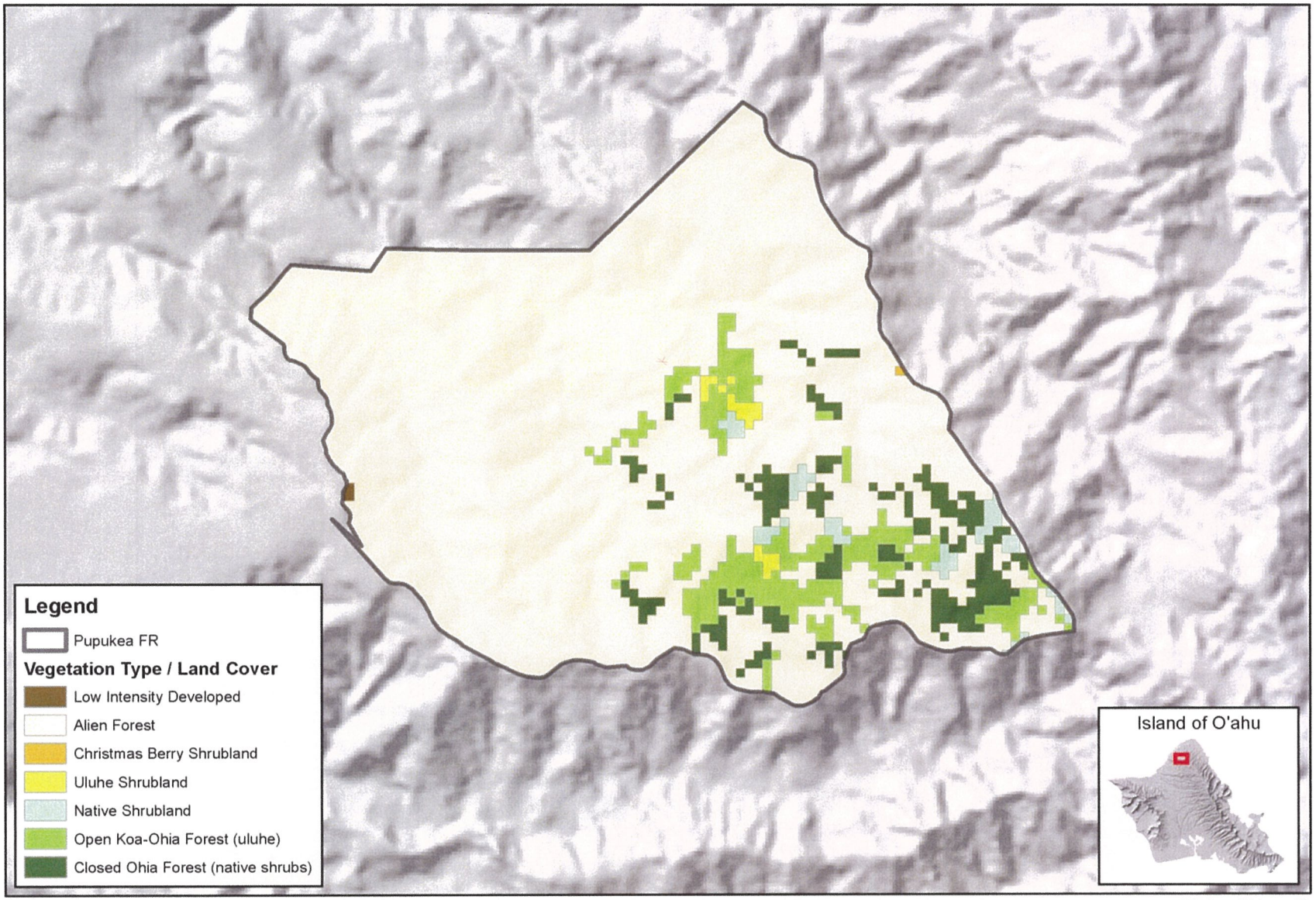
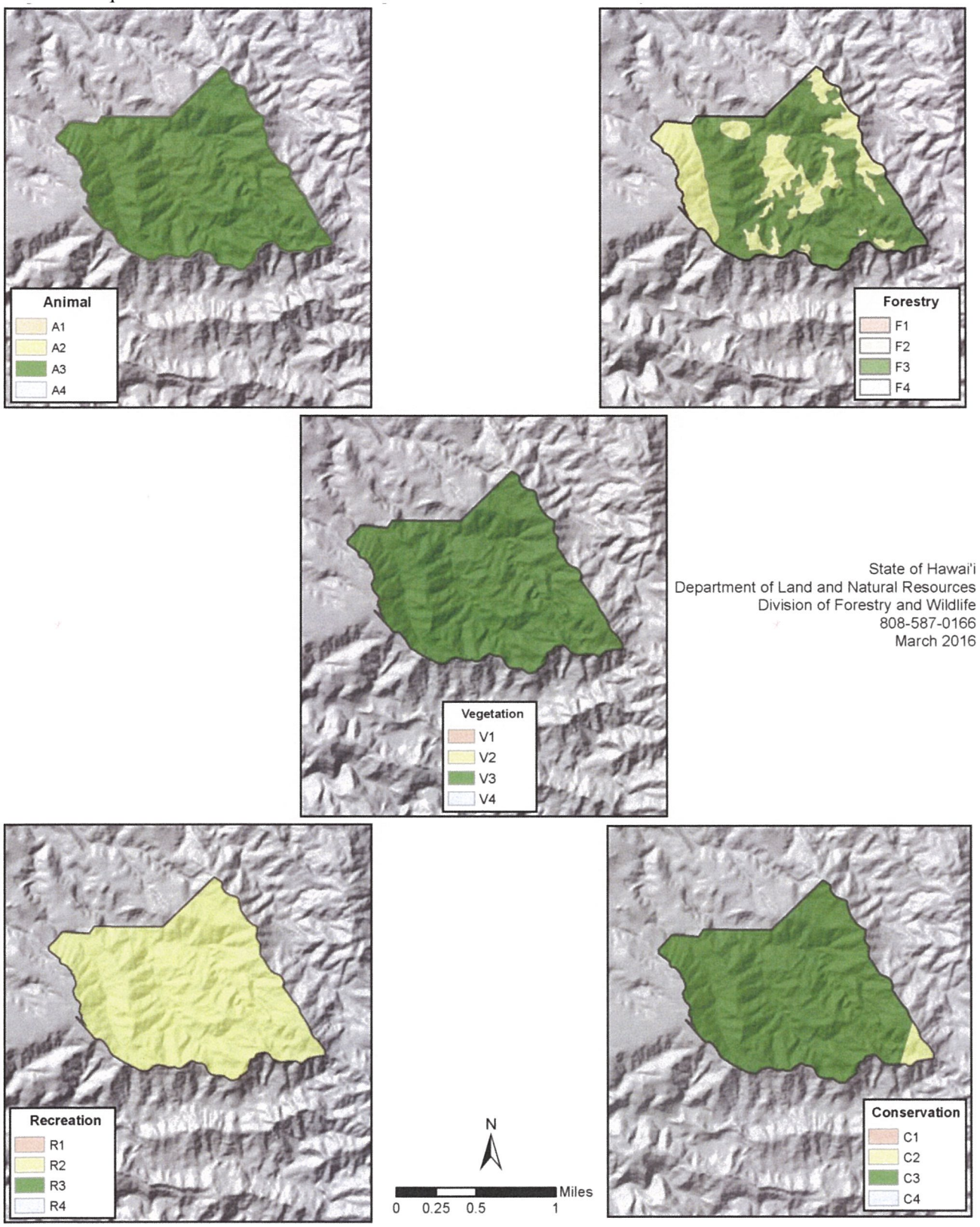


Figure 9: DOFAW's 2015 Draft Management Guidelines for Pūpūkea Forest Reserve. See Appendix D for class descriptions.



accounted for during census monitoring in 2015 and 2016. The fence is checked and maintained quarterly, but other habitat protection and management have been discontinued until the wild plants and outplants can be protected from infection of *Puccinia psidii* or be sufficiently controlled with legal application of fungicide chemicals. No outplanting is planned for the next 5 years. Work done by OANRP to manage *Eugenia koolauensis* in the Pūpūkea FR vicinity is outlined by their five-year rare plant plan (http://manoa.hawaii.edu/hpicesu/DPW/2014_YER/default.htm).

To minimize potential adverse effects to listed plants, the following actions will be considered should any proposed activities occur outside existing disturbed areas: a botanical survey of the proposed activity area including a 200 foot buffer, flagging of all listed plants within the survey area, avoidance of cutting or removing vegetation within 200 feet of listed plants. Additional information on state and federally listed endangered species can be viewed on the USFWS website (http://www.fws.gov/endangered/). USFWS also provides recovery plans for select species which can also be found on their website (http://www.fws.gov/endangered/species/recovery-plans.html).

Table 4: Rare and endangered plants that have been observed within Pūpūkea FR (Hawai'i Biodiversity and Mapping Program 2008). Species listed may have more than one observation. An observation is considered historical if it occurred more than 30 years ago. Also see Figure 10.

	Species	Current/ Historical	ESA Listing Status	Mgmt Program
Plants	*Euphorbia rockii* ('Akoko)	Current	Endangered	DOFAW
	Eugenia koolauensis (Nīoi)	Current	Endangered	OANRP
	Gardenia mannii (Nanu)	Current	Endangered	OANRP
	Polyscias gymnocarpa ('Ohe 'ohe)	Current	Endangered	DOFAW
	Pteralyxia macrocarpa (Kaulu)	Current	Endangered	DOFAW
	Bidens campylotheca ssp. campylotheca (Ko'oko'olau)	Current	Not listed, but recognized as a species of concern	DOFAW
	Platydesma cornuta var cornuta (Pilo kea)	Historical	Endangered	PEPP

Plant Critical Habitat: As outlined by the US-ESA, critical habitat is defined as "specific geographic areas, whether occupied by a listed species or not, that are determined to be essential for the conservation and management of listed species, and that have been formally described in the Federal Register," (U.S. Fish and Wildlife Service, 2014). There is no designated plant critical habitat located within Pūpūkea FR (Figure **10**).

Timber Species: The first commercial forest product industry in Hawai'i started in 1791, with the harvesting of sandalwood, or 'iliahi. Sandalwood is prized for its fragrant wood and is a valuable commodity in national and international trade. By the late 1830's, the six endemic species of sandalwood were largely exhausted from the forests of Hawai'i (Merlin and Van Ravenswaay, 1990). Since the sandalwood trade, a sustainable export market for Hawai'i grown wood has not developed in Hawai'i due to less expensive wood-based building materials that are available from the Pacific Northwest and Southeast Asia.

There are a number of mid to large-scale timber plantations both on public and private lands throughout the state. In the late 1800's, ranchers and sugar plantations began replanting efforts to replace the forests that were lost due to fire, cattle grazing, and harvesting for fence posts and

Figure 10: Threatened and Endangered Species in Pūpūkea Forest Reserve. (Hawai'i Biodiversity Mapping Program, 2008)

fuel wood for whaling ships and sugar mills. The Territorial government also had a tree planting program in which they utilized both introduced and native trees species. Reforestation was primarily done to protect and replenish the fresh water resources, but was also done to conduct trials with commercially valuable timber species.

According to a list of the recorded plantings made by the Division between 1910 and 1960, over 283,000 trees were planted in Pūpūkea FR on government and privately owned lands (Skolmen, 1980). The largest majority of trees planted were silk-oak (*Grevillea robusta*, 46%), paperbark (*Melaleuca quinquenervia*, 13%), and koa (*Acacia koa*, 12%) (see Appendix B). This list does not indicate which species survived.

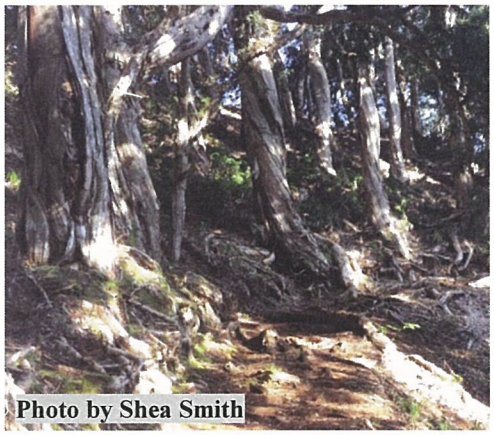


Figure 11: Paperbark trees in Pūpūkea FR

Mylar maps of tree plantations made from aerial photography show that 25 plantation plots were established in Pūpūkea FR by 1967 (Klingensmith, 1967). These plots were planted with 6 species: ironwood (*Casuarina equisetifolia*), blackbutt eucalyptus (*Eucalyptus pilularis*), brushbox (*Lophostemon confertus*), paperbark (*Melaleuca quinquenervia*), swamp mahagony (*Eucalyptus robusta*), and lemon-gum eucalyptus (*Eucalyptus citriodora*) (Nelson et al., 1966). These stands were established prior to 1950 and encompass approximately 166 acres (Figure **12**) (Klingensmith, 1967).

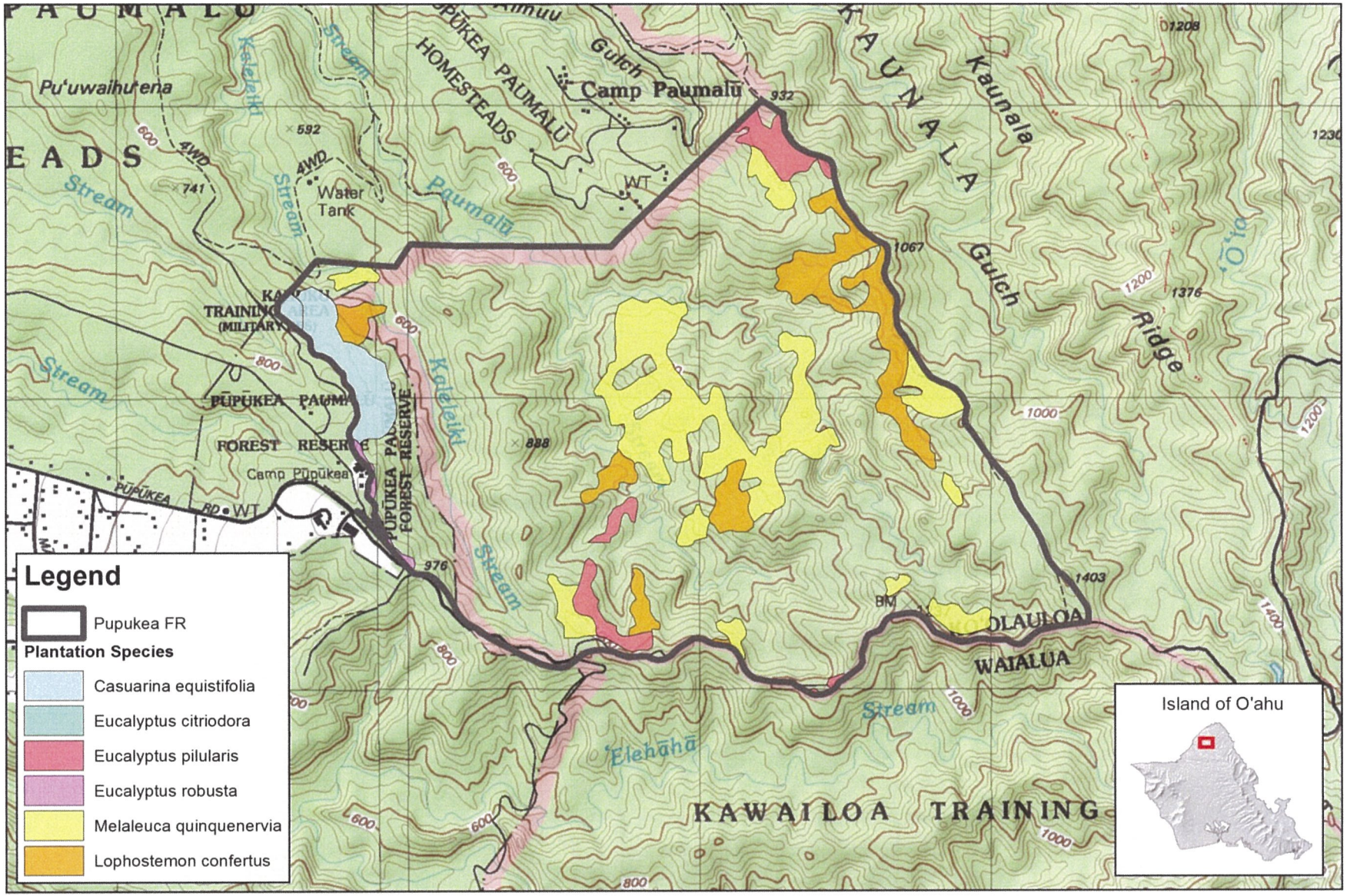
DOFAW's Draft Management Guidelines separate forestry management into four categories (see Appendix D for classes and class descriptions). Pūpūkea FR contains two of four possible Forest Management categories: F2 and F3 (Figure 9). Approximately 157.74 acres are classified as F2, where limited small-scale (no more than 5% of the total F2 acreage for each forest reserve, annually) commercial timber harvesting or salvage is allowed . Harvesting of non-timber forest products is also allowed. Approximately 696.57 acres are classified as F3, where limited non-commercial timber harvesting and commercial timber salvage is allowed. Harvesting of non-timber forest products is generally not allowed and will be considered on a case by case basis for improving forest health, watershed protection, cultural uses and conservation efforts. All classification levels have restrictions regulated by DOFAW and require appropriate permits and/or licenses. DOFAW is in the process of updating its Management Guidelines.

The Division does not have any current plans for large scale timber harvesting in Pūpūkea FR, but may issue commercial salvage permits for the purpose of purchasing and removing dead or hazardous trees. Each application for a commercial salvage permit shall be considered on its own merits, including its effect on the premises and the public's use and enjoyment of the forest reserve. 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.

F. Wildlife:

Native Wildlife: The occurrence of native animal species in Pūpūkea FR is limited to small populations of common species. During a comprehensive bird survey of Pūpūkea FR conducted

Figure 12: Plantation timber stands in in Pūpūkea Forest Reserve. (Aerial photo interpretations Klingensmith, 1967)



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in 2015 (Table 5, Appendix C), the O'ahu 'amakihi (*Hemignathus flavus*) and 'apapane (*Himatione sanguinea*) were found to be uncommonly present (VanderWerf, 2015). Pūpūkea FR contains valuable native montane forest habitat for both native forest birds. One endangered bird species, the O'ahu 'elepaio (*Chasiempis ibidis*), was observed in the FR in 1965 (Hawai'i Biodiversity and Mapping Program, 2005) but was not detected in the most recent survey.

In May 2015, a survey for the Hawaiian hoary bat, 'ope'ape'a, was also conducted. Although the presence of the native bat was not detected during the survey (VanderWerf, 2015), the amount of time spent (7 nights) was short. The native bat has been regularly detected in nearby areas, including the Kawailoa Wind Farm, and is likely to occur or transit near Pūpūkea FR. Additional surveys need to be conducted to determine if the hoary bat is present in the FR. The endangered Oceanic Hawaiian damselfly (*Megalagrion oceanicum*) was last observed in Pūpūkea FR in 1928. A damselfly was recently observed near Opaeula summit in a pristine reach of stream. A survey for invertebrate present in the FR should be considered.

Figure 13: View of the Kawailoa Wind Farm from Pūpūkea FR

Non-native wildlife: A wide variety of introduced birds exist across the island of O'ahu. Eighteen species of non-native birds (Table 6, Appendix C), including a mix of birds usually found in the forest and others more typical of urban or open habitats, were documented during the bird survey (VanderWerf, 2015). Invasive species such as mosquitos, rats, pigs, and mongoose are also present in Pūpūkea FR. Non-native wildlife competes with native species for resources and serve as reservoirs for diseases that affect native bird populations.

Table 5: Rare and endangered animals that have been observed within Pūpūkea FR (Hawai'i Biodiversity and Mapping Program 2008). Species listed may have more than one observation. An observation is considered historical if it occurred more than 30 years ago. Also see Figure 9.

	Species	Current/ Historical	US-ESA Listing Status	Mgmt Program
Animals	*Chasiempis ibidis* (O'ahu 'elepaio)	Historical	Endangered	DOFAW
	Megalagrion oceanicum (Oceanic Hawaiian damselfly)	Historical	Endangered	DOFAW

Animal Critical Habitat:
There is no animal critical habitat located in Pūpūkea FR.

Table 6: Wildlife found in Pūpūkea FR.

Species	Common name	Native/Non-native	Game species
Birds			
Acridotheres tristis	common myna	Non-native	No
Amazona viridigenalis	red-crowned parrot	Non-native	No
Cardinalis	northern cardinal	Non-native	No
Copsychus malabaricus	white-rumped shama	Non-native	No
Estrilda astrild	common waxbill	Non-native	No
Garrulax canorus	melodious laughing thrush	Non-native	No
Haemorhous mexicanus	house finch	Non-native	No
Hemignathus flavus	O'ahu 'amakihi	Native	No
Himatione sanguinea	'apapane	Native	No
Horornis diphone	Japanese bush warbler	Non-native	No
Leiothrix lutea	red-billed leiothrix	Non-native	No
Lonchura punctulata	nutmeg mannikin	Non-native	No
Paroaria coronata	red-crested cardinal	Non-native	No
Pycnonotus cafer	red-vented bulbul	Non-native	No
Pycnonotus jocosus	red-whiskered bulbul	Non-native	No
Spilopelia chinensis	spotted dove	Non-native	Yes
Thectocercus acuticaudatus	blue-crowned parakeet	Non-native	No
Zosterops japonicus	Japanese white-eye	Non-native	No
Mammals			
Sus scrofa	pig	Non-native	Yes
Rattus spp.	rat	Non-native	No
Felis catus	cat	Non-native	No
Herpestes auropunctatus	mongoose	Non-native	No
Mus musculus	house mouse	Non-native	No

G: Access: There is public access to Pūpūkea FR via Pūpūkea Road (Figure 17).

Figure 14: Entrance gate to Camp Pūpūkea on left; public trail access to Pūpūkea FR on right

Vehicular Access: Pūpūkea FR is located at the end of Pūpūkea Road, which terminates at the gated entrance to the FR. Beyond the gate, the road continues as a dirt road along the southern boundary of the FR, providing principal vehicular access for management purposes. The dirt access road meets up with the paved military training road called Drum Road, which runs along the southern boundary of the FR and continues onto the military owned land adjacent to the FR. Upon reaching the eastern boundary of the FR, a four-wheel drive jeep road follows the northeastern boundary of the FR until it reaches Camp Paumalū (Girl Scout camp). The military has gate keys to utilize the jeep road. Public vehicular access is not permitted in the reserve; vehicular access is for management purposes only.

Trails: Nā Ala Hele, the State of Hawai'i trail and access system (https://hawaiitrails.org/trails/#/) oversees 38 trails on O'ahu including the Kaunala trail, the only trail within Pūpūkea FR

(Figure 17). The trail is 2.5 miles (4.0 km) long and its use is restricted to hikers and mountain bikers. Commercial trail tour activities are not permitted. The trail begins 0.6 miles from the gated entrance and traverses the gulches between the primary FR access road and the jeep road leading to Camp Paumalū. The current lease with the U.S. Army allows for hiking on weekends and state and national holidays unless otherwise posted. The purpose of the limited public access days was to allow the Army to train during the week. Although the FR is only open to the public on weekends, the area is used by members of the public for recreation seven days a week. As of yet, a conflict between training and public recreation has not surfaced.

Figure 15: Na Ala Hele - Kaunala Trail

Designated Helicopter Landing Zone: A helicopter landing zone is located approximately 250 yards northwest of Fox Gate up the jeep road (Figure 18).

Restricted Watershed: Pūpūkea Forest Reserve is not designated as restricted watershed.

H: Infrastructure: A 12'x12' shelter with a picnic table can be found along Drum Road, approximately 1.65 miles mauka of the FR entrance gate (Figure **18**). This structure provides hikers with a destination and rest stop while hiking. There is one 0.5 acre *Eugenia Koolauensis* exclosure in the FR, and one bridge along the Kaunala trail. Other infrastructure includes 4 gates, 1 landing zone, and a hunter check in station. A Hawaiian Electric Company easement also runs north to south through the western portion of the FR.

Figure 16: Shelter and picnic table in Pūpūkea FR

I: Archaeological and Historical Sites: An archaeological inventory survey has not been conducted in Pūpūkea FR, but adjacent land surveys have shown there to be numerous pre and post-contact archaeological resources. Considering the FR's active freshwater streams and proximity to Pu'u O Mahuka Heiau (makai of the area) and the ahupua'a of Waimea, an archaeological inventory survey should be carried out in the region prior to any management activities conducted in the FR. There are no known historic burial sites within Pūpūkea FR. 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, DOFAW will immediately cease activity in the area, protect the discovery from further disturbance, and contact SHPD for further advisement.

If significant historical sites are present and require mitigation, a mitigation or preservation plan will need to be developed and submitted to SHPD for review and acceptance prior to initiation of project work.

Figure 17: Public Access Routes to Pūpūkea Forest Reserve.

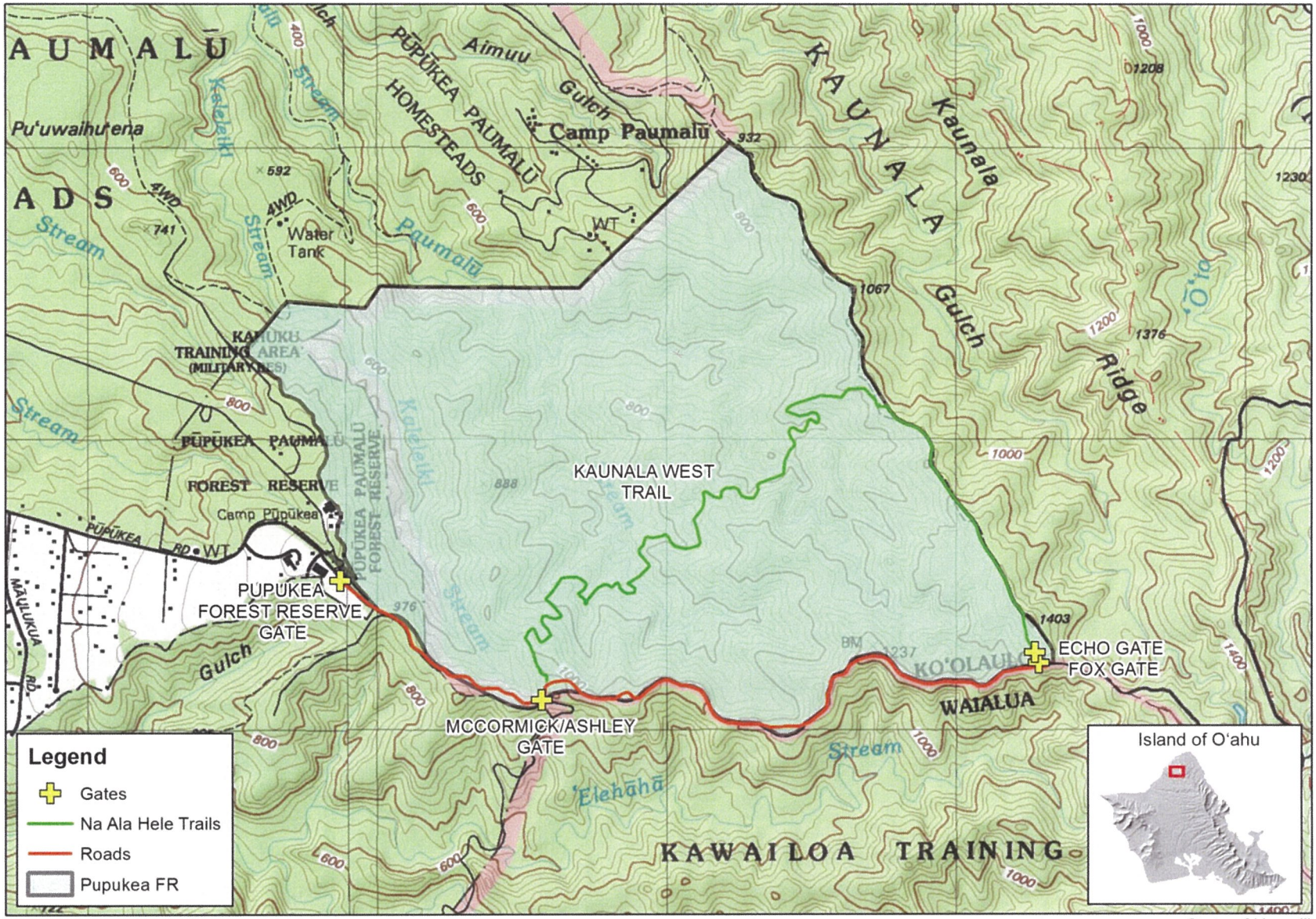

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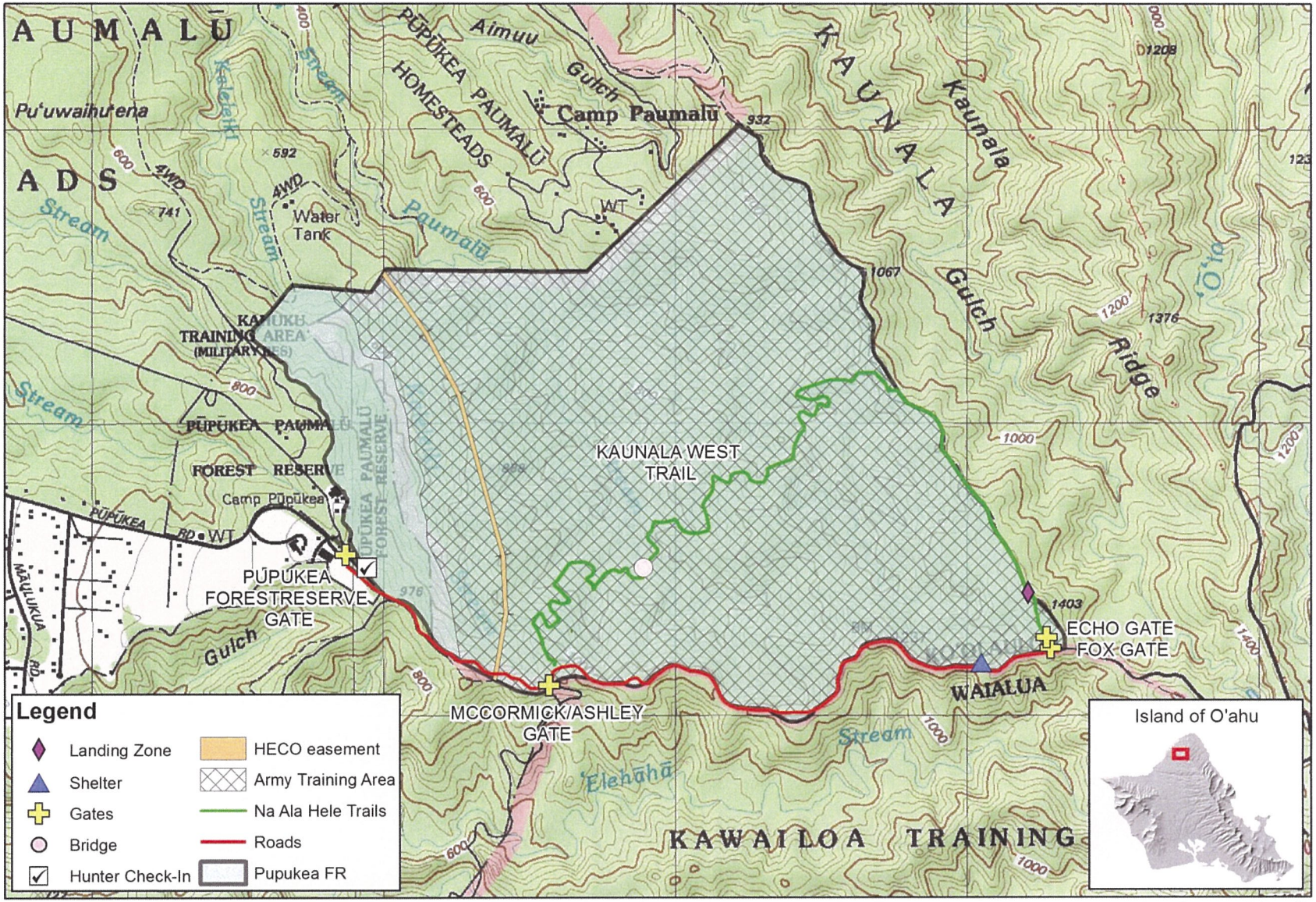
Figure 18: Infrastructure of Pūpūkea Forest Reserve.



J. Public Use:

General Recreation: DOFAW's Draft Management Guidelines consist of four categories for Recreation Management (see Appendix D for descriptions). Pūpūkea FR is designated as R2 (781.97 acres); these are areas where outdoor recreation is limited or controlled, or where it may be integrated with other uses. Facilities are not highly developed and include trails and trail shelters (Figure 9). DOFAW is currently in the process of updating its Management Guidelines.

Hunting: DOFAW manages public hunting on FR lands on O'ahu by regulation of hunting days, seasons, bag limits, and hunting methods. The Division of Conservation and Resources Enforcement enforces hunting regulations found in Chapter 121, HAR Rules Regulating the Hunting of Wildlife on Public Lands and Other Lands, Chapter 122, HAR Rules Regulating Game Bird Hunting, and Chapter 123, HAR Rules Regulating Game Mammal Hunting. Pūpūkea FR comprises 759 acres of the Division's Game Mammal Hunting Area C for the island of O'ahu (Figure 20). A hunter check-in station is located just inside the Pūpūkea FR Gate (Figure **18**). Hunters are required to check in before hunting and check out after hunting at this check-in station. There is no hunting allowed within 100 yards of the BSA camp. Hunting is allowed for feral pigs and feral goats using rifles, shotguns, handguns, knives, spears, bow & arrows, and dogs. Dogs must be kept under physical restraint and control at all times except when actively pursuing game. There is a bag limit of two pigs and two goats of either sex per hunter per day but there is no season limit. Hunting Area C is open year round but only on weekends and state holidays. There is no game bird hunting permitted within the FR.

Figure 19: Hunter check-in station in Pūpūkea FR

DOFAW's Draft Management Guidelines separate Game Animal Management into four categories (see Appendix D for descriptions). Lands within Pūpūkea FR (781.97 acres) are classified as A-3, where game control is managed through public hunting to protect native plant communities and watersheds (Figure 9). DOFAW is currently in the process of updating its Management Guidelines.

Camping: Camping along Kaunala trail within 10 feet of the center of the trail is allowed with a permit. Campsites are not designated. Camping permits are available for weekends and holidays at a fee. These permits are available online at https://camping.ehawaii.gov/.

Fishing: No fishing opportunities are available in this forest reserve.

Hiking: Hiking opportunities include the paved and unpaved access roads and the Nā Ala Hele Kaunala trail. See section G above for more details.

Horseback Riding: Horseback riding is not allowed in Pūpūkea FR. **Motorized Vehicles:** Dirt bikes and ATVs are not allowed in Pūpūkea FR.

Non-motorized Vehicles: Non-motorized mountain bikes may be used on access roads and Kaunala Trail.

Non-Timber Forest Product Collection: Non-timber forest products may be collected within the forest reserves. Examples include, but are not limited to:

a. Ferns
b. Flowers
c. Fruits
d. Guava *(Psidium* spp.) poles

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 104, 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 Products Fee Schedule for information on personal versus commercial use quantities, as well as current commercial use pricing.
http://dlnr.hawaii.gov/forestry/files/2013/09/Forest-Product-Fee-Schedule.pdf

Collection of:

1. Listed threatened, endangered, or other rare species;
2. Common invertebrate species; or
3. Any migratory bird species,

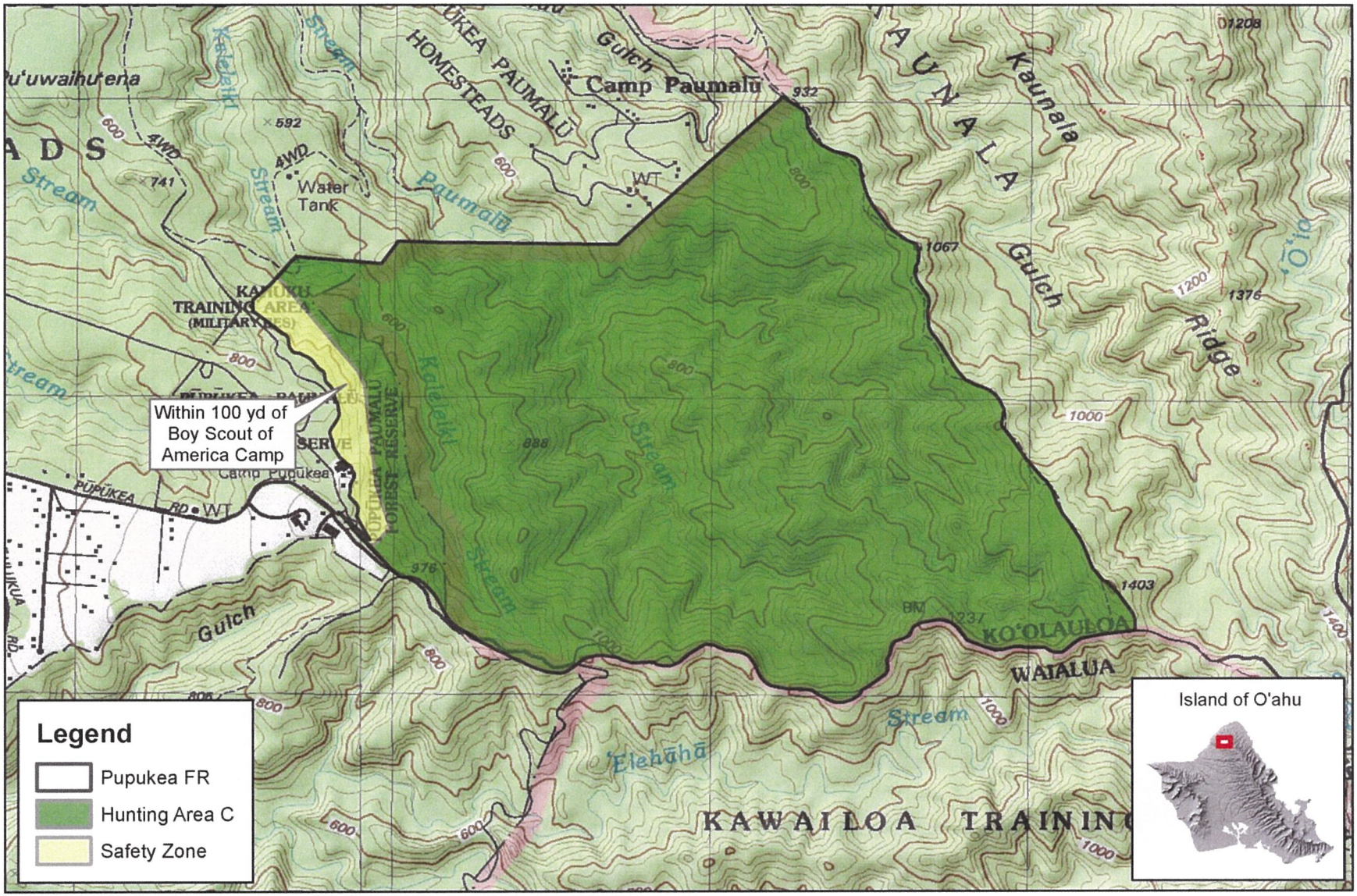
are prohibited under state laws Chapter 183D and 195D, HRS and subject to regulation under applicable HAR. Applications for permits for such activities may be submitted to the "Administrator," at the DOFAW Honolulu office. In these cases, a separate Access Permit may be required which is obtained through the Branch Manager at the DOFAW O'ahu office. Both addresses follow:

Administrator
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, HI 96813
Phone (808) 587-0166
O'ahu Branch Manager
Division of Forestry & Wildlife
2135 Makiki Hts. Drive
Honolulu, HI 96822
Phone: (808) 973-9784

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. In the Constitution of the State of Hawai'i, Article XII, Section 7, "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." Any inquiries regard traditional and customary rights, please contact Forestry Manager at the DOFAW O'ahu Office:

Figure 20: Game mammal public hunting area in Pūpūkea Forest Reserve.



Forestry Manager
Division of Forestry and Wildlife
2135 Makiki Hts. Drive
Honolulu, HI 96822
Phone: (808) 973-9784

K. Threats:

Plants: Invasive plants are non-native species that can invade natural areas, grow and reproduce rapidly, reduce biodiversity and alter ecosystem functions. Invasive plants presently found in Pūpūkea FR or adjacent areas that have some of the greatest potential to impact, disrupt, and alter the ecosystem are listed in the table below. These species have been identified by Hawai'i Pacific Weed Risk Assessment (HPWRA) as having a high risk of causing ecological or economic harm. For more information on the HPWR, please visit https://sites.google.com/site/weedriskassessment/assessments.

Some of these species are also designated as a noxious weed by the Hawai'i Department of Agriculture. A noxious weed is defined as a plant species which is, or likely may 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.

Table 7: Invasive plant species that occur in or near Pūpūkea FR

Potential impact	Species	Common name	HPWRA Score	Risk Rating	Official State or Federal Listing
Ecosystem altering	*Chromolaena odorata*	Devil weed	28	High	Hawai'i Noxious Weed List
	Falcataria moluccana	Albizia	8	High	none
High impact	*Angiopteris evecta*	Mule's foot fern	8	High	none
	Ardisia elliptica	Shoebutton ardisa	11	High	Hawai'i Noxious Weed List
	Chrysophyllum oliviforme	Satin leaf	7	High	none
	Casuarina equisitifolia	Ironwood	21	High	none
	Heliocarpus popayanensis	Moho	7	High	none
	Melochia umbellata	Melochia	7	High	none
	Psidium cattleianum	Strawberry guava	18	High	none
	Schefflera actinophylla	Octopus tree	13	High	none
	Urochloa maxima	Guinea grass	17	High	none

Many of these invasive plants have the potential to spread or be introduced from adjacent areas via animals, military training vehicles, and recreational activities such as hiking, biking, and motocross. For example, OANRP has observed that illegal motocross activity fosters the spread of devil weed in the Kahuku Training Area. One immature plant was found within the *Eugenia koolauensis* fence in February 2017. For more information on these invasive species, please visit http://dlnr.hawaii.gov/hisc/info/invasive-species-profiles/

Animals: Non-native animals that have the potential to disrupt the ecosystem in Pūpūkea FR include:

- *Felis catus* (cats) - Prey on native and game birds and can be vectors of disease
- *Sus scrofa scrofa* (pigs) - Cause vegetation damage and erosion
- *Rattus* spp. (rats) - Predate on native plant fruits/seeds and birds
- *Mus musculus* (mice) - Predate on native plant fruits/seeds
- *Herpestes javanicus* (mongoose) - Predate on native and game birds
- *Aedes* spp., *Culex quinquefasciatus, Wyeomyia mitchelli* (Mosquitoes) - Vectors of disease
- *Trioceros jacksonii* (Jackson's chameleon) - Predate on native insects

Transport and release of any injurious wildlife is restricted by Chapter 124, HAR Rules Regulating Indigenous Wildlife, Endangered and Threatened Wildlife, Injurious Wildlife, Introduced Wild Birds, and Introduced Wildlife. Any non-native has the potential to pose a threat to native flora and fauna.

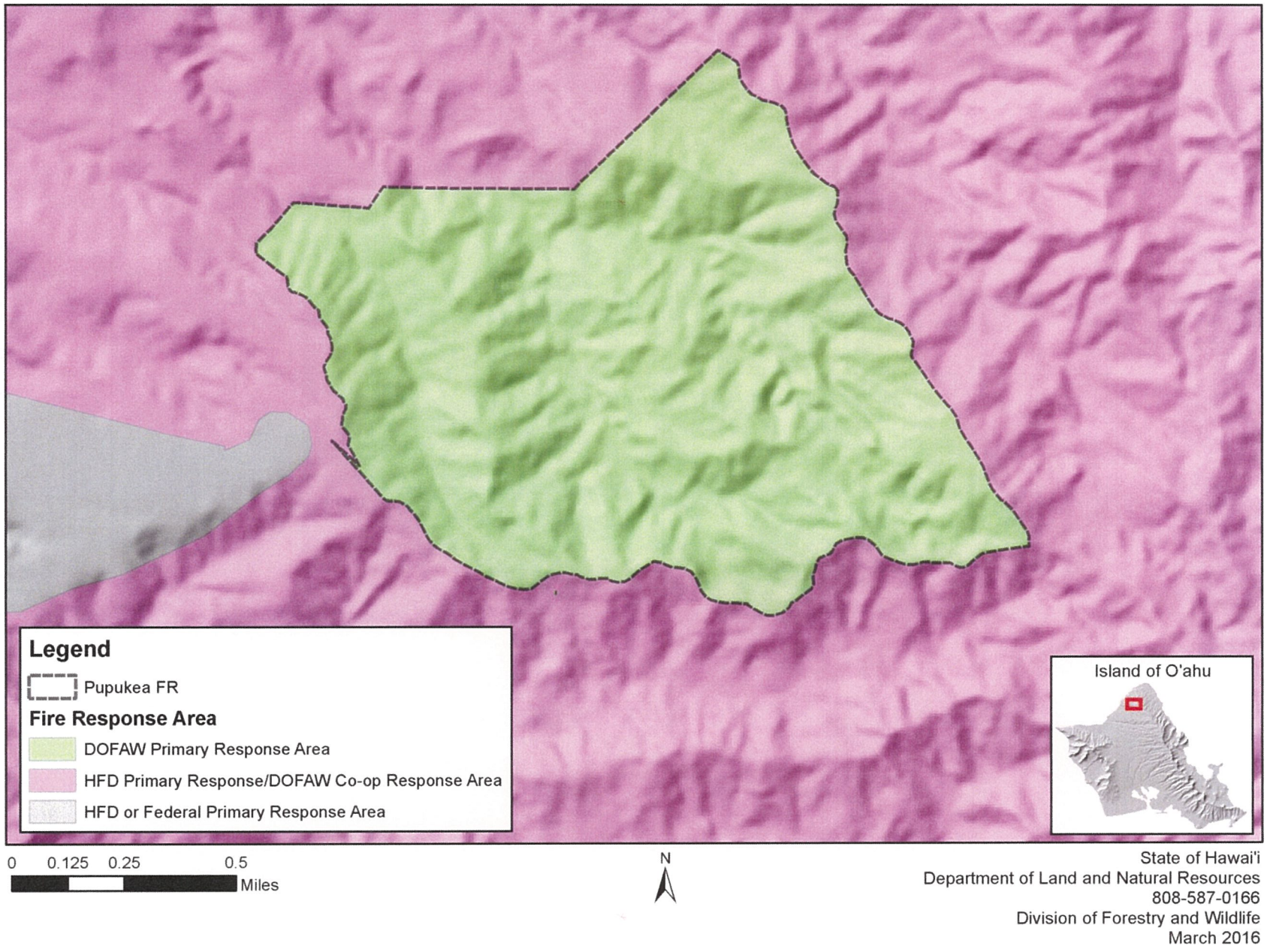
Fire: Native ecosystems in Hawai'i are not adapted to wildfire with the majority of plant species not being able to regenerate after a fire. Introduced fire adapted grasses and shrubs now cover 25 percent of the total land mass in Hawai'i (Trauernicht, 2014). This in combination with an increase in human caused ignition has resulted in a fourfold increase of area burned annually by wildfires in Hawai'i (Trauernicht and Pickett, 2016). Wildfires are a serious threat to human safety and property, and impact native ecosystems, watersheds, and near shore coastal resources statewide. Pūpūkea FR is a DOFAW Primary Response area, and the areas surrounding the FR are DOFAW-HFD Co-op Response areas (Figure 21). Fire pre-suppression activities, including road and trail maintenance, are needed for effective fire suppression in Pūpūkea FR.

Insects and Diseases: Introduction of insects and disease are a serious threat to the natural areas of Hawai'i. Of particular concern are pest and diseases that could cause widespread dieback of predominant forest canopy species such as koa and 'ōhi'a. With globalization and an increased dependence on imports, approximately 20 insect species become established in Hawai'i every year (DOFAW 2010).

Recent notable introductions of insects and diseases include a Puccinia rust (*Puccinia psidii*), and koa wilt (*Fusarium oxysporum* f.sp *koae*). Puccinia rust has severely impacted nīoi (*Eugenia koolauensis*), including individuals in Pūpūkea FR, as well as rose apple (*Sygyzium jambos*). It can also damage 'ōhi'a seedlings and saplings. Koa wilt is a soil born disease that is causing dieback and decline of koa primarily in lowland plantation stands on former agricultural land.

The most recent epidemic that has caused major concern across the state is rapid 'ōhi'a death (ROD), which is caused by a fungus (*Ceratocystis fimbriata*). Currently, it has only been confirmed to occur on Hawai'i island where hundreds of thousands of 'ōhi'a trees have been killed by this disease spanning across approximately 75,000 acres of forest. Aerial surveys for ROD have been completed for the neighboring islands. Based on the results of the aerial surveys, the Division collected samples from targeted areas to determine if ROD is present. Thus far, ROD has not been detected on O'ahu or any of the other islands given that samples tested have not been shown to be ROD.

Figure 21: Fire response zones in Pūpūkea FR



Climate Change: According to the 2012 Pacific Islands Regional Climate Assessment (PIRCA), documented indicators of climate change in the region include an increase in 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), changes in species distributions, increasing ocean surface temperature and changing ocean chemistry. However, there is no level of certainty as to how these changes will specifically affect Pūpūkea FR.

Potential impacts to communities and natural environments include shifts in rainfall patterns, a decrease in freshwater supplies, increase in extreme weather events, flooding and erosion, increase in prevalence and transmission of disease (e.g. avian malaria), increase in non-native biological invasions, increase in frequency and size of wildfires, and an increased risk of species extinction.

The primary mitigation for climate change involves actions to reduce emissions and enhance sinks of greenhouse gases. Tropical forests are important for carbon sequestration because compared to other biomes they have a high carbon content and productivity. Maintaining and ideally increasing carbon storage within forests will help decrease atmospheric carbon. 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.

Even with the above mitigation actions, forest ecosystems in Hawai'i will face new climatic 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. The Pacific Island Climate Change Cooperative (PICCC) has 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.

Flooding: The Kaunala Trail crosses multiple streams. Flash floods may occur posing a threat to public safety.

Other Issues: The current lease with the Army only allows for public access on weekends and holidays. However, public recreation is continuous seven days a week. The purpose of the limited public access days was to allow the Army to train during the week. As of yet, a conflict between training and public recreation has not surfaced.

Figure 22: Bridge crossing the Paumalū Stream

Since the Army paved the road, the cost to maintain and repair the road has risen dramatically. In 2015, there was a small landslide that undermined the road. Historically, DOFAW could task a bulldozer and an equipment operator to fix the road but the repair of a paved road has caused a rise in cost and difficulty in comparison to a dirt road. DOFAW currently does not have funds to repair the road.

L. 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."

Camping fees are the only source of revenue coming from Pūpūkea FR. The Division may issue commercial permits for non-timber forest products and small scale salvaging of dead, down, or hazardous trees if the opportunity arises. Each application for a commercial salvage permit shall be considered on its own merits, including its effect on the premises and the public's use and enjoyment of the forest reserve. 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.

III. MANAGEMENT

A. Past Planning: A previous management plan was created for Pūpūkea FR during the early 1960's. Pūpūkea FR is also included in the Ko'olau Mountain Watershed Partnership Management Plan.

B. Related Plans: Plans that contain relevant information on the resources and management strategies pertinent to the management of Pūpūkea FR are listed below.

- Ko'olau Mountain Watershed Partnership Management Plan
- Hawai'i's State Wildlife Action Plan
- DOFAW Forest Action Plan
- Nā Ala Hele Program Plan
- DOFAW Draft Management Guidelines
- O'ahu Invasive Species Committee Strategic Plan
- USFWS Endangered Species Recovery Plans

C. Summary of Existing Management Activities: Current management activities include:

- Hiking trails: Nā Ala Hele maintains the Kaunala Trail in Pūpūkea FR. The trail requires maintenance three times a year (four days each), equivalent to 12 person-days per year. The objectives for the trail system include the maintenance of trails through weed and brush clearing, removal of downed trees, repairing washout areas, and installation and maintenance of regulatory and directional signage. Additional improvements are needed including ground maintenance of graveling, re-establishing, or re-routing of the trail.
- Fences: The rare plant exclosure fence for endangered nīoi (*Eugenia koolauensis*) is maintained by OANRP.
- Other infrastructure: Additional infrastructure currently maintained includes the entry gate, locks, picnic table, bridge, and shelter.
- Public hunting: The area is managed as a public hunting area, allowing for public access for hunting purposes and includes a hunter check-in station.
- Resource monitoring: Intermittent resource monitoring for wildlife and plants is conducted in the FR.
- Sandalwood research: The 'iliahi (*Santalum frecynatium)* stand in Pūpūkea FR is healthy with relatively large trees that could be a resource for genetic conservation and

commercial use. In 2015, sandalwood in the FR was measured to begin the process of determining the economic potential of Hawaiian sandalwood oil and wood. Oil from individuals in Pūpūkea FR will be sampled and tested to determine oil content and potential commercial opportunities.

D. Management Objectives and Goals:

Broad management categories for each FR were derived from the mandates that regulate DOFAW activities including the Draft Management Guidelines and Administrative Rules, as well as input from Branch staff. These management priorities were divided into eight categories:

- Watershed Values (aquifer recharge, erosion control)
- Resource Protection (fire, insects, disease)
- Native Ecosystems (landscape level protection)
- Public Activity (non-income generating uses, such as recreation, cultural activities, personal gathering, educational or research activities, and events among others)
- Invasive Species Control (incipient and established plants and animals)
- Game Animal Management (areas managed for public hunting and/or habitat enhancement for game animals)
- Threatened and Endangered (T&E) Species Management (federally listed, state listed, and rare plants and animals)
- Commercial Activity (income generating activities such as timber, tours, etc.)

Each category has been ranked on a qualitative scale of 1 to 8, with 1 as higher priority and 8 as lower priority. Table 7 lists qualitative rankings of the management priority categories for Pūpūkea FR.

Table 8: Pūpūkea Forest Reserve and associated management priority categories

Forest Reserve Name	Resource Protection	Watershed Values	Invasive Species Control	T&E Species Mgmt.	Native Ecosystems	Game Animal Mgmt.	Commercial Activity	Public Activity
Pūpūkea	2	1	4	7	6	5	8	3

Table 9 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 9: Management objectives and associated plans for Pūpūkea Forest Reserve. Estimated cost refers to state funds.

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
Watershed Values (1)	Increase amount of lands under Forest Reserve status	Addition of adjacent Dole land TMK: 6-3-1:2 (approximately 3,700 acres)	Secure state/grant funding to acquire TMK 6-3-1:2. Follow procedures to establish as forest reserve.	$3,734,600.00
	Reduce the threat and impact of erosion on reserve resources	Maintain diverse forest cover on watershed lands to provide high quality water for residents	Periodic ground and aerial surveys of the area to maintain vigilance on forest health status	$5K/year

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		Maintain ground cover	Collect and store seed stock for various native plant species to be used for erosion mitigation	$5K/year
			Outplant as needed	
Resource Protection (2)	Fire Mitigation	Maintain ground cover post fire	Collect and store seed stock for various native plant species to be used for post-fire mitigation work	Costs under watershed values
			Outplant as needed	
		Maintain access for fire crews	Road and trail maintenance	Staff & mgmt costs only
		Fire prevention campaign at campsites	Post Smokey Bear signs at picnic and camping shelter and trail head	$300
		Maintain fire suppression force readiness	Train, equip and supply staff for fire suppression	Staff & mgmt costs only
Public Activity (3)	Increase amount of lands under Forest Reserve status for recreation	Addition of adjacent Dole land TMK: 6-3-1:2 (approximately 3,700 acres)	Secure state/grant funding to acquire TMK 6-3-1:2. Follow procedures to establish as forest reserve.	Costs under watershed values
	Sustain public recreation enjoyment	Maintain public recreation infrastructure	Trail and picnic table and shelter maintenance	$1K/year
			Weed and brush clearing	$3.2K/year
	Public information	Update informational signage	Sign installation and replacement as needed	$800
Invasive Species Control (4)	Manage incipient and established invasive plants and animals	Invasive species monitoring and control	Chemical, mechanical, and/or biological control in high priority areas	TBD
			Periodic weed surveys	
		Invasive species outreach	Provide surrounding landowners with educational outreach programs; Educate botanical gardens, commercial nurseries, and residential landscaping projects on the risks of using potential invasive species and in Weed Risk Assessment	$5K/year
		Invasive species prevention	Encourage cleaning of gear via informational signage and boot brushes at the trailhead	$2K

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
Game Animal Management (5)	Promote public hunting through Chapter 122 & 123	Amendments to HAR Chapter 122 & 123	Add to Chapter 122 & 123	$22.5K
	Increase land area for public hunting	Addition of adjacent Dole land TMK: 6-3-1:2 (appx. 3,700 acres)	Purchase property	Costs under watershed values
Native Ecosystems (6)	Native ecosystem restoration	Determine landscape level needs	Common native outplanting (low priority action)	$50K/acre
	Expand 'iliahi forest	Increase footprint of 'iliahi by 10%/year	Map 'iliahi forest	$40K/year
			Collect and store 'iliahi seed for potential outplanting	
T&E Species Management (7)	Protection and recovery of listed rare plants and animals	Determine specific areas and species of interest	Research historical presence of T&E species and conduct field surveys	$15K
		Identify and address threats to identified species	Address threats to species, fence, predator control, hand pollinate, etc	$15K/year
		Increase number of individuals	Collect plant material for potential outplanting	$10K
Commercial Activity (8)	Generate income from commercial use activities in the Forest Reserve	Determine future income possibilities – commercial tour permits and film industry.	Determine protocol to manage fee collection	Staff & mgmt costs only
			Evaluate potential of doing commercial tours on jeep road	
	Provide opportunities for sustainable commercial forest product collection	Identify potential locations and species	Issue commercial harvest permits for harvest of forest products	Staff & mgmt costs only
		Collect revenue from timber salvage sales	Issue commercial timber harvest permits on an as needed basis	Staff & mgmt costs only
		Manage commercial harvest permits for non-timber forest products	Issue commercial harvest permits on an as needed basis	Staff & mgmt costs only

E. 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 that may be applicable to Pūpūkea FR include:

- Number of volunteer service projects
- Acres of noxious plants controlled
- Acres of fire protection area
- Acres of exclosure developed
- Acres of exclosure maintained
- Acres of native forest protected
- Number of rare, threatened, or endangered plant/animal species protected

- Number of cultural resources protected
- Number of commercial leases/licenses/permits issued
- Number of signs replaced
- Number of appurtenant features maintained
- Number of miles of trails maintained
- Number of game species harvested (game birds, game mammals)
- Number of common native species outplanted

IV. FUTURE RECOMMENDATIONS

A. Desired Outcome for the Forest Reserve: Protection of watershed quality and quantity provided by the lands of Pūpūkea FR is essential. Another important goal is to maintain and enhance public access and activity in Pūpūkea FR.

B. Future Recommendations:

- Amend Army lease to allow more public access
- Increase public parking areas
- Increase recreational opportunities (developed camping site, horseback riding, and additional trails)
- Conduct further surveys for the Hawaiian hoary bat and other biological resources
- Expand the FR by pursuing acquisition of adjacent land
- Explore potential for commercial bike tours
- Collect seeds for potential outplanting projects for fire mitigation, ground cover, maintenance, and native species protection and expansion
- Update/upgrade informational signage
- Survey for early detection and rapid response of high priority invasive species targets
- Introduce biocontrol for strawberry guava
- Investigate potential to research and discuss the carrying capacity of the FR for recreation, hunting, collection, and harvesting activities

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VI. APPENDIX

Appendix A: Pūpūkea Forest Reserve Plant Species List

Appendix B: Historic Tree Plantings in Pūpūkea Forest Reserve

Appendix C: Pūpūkea Forest Reserve Bird and Bat Survey Report

Appendix D: DOFAW Draft Management Guidelines (2014)

Appendix A: Pupukea Forest Reserve Plant Species List

Compiled by Lara Reynolds, O'ahu Botanist

This species list (native and non-native flowering plants and ferns and fern allies) was complied by updating the plant species list from the previous draft management plan (2005), consulting records of the Hawaii Biodiversity and Mapping Program, conducting a botanical inventory of Kaunala Trail and Kaunala Trail West, consulting with the O'ahu Army Natural Resources staff, and checking available literature sources to update taxonomic names.

*Inclusion of indicated species comes from referencing data from the Hawaii Biodiversity and Mapping Program

Affinity:
End = Endemic
Ind = Indigenous
Non = Non-native
Pol = Polynesian

Satus: Federal and State endgangered species list
E = Endangered
T = Threatened
C = Candidate species
SOC = Species of concern (unofficial)

Scientific Name	Common Name	Family	Affinity	Status
Flowering Plants				
Acacia confusa	Formosa koa	Fabaceae	Non	
Acacia koa	Koa	Fabaceae	End	
Ageratum conyzoides	Billy goat weed	Asteraceae	Non	
Aleurites moluccana	Kukui	Euphorbiaceae	Non	
Alyxia stellata	Maile	Apocynaceae	End	
Andropogon virginicus	Broomsedge	Poaceae	Non	
Antidesma platyphyllum	Hame	Euphorbiaceae	End	
Araucaria heterophylla	Norfolk pine	Araucariaceae	Non	
Ardisia elliptica	Shoebutton	Primulaceae	Non	
Arundina graminifolia	Bamboo orchid	Orchidaceae	Non	
Bidens alba	Beggar's tick	Asteraceae	Non	
Bidens campylotheca spp. campylotheca *	Koʻokoʻolau	Asteraceae	End	SOC
Bobea elatior	Ahakea	Rubiaceae	End	
Buddleja asiatica	Buddleia	Buddlejaceae	Non	
Carex meyenii	Kaluhalua	Cyperaceae	Ind	
Carex wahuensis	Carex	Cyperaceae	End	
Casuarina equisetifolia	Ironwood	Casuarinaceae	Non	

Appendix A: Pupukea Forest Reserve Plant Species List

Compiled by Lara Reynolds, O'ahu Botanist

Scientific Name	Common Name	Family	Affinity	Status
Casuarina glauca	Swamp mahogany	Casuarinaceae	Non	
Cecropia obtusifolia	Trumpet tree	Urticaceae	Non	
Centella asiatica	Gotu kola	Apiaceae	Non	
Chamaechrista nictitans	Partridge pea	Fabaceae	Non	
Chrysodracon halapepe	Halapepe	Asparagaceae	End	
Chrysophyllum oliviforme	Satin leaf	Sapotaceae	Non	
Cinnamomum burmanii	Padang Cassia	Lauraceae	Non	
Clidemia hirta	Koster's curse	Melastomataceae	Non	
Cocculus orbiculatus	Huehue	Menispermaceae	Ind	
Conyza bonariensis	Hairy horseweed	Asteraceae	Non	
Cordyline fruticosa	Tī leaf	Asparagaceae	Pol	
Cyanea sessilifolia *	Oha Haha/Wai	Campanulaceae	End	E
Cyanthilium cinereum	Little ironweed	Asteraceae	Non	
Desmodium incanum	Desmodium	Fabaceae	Non	
Desmodium intortum		Fabaceae	Non	
Dianella sandwicensis	Ukiuki	Xanthorrhoeaceae	End	
Diospyros sandwicensis	Lama	Ebenaceae	End	
Emilia sp.		Asteraceae	Non	
Epipremnum pinnatum	Pothos	Araceae	Non	
Erechtites sp.	Fireweed	Asteraceae	Non	
Eucalyptus globulus	Bluegum	Myrtaceae	Non	
Eucalyptus robusta	Swamp mahogany	Myrtaceae	Non	
Eugenia koolauensis	Nioi	Myrtaceae	End	E
Euphorbia rockii *	ʻAkoko	Euphorbiaceae	End	E
Falcataria moluccana	Albizia	Fabaceae	Non	
Ficus sp.	Ficus	Moraceae	Non	
Freycinetia arborea	ʻIeʻie	Pandanaceae	Ind	
Gahnia beecheyi	Uki	Cyperaceae	End	
Gardenia mannii *	Nanu	Rubiaceae	End	E

Appendix A: Pupukea Forest Reserve Plant Species List

Compiled by Lara Reynolds, O'ahu Botanist

Scientific Name	Common Name	Family	Affinity	Status
Grevillea robusta	Silk oak	Proteaceae	Non	
Heliocarpus popayanensis	Moho	Malvaceae	Non	
Hibiscus tiliaceus	Hau	Malvaceae	Pol	
Lantana sp.	Lantana	Verbenaceae	Non	
Leptecophylla tameiameiae	Pukiawe	Ericaceae	Ind	
Leucaena leucocephala	Koa haole	Fabaceae	Non	
Lophostemon confertus	Brush box	Myrtaceae	Non	
Machaerina mariscoides subsp. *meyenii*	Uki	Cyperaceae	End	
Mangifera indica	Mango	Anacardiaceae	Non	
Melaleuca quinquenervia	Paperbark	Myrtaceae	Non	
Melochia umbellata	Melochia	Malvaceae	Non	
Melinis minutiflora P. Beauv.	Molasses grass	Poaceae	Non	
Metrosideros polymorpha	ʻŌhiʻa	Myrtaceae	End	
Mimosa pudica	Sleeping grass	Fabaceae	Non	
Mimusops elengi	Bullet wood	Sapotaceae	Non	
Nestegis sandwicensis	Olopua	Oleaceae	End	
Oplismenus hirtellus	Basketgrass	Poaceae	Non	
Pandanus tectorius	Hala	Pandanaceae	Ind	
Paspalum conjugatum	Hilo grass	Poaceae	Non	
Passiflora edulis	Passion fruit, lilikoi	Passifloraceae	Non	
Passiflora suberosa	Corky passion vine	Passifloraceae	Non	
Persea americana	Avocado	Lauraceae	Non	
Phaius tankarvillae	Nun's cap	Orchidaceae	Non	
Planchonella sandwicensis	Alaʻa	Sapotaceae	End	
Plantago major	Plantain	Plantaginaceae	Non	
Platydesma cornuta var. cornuta *		Rutaceae	End	E
Pluchea carolinensis	Sourbush	Asteraceae	Non	
Polygala paniculata	Island snakeroot	Polygalaceae	Non	

Appendix A: Pupukea Forest Reserve Plant Species List

Compiled by Lara Reynolds, O'ahu Botanist

Scientific Name	Common Name	Family	Affinity	Status
Polyscias gymnocarpa	ʻOhe	Araliaceae	End	E
Pouteria sandwicensis	ʻAlaʻa	Sapotaceae	End	
Psidium cattleianum	Strawberry guava	Myrtaceae	Non	
Psidium guajava	Common guava	Myrtaceae	Non	
Psychotria fauriei	Kopiko	Rubiaceae	End	
Psychotria mariniana	Kōpiko	Rubiaceae	End	
Psydrax odorata	Alaheʻe	Rubiaceae	End	
Pteralyxia macrocarpa *	Kaulu	Apocynaceae	End	C
Pterolepis glomerata		Melastomataceae	Non	
Rauvolfia sandwicensis	Hao	Apocynaceae	End	
Rubus rosifolius	Thimbleberry	Rosaceae	Non	
Sacciolepis indica	Glenwood grass	Poaceae	Non	
Santalum freycinetianum	Iliahi	Santalaceae	End	
Scaevola gaudichaudiana	Naupaka kuahiwi	Goodeniaceae	End	
Schinus terebinthifolius	Christmas berry	Anacardiaceae	Non	
Setaria palmifolia	Palm grass	Poaceae	Non	
Spathodea campanulata	African tulip	Bignoniaceae	Non	
Spathoglottis plicata	Philippine ground orchid	Orchidaceae	Non	
Spermacoce assurgens	Buttonweed	Rubiaceae	Non	
Stachytarpheta cayennensis	Vervain	Verbenaceae	Non	
Syzygium cumini	Java Plum	Myrtaceae	Non	
Urochloa maxima	Guinea grass	Poaceae	Non	
Vitex parviflora	Molave	Verbenaceae	Non	
Waltheria indica	ʻUhaloa	Malvaceae	Ind	
Wikstroemia oahuensis var. *oahuensis*	ʻĀkia	Thymelaeaceae	End	

Appendix A: Pupukea Forest Reserve Plant Species List

Compiled by Lara Reynolds, O'ahu Botanist

Scientific Name	Common Name	Family	Affinity	Status
Ferns and fern allies:				
Angiopteris evecta	Mule's foot fern	Marattiaceae	Non	
Blechnum appendiculatum	Blechnum	Blechnaceae	Non	
Cibotium chamissoi	Hapu'u	Cibotiaceae	End	
Cyclosorus dentatus	Downy wood fern	Thelypteridaceae	Non	
Cyclosorus parasiticus	Christella	Thelypteridaceae	Non	
Dicranopteris linearis	'Uluhe	Gleicheneaceae	Ind	
Lepisorus thunbergianus	'Ekaha	Polypodiaceae	Ind	
Nephrolepis multiflora	Nephrolepis	Lomariopsidaceae	Non	
Odontosoria chinensis	Pala'ā	Lindsaceae	Ind	
Ophioglossum pendulum	Puapuamoa	Ophioglossaceae	Ind	
Phlebodium aureum	Rabbit foot's fern	Polypodiaceae	Non	
Phymatosorus grossus	Laua'e, maile-scented fern	Polypodiaceae	Non	
Psilotum nudum	Moa	Psilotaceae	Ind	
Pteridium aquilinum subsp. *decompositum*	Kilau, bracken fern	Dennstaedtiaceae	End	

Appendix B: Historic Tree Plantings in Pūpūkea Forest Reserve (Skolmen, 1980)

Species	Year	Number planted	Total planted per species	% of all trees planted
Acacia confusa	1936	8,707	8,707	3.65%
Acacia koa	1920	283	29,525	12.37%
	1921	630		
	1921	913		
	1922	5310		
	1922	2430		
	1922	2880		
	1923	5206		
	1923	450		
	1923	1410		
	1923	3001		
	1924	2800		
	1924	300		
	1924	2500		
	1938	1412		
Albizia coriaria	1938	1000	1,000	0.42%
Allocasuarina verticillata	1924	250	370	0.16%
	1926	120		
Araucaria columnaris	1926	306	346	0.15%
	1927	40		
Araucaria heterophylla	1938	803	849	0.36%
	1941	46		
Barringtinia asiatica	1928	20	20	0.01%
Bauhinia variegata	1928	15	15	0.01%
Bischofia Javanica	1926	20	20	0.01%
Calophyllum inophyllum	1928	25	25	0.01%
Casimiroa edulis	1933	250	250	0.10%
Casuarina cunninghamiana	1924	800	800	0.34%
Casuarina glauca	1933	500	700	0.29%
	1936	200		
Casuarina sp	1924	800	800	0.34%
Chionanthus macrophylla	1933	528	528	0.22%
Cordia alliodora	1926	600	1,200	0.50%
	1926	600		
Cordyline fruticosa	1933	1080	1,080	0.45%
Corymbia citriodora	1921	252	2,941	1.23%
	1922	152		
	1922	152		
	1926	326		
	1927	1000		
	1938	31		
	1949	1028		

	1950	1232		
Cryptomeria japonica	1923	800	2,200	0.92%
	1923	800		
	1924	300		
	1924	300		
Dovyalis hebecarpa	1939	75	75	0.03%
Enterolobium cyclocarpum	1928	25	25	0.01%
Eucalyptus bridgesiana	1936	1960	2,114	0.89%
	1938	154		
Eucalyptus camaldulensis	1924	947	4,544	1.91%
	1924	947		
	1926	2300		
	1939	350		
Eucalyptus paniculata	1939	664	664	0.28%
Eucalyptus pilularis	1929	250	1,477	0.62%
	1938	1227		
Eucalyptus robusta	1933	107	107	0.04%
Eucalyptus rubida	1928	60	60	0.03%
Eucalyptus rudis	1938	284	284	0.12%
Eucalyptus sideroxylon	1938	105	105	0.04%
Falcataria moluccana	1928	50	50	0.02%
Ficus sp.	1920	129	129	0.05%
Ficus altissima	1921	91	91	0.04%
Ficus rubiginosa	1923	405	835	0.35%
	1923	225		
	1923	180		
	1926	25		
Faraxinus americana	1928	15	1,015	0.43%
	1929	1000		
Fraxinus uhdei	1957	10	10	0.00%
Grevillea robusta	1926	954	110,279	46.21%
	1928	15		
	1929	600		
	1933	14331		
	1934	3754		
	1936	46889		
	1938	14472		
	1938	4757		
	1939	24507		
Guaiacum officinale	1923	200	400	0.17%
	1923	200		
Harpullia hillii	1933	432	432	0.18%
Kigelia pinnata	1938	50	50	0.02%
Lophostemon confertus	1929	1000	18,505	7.77%

	1938	5889		
	1939	11616		
Lysiloma latisiliquum	1957	100	1,000	0.42%
Macadamia integrifolia	1929	100	100	0.04%
Melaleuca quinquenervia	1926	150	30,755	12.89%
	1927	1050		
	1928	40		
	1929	150		
	1933	3637		
	1934	1448		
	1936	7880		
	1939	16400		
Mimusops elengi	1933	118	118	0.05%
Morella fiya	1956	2	2	0.00%
Morus nigra	1938	50	454	0.19%
	1939	404		
Nesoluma polynesicum	1933	118	118	0.05%
Persea americana	1938	2897	2,897	1.22%
Pritchardia sp.	1928	25	25	0.01%
Santalum album	1936	1430	1430	0.60%
Scheflerra actinophylla	1928	15	15	0.01%
Swietenia mahagoni	1921	250	1,100	0.46%
	1923	300		
	1923	300		
	1926	250		
Syncarpia glomulifera	1938	508	508	0.21%
Syzygium cumini	1923	200	200	0.08%
Syzygium jambos	1923	200	392	0.16%
	1933	192		
Syzygium malaccense	1938	650	650	0.27%
Taxodium distichum	1927	350	350	0.15%
Tipuana tipu	1938	2038	2,038	0.85%
Toona ciliata	1920	88	3,374	1.41%
	1921	538		
	1921	450		
	1923	550		
	1923	550		
	1924	594		
	1924	594		
	1957	10		
Trema orientalis	1926	150	150	0.06%
		238,635		

Appendix C
Pupukea Bird and Bat Survey Report

Prepared by: Dr. Eric VanderWerf, Pacific Rim Conservation, 3038 Oahu Avenue, Honolulu, HI 96822

Prepared for: The Hawaii Division of Forestry and Wildlife, 2135 Makiki Heights Drive, Honolulu, HI 96822

Introduction and Background

The 782-acre Pupukea-Paumalu Forest Reserve is located in the northern Koolau Mountains of Oahu and contains the northernmost native forest on the island. The lower portions of the reserve are dominated by a variety of non-native plant species, but the higher portions, adjacent to the U.S. Army Kawailoa and Kahuku training areas, support remnants of native montane forest including koa (*Acacia koa*) and ohia (*Metrosideros polymorpha*) trees, with extensive ground cover of the mat-forming uluhe fern (*Dicranopteris linearis*).

There is limited information about the distribution and abundance of forest birds on Oahu, except for the Oahu Elepaio (*Chasiempis ibidis*), which has been the subject of intensive survey effort (VanderWerf et al. 2001, 2013). Oahu was not included in the original forest bird surveys conducted on most other islands in the 1970s and 1980s (Scott et al. 1986), or in the annual surveys that currently rotate among islands (Gorreson et al. 2009). A forest bird survey was conducted on Oahu by the Hawaii Division of Forestry and Wildlife (DOFAW) in 1991, but the results were never published and it has not been repeated since. The only previous quantitative data available for most forest bird species on Oahu are from Shallenberger (1977), who surveyed military bases on Oahu, including the Kawailoa Training Area, and from Shallenberger and Vaughn (1978), who surveyed several valleys in the leeward Koolau Mountains as part of an environmental assessment for the construction of the H-3 Freeway. There have been no previous quantitative surveys for birds in the Pupukea area.

The Hawaiian hoary bat (*Lasiurus cinereus semotus*) is the only land mammal native to Hawai'i. It is considered a subspecies of the North American hoary bat, but additional research would help to confirm this status (Tomich 1986, Bonaccorso 2010). Unlike many bats, it roosts solitarily in large trees rather than in caves. Recent research has begun to shed light on its ecology, behavior, and movements, but it still relatively little-known and more information is needed. It is found on most of the larger islands, but its population size and trend are unknown because of the difficulty in detecting this nocturnal species. Important conservation actions are to minimize lethal collisions with wind turbines, barbed wire fences, and other structures, while identifying and conserving habitat.

Pacific Rim Conservation (PRC) was contracted in 2015 by the Hawaii Division of Forestry and Wildlife to survey the Pupukea-Paumalu Forest Reserve for birds and the Hawaiian hoary bat. The purposes of these surveys were to provide data on the presence and abundance of these natural resources that can be used to monitor their abundance and help inform management decisions.

Methods

Birds. Birds were surveyed using the variable circular plot (VCP) method, which has been the standard method used for forest birds in the Hawaiian Islands for over 30 years (Shallenberger and Vaughn 1978, Scott et al. 1986, Gorreson et al. 2009). Twenty-six survey points were

located at 200 meter intervals along two transects (Figure 1). The first transect followed Pupukea Road along the southern edge of the reserve and consisted of 12 stations. The second transect followed the mauka boundary road along the eastern edge of the reserve and then the Kaunala Trail through the center of the reserve and consisted of 14 points. Survey points were located with a hand-held GPS unit. Surveys were conducted on 7 and 14 May 2015.

At each point, an 8-minute count of all birds was conducted, during which the species of each bird and its horizontal distance from the observer were recorded. A laser range-finder was used to help estimate distance to each bird. Two measures of abundance were calculated for each species: 1) relative abundance, which was the number of detections divided by the number of points surveyed; 2) frequency, which was the number of points at which the species was detected divided by the number of points surveyed. The data collected during these surveys eventually can be used to estimate the absolute abundance (# of individuals per hectare) of each bird species using distance-based methods, but larger sample sizes are needed for reliable estimates and this will be done after surveys are completed in additional areas on Oahu.

Bats. Surveys for the Hawaiian hoary bat were conducted using a Wildlife Acoustics SM2Bat+ detector (Wildlife Acoustics Inc., Concord, Massachusetts). This device detects and records sounds in the frequency range of bat calls, which are generally inaudible to humans. The recorded sounds were examined by Corinna Pinzari of the U.S. Geological Survey, Biological Resources Discipline, Kilauea Field Station, to determine if they were made by bats. The bat detector was deployed in two locations (Figure 1). The first deployment was from 7-14 May 2015 (7 nights) at the junction of Pupukea Road and the mauka boundary road. The second deployment was from 14-26 May 2015 (12 nights) at the start of the Kaunala Trail on Pupukea Road. In both cases the detector was attached to a tree about two meters off the ground. Both locations where the bat detector was deployed encompassed a corridor along the road overhung by large trees and a small clearing. The bat detector was programmed to automatically turn on at sunset and turn off at sunrise each day. This method provides information about the presence of bats and their activity patterns over time, but it does not provide information about the number of bats using the area.

Results

Birds. A total of 397 birds of 18 species were detected at the 26 points surveyed (Table 1). The Red-billed Leiothrix (*Leiothrix lutea*) was the most abundant species, followed by Red-vented Bulbul (*Pycnonotus cafer*), House Finch (*Haemorhous mexicanus*), and Japanese White-eye (*Zosterops japonicus*). Those four species, all of which were introduced to Hawaii, also were the most frequently detected, each being observed at 25 of the 26 points. Two species of native Hawaiian honeycreepers were observed, the Apapane (*Himatione sanguinea*) and Oahu Amakihi (*Hemignathus flavus*), both of which were uncommon. A total of five Apapane were observed at three points, and a single amakihi was observed. The Amakihi and four of the five Apapane were observed in the highest portion of the reserve along the mauka boundary road at survey points 2-2 and 2-3, and the fifth Apapane was observed in the interior of the reserve at survey point 2-8 (see Figure 1). Two species of introduced parrots were observed; 1-3 Blue-crowned Parakeets (*Aratinga acuticauda*) were seen or heard at points 2-8, 2-11, and 2-12, and two larger parrots, likely Red-crowned Parrots (*Amazona viridigenalis*) were heard at point 1-9. The Red-crowned Parrot identification was based on their distinctive calls. No Oahu Elepaio, Iiwi (*Vestiaria coccinea*), or Oahu Creeper (*Paroreomyza maculata*) were detected during the surveys.

Bats. No bats were detected at the first location where the bat detector was deployed, indicating no bats used the area during those dates. Unfortunately the bat detector malfunctioned during the second deployment and no data were recorded.

Discussion

The Pupukea-Paumalu Forest Reserve, though small, contains native montaine forest habitat that is valuable to two species native Hawaiian forest birds, the Apapane and the Oahu Amakihi. Both of these species were uncommon in the reserve, but Pupukea is the northern-most location where they occur and it thus represents an important part of their range. No Oahu Elepaio were observed during the surveys, which was expected. The last observation of elepaio in the northern Koolau Mountains was in 1977, when a single bird was observed in the Kawailoa Training Area (Shallenberger 1977), but none have been detected since despite numerous visits to the area.

A variety of non-native bird species also were found in the Pupukea-Paumalu Forest Reserve. These species included a mix of birds usually found in forest and other species more typical of urban or open habitats, reflecting the proximity of Pupukea to suburban and agricultural areas. Pupukea Road in particular appeared to serve as a corridor that allowed species usually found in suburban areas, such as Common Myna (*Acridotheres tristis*) and Red-crested Cardinal (*Paroaria coronata*), to penetrate farther than usual into forest habitat.

The observations of the two parrot species in Pupukea are noteworthy. Red-crowned Parrots were first sighted on Oahu in about 1969 in Kapiolani Park, and an additional 3-4 pairs escaped from an aviary in Aiea during hurricane Iwa in 1982 (Pyle and Pyle 2009). More recently, a flock of about 40 Red-crowned Parrots has become established in central Oahu, and is known to roost and nest near Waimano, and to disperse widely in central Oahu while foraging (Kalodimas 2013). The observation of two Red-crowned Parrots in Pupukea indicates their range extends to the northern Koolaus. Blue-crowned Parakeets are much less common on Oahu and less is known about their range or behavior. Single birds have been observed in Honolulu in 1986-1988 (with a flock of Red-crowned Parrots) and in 1999, and one was observed nesting with a Red-masked Parakeet (*Aratinga erythrogenys*) and producing hybrid offspring in Honolulu in 2004 (Pyle and Pyle 2004-2006). A single bird was observed at Turtle Bay in February 2012 (E. VanderWerf pers. obs.). The bird observed at Turtle Bay and the birds seen at Pupukea had only a small amount of dull blue coloration on the head, which is characteristic of the *haemorrhous* subspecies of the Blue-crowned Parakeet, which is native to northeastern Brazil (del Hoyo et al. 1997), though it is also possible they were hybrids. The presence of multiple individuals in Pupukea suggests this species may be established in the northern Koolaus.

Although no bats were detected during the surveys, the amount of time surveyed was short in duration (7 nights total), and it is desirable to conduct additional surveys to confirm whether bats may use the area seasonally or sporadically in low numbers. Bats have been detected regularly in nearby areas, including the Kawailoa wind farm.

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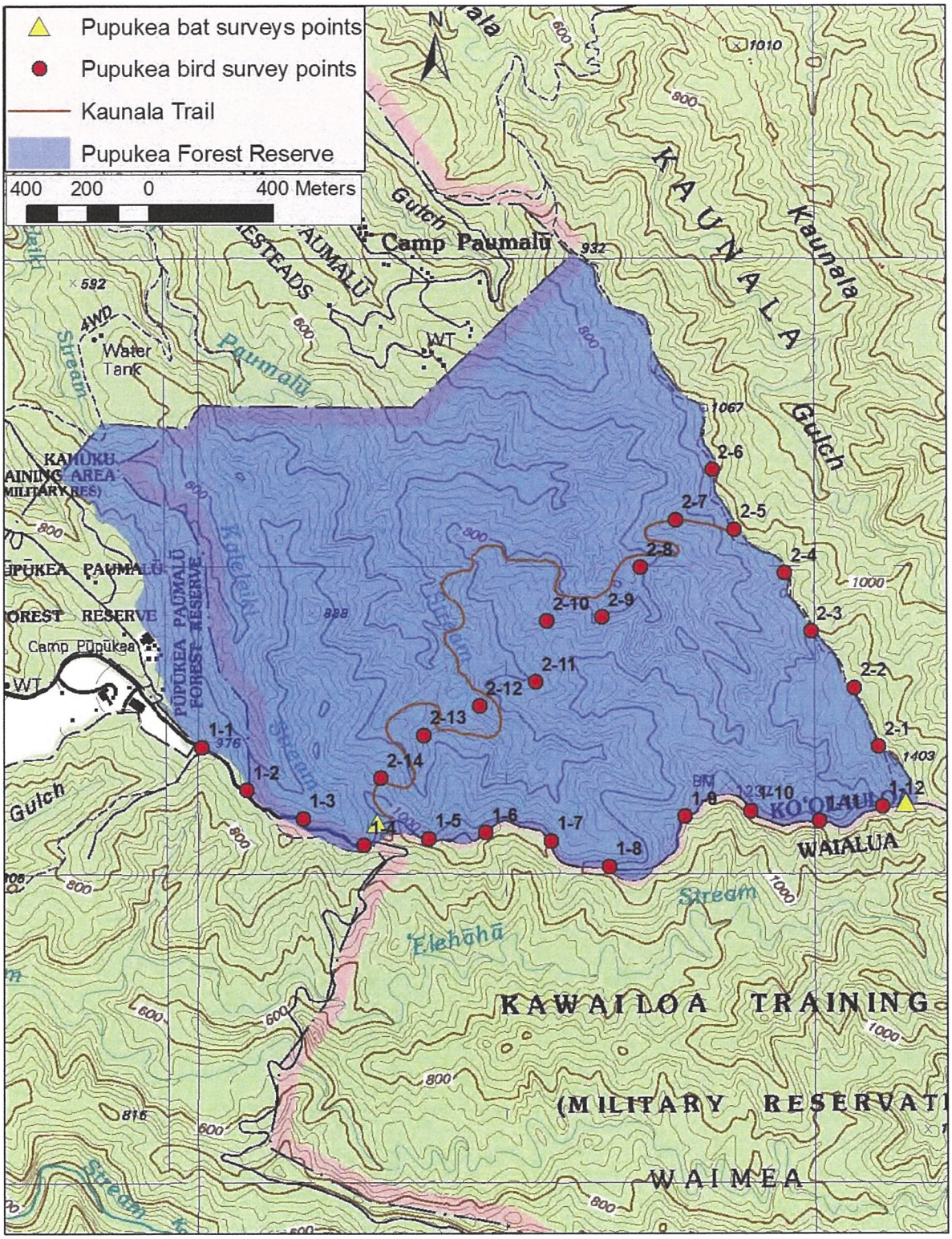
Table 1. Abundance of birds in the Pupukea-Paumalu Forest Reserve on Oahu based on surveys conducted from 7-14 May 2015.

Species	# points occupied	Frequency (% points occupied)	Total detections	Relative abundance (birds per point)
Red-billed Leiothrix	25	96%	83	3.19
Red-vented Bulbul	25	96%	75	2.88
House Finch	25	96%	65	2.50
Japanese White-eye	25	96%	50	1.92
Red-whiskered Bulbul	13	50%	28	1.08
Japanese Bush-warbler	11	42%	22	0.85
White-rumped Shama	15	58%	20	0.77
Common Waxbill	7	27%	17	0.65
Red-crested Cardinal	9	35%	10	0.38
Common Myna	4	15%	8	0.31
Blue-crowned Parakeet	3	12%	6	0.23
Apapane	3	12%	5	0.19
Spotted Dove	2	8%	3	0.12
Red-crowned Parrot	1	4%	2	0.08
Melodious Laughing-thrush	1	4%	1	0.04
Northern Cardinal	1	4%	1	0.04
Nutmeg Mannikin	1	4%	1	0.04
Oahu Amakihi	1	4%	1	0.04
All	26		397	15.27

Figure 1. Map showing the locations of Pupukea-Paumalu Forest Reserve, bird and bat survey points, and the Kaunala Trail.



Appendix D

DRAFT MANGEMENT GUIDELINES (2014)

Vegetation Management		
Class Name	Class Definition	Management Goal
V-1 Highest Quality Native Ecosystems	These units 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. Examples are portions of the Alakai Wilderness Preserve (Kauai), Eke Crater (Maui), Wright Road section of Puu Makaala NAR (Hawaii). 90-100% Native Plant Cover	To protect and perpetuate these areas, by preventing non-sustainable activities or intensities of use. Permitted activities in these areas are minimally disruptive, and would be focused on ecosystem preservation.
V-2 Predominantly Native Areas:	Areas in which native plants predominate in communities that are relatively intact. They have a significant component of non-native plants (>10% in any layer). Examples are the most native portions of some NARs and Forest Reserves. 50-90% Native Plant Cover	To prevent activities or intensities of use that create further significant degradation of native plant or animal communities, and encourage activities or intensities of use that are beneficial to those communities. Permitted activities may have a higher level of disturbance than in V-1 areas, provided they remain within sustainable levels.
V-3 Considerably Disturbed Areas:	Units consist of areas that had a considerable amount of disturbance. The vegetation in the area does not reflect a naturally evolved species composition, but rather a mixture of small remnant patches dominated by native plants, patches of largely invasive weedy alien plants, and areas of mixed native and non-native plants. Examples are portions of Puu Ka Pele Forest Reserve (Kauai), Puu Waawaa public hunting area (Big Island). 10-50% Native Plant Cover	To prevent activities or intensities of use that result in degradation of unique native species and secondary forest resources (water supply erosion control & aesthetic values). Permitted activities may have high levels of disturbance, as long as they don't negatively impact remaining native plant populations and have an eventual net benefit to other resources like water, or an improved vegetative cover for other activities. Native plant conservation may be focused at a species, rather than an ecosystem level.
V-4 Badly Degraded Areas:	Units are areas that are severely degraded or highly altered from their natural state. They 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. Examples are portions of the Kakaha Game Management Area (Kauai), and Puu Anahulu Game Management Area (Hawaii). 0-10% Native Plant Cover	To prevent activities or intensities of use that result in degradation of watershed cover or soils. These areas are where the most disruptive activities would be allowed, such as large-scale commercial forestry, game habitat manipulation, etc. Native plant conservation is mainly focused at the species level.

DRAFT MANGEMENT GUIDELINES (2014)

Conservation Management		
Class Name	Class Definition	Management Goal
C-1: High Conservation Value (High)	Area has two or more of the following factors: 1. Area has a high degree of regulatory encumbrances (i.e., critical habitat, conservation district, T&E species occurrences, court orders, deed restrictions, etc); 2. Is important to the conservation and/or recovery of native species (i.e., forest bird recovery habitat, essential plant habitat, etc); 3. High level of native biological diversity and/or native ecosystem intactness (e.g. V-1)	1. Protect and restore native species and ecosystems (collect genetic material, reintroduce species, protect areas from degradation, restore damaged resources); 2. Reduce the threat of alien species or other factors to the greatest extent possible (fence, intensive animal and weed control, etc); 3. All other uses are secondary to the protection and restoration of native species and ecosystems; 4. Funding and management rules support conservation efforts above all other uses.
C-2: Medium Conservation Value (Medium)	Area has two or more of the following factors: 1. Area has a medium degree of regulatory encumbrances (i.e., critical habitat, conservation district, T&E species occurrences, court orders, deed restrictions, etc); 2. Contributes to the conservation and/or recovery of native species (i.e., forest bird recovery habitat, essential plant habitat, etc); 3. Medium level of native biological diversity and/or native ecosystem intactness	1. Provide ecological buffer from threats to C1, areas; 2. Maintain & improve native ecosystem processes; 3. Conservation of native resources is balanced with other public uses.
C-3: Low Conservation Value (Low)	Area has two or more of the following factors: 1. Area has a low degree of regulatory encumbrances (i.e., critical habitat, conservation district, T&E species occurrences, recovery habitat, etc); 2. Contributes to the conservation of native species (i.e., genetic collection); 3. Low level of native biological diversity and/or native ecosystem intactness	1. Control invasive dispersal corridors, incipient populations of invasive species, localized mammal control; 2. Activities are focused on erosion & fuel control; 3. May provide for ecological corridors or emergency conservation actions for individual species; 4. Other uses may have a higher priority than conservation.
C-4: Very Low Conservation Value (None)	Area has two or more of the following factors: 1. Area has a very low or no regulatory encumbrances (i.e., critical habitat, conservation district, T&E species occurrences, recovery habitat, etc); 2. Little to no contribution to the conservation of native species (i.e., genetic collection); 3. Low to no level of native biological diversity and/or native ecosystem intactness	1. Areas where non conservation dominated uses are encouraged. For example: commercial forestry, sustained game yield, commercial tourism;. 2. All other uses have a higher priority than conservation. 3. Conservation activities are focused on localized threat abatement and emergency response.

DRAFT MANGEMENT GUIDELINES (2014)

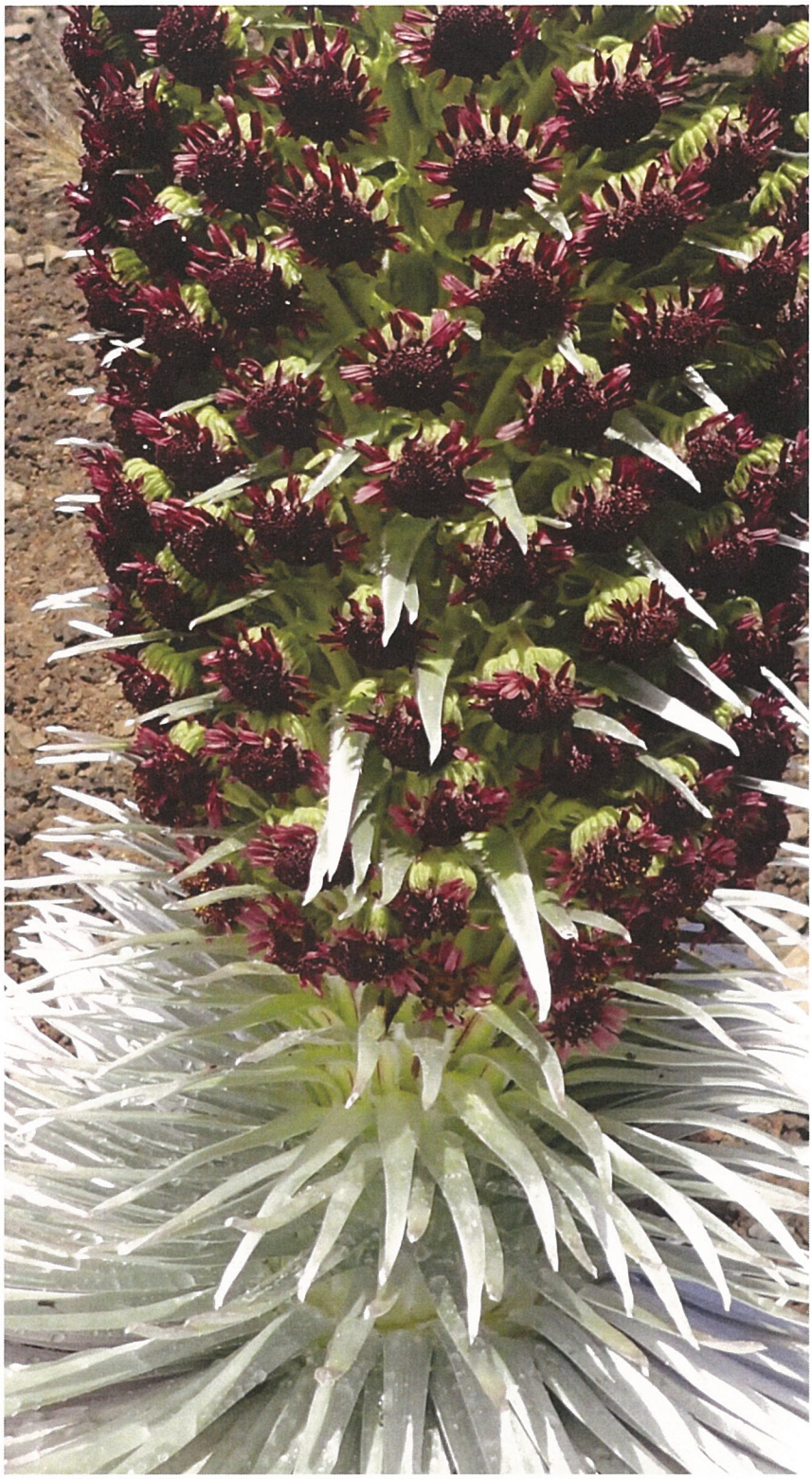
Game Animal Management		
Class Name	Class Definition	Management Goal
A1 Game Production:	Game is a primary objective. Hunting seasons and bag limits provide maximal sustained public hunting opportunities and benefits. Areas include Game Management Areas (GMA).	Game is a primary objective. Oahu: Game birds are the only game in this category
A2 Mixed Game and Other Uses:	Areas where game management is an objective integrated with other uses. Habitat may be manipulated for game enhancement. Game populations are managed to acceptable levels using public hunting.	Areas where game management is an objective integrated with other uses. Oahu: Only PHAs impacted by bird seasons are in this category
A3 Liberal Public Hunting:	Areas where native resource protection is the primary objective, with emphasis on native plant communities and watersheds. Seasons and bag limits are designed for public hunting to reduce impacts to native resources (e.g. liberal hunting rules).	Areas where resource protection is the primary objective, with emphasis on native plant communities and watersheds. Oahu: most PHAs are in this category. Goal is to maximize public access, game take, and public hunting opportunities in general in order to reduce non-native animal impact on native resources.
A4 Game Control (Staff):	Areas designated for animal removal by staff or agency designees because of environmental sensitivity, remoteness, or public safety.	Areas designated for animal removal. Oahu: areas that are fenced or are targeted for aerial hunting.
Forestry Management		
Class Name	Class Definition	Management Goal
F1 Large Scale Commercial	Forest products are a primary objective and large scale commercial timber harvesting or salvage is allowed. Permits and/or licenses are required with appropriate restrictions. Harvesting of non-timber forest products is allowed. All Timber Management Areas are designated as F1 areas.	To produce timber while allowing other uses such as recreation, hunting and gathering. Activities may include, but are not limited to pre-commercial thinning, commercial thinning, and forest stand improvement. Harvesting activities should follow Best Management Practices for maintaining water quality. Sustained yield management is encouraged and planting or revegetation must follow harvesting to ensure sustainability.
F2 Small Scale Commercial	Areas where limited small-scale (no more than 5% of the total F2 acreage for each forest reserve, annually) commercial timber harvesting or salvage is allowed. Harvesting of non-timber forest products is allowed. Permits and/or licenses are required with appropriate restrictions.	To ensure sustainability of forest product resources while minimizing impacts to non-target native species. Activities may include, but are not limited to pre-commercial thinning and forest stand improvement thinning. To distribute impacts of harvesting over the resource area through controlled seasons and harvest. Depending on the scale and impact of harvesting, planting or revegetation may be required, if deemed necessary by land managers. To encourage active management of culturally and economically significant forest products.

F3 Personal Use	Areas where limited non-commercial timber harvesting and commercial timber salvage is allowed. Harvesting of non-timber products will be considered on a case by case basis. Permits are required with appropriate restrictions.	To minimize human impacts to native species and native ecosystems. To encourage active management of culturally and economically significant forest products for sustainable personal use.
F4 Restricted	Forest Products are not a primary objective. Harvesting of timber products is not allowed. Harvesting of non-timber forest products is generally not allowed and will be considered on a case by case basis for improving forest health, watershed protection, cultural uses and conservation efforts. Permits are required with appropriate restrictions.	To ensure protection of native species and native ecosystems. Permitted activities in these areas are minimally disruptive, and would be focused on improving forest health, watershed protection, and conservation efforts.
Recreation Management		
Class Name	Class Definition	Management Goal
R1 Heavy Use Areas:	Areas where outdoor recreation is a primary objective. Areas may have highly developed recreational facilities such as checking stations, camp sites with utilities and parking lots. Generally restricted to Considerably Disturbed Areas (V-3) and Badly Degraded Areas (V-4).	Areas where outdoor recreation is a primary objective.
R2 Medium Use:	Areas where outdoor recreation is limited or controlled, or where it may be integrated with other uses. Facilities are not highly developed and include trails, rustic shelters, or unimproved campsites.	Areas where outdoor recreation is limited or controlled, or where it may be integrated with other uses.
R3 Light Use:	Areas where recreation would be limited to certain areas, or occasional levels of use due to impacts on resources or programs. Trails would be the main recreational feature, and their use may be restricted.	Areas where recreation would be limited to certain areas, or occasional levels of use due to impacts on resources or programs.
R4 Restricted:	Areas where outdoor recreation is heavily restricted or controlled, if permitted at all. Trails would be the main feature considered. Areas may be classified "restricted" due to hazardous conditions, fragile ecosystems, limited accessibility or other management practices incompatible with recreational activities.	Areas where outdoor recreation is heavily restricted or controlled

EXHIBIT B

Kula Forest Reserve and Papa'anui Tract of Kahikinui Forest Reserve

Management Plan



2017

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

EXECUTIVE SUMMARY

This ten-year management plan for Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve (FR) on Maui 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.

According to a report by the Territorial Forester Ralph S. Hosmer, prior to the late 1800's "there was a belt of heavy forest with dense undergrowth," in the Kula district (Hosmer 1912, p. 275). By 1912, the effects of grazing resulted in the conversion of the forest to open grass land with the exception of scattered groves of māmane (*Sophora chrysophylla*) and steep sided gulches that provided protection to pockets of forest from cattle. Kula Forest Reserve was established by Governor's Proclamation on September 11, 1912, with a purpose different from most other forest reserves. The reserve was established with the intent to reforest the area that was converted to pasture after 20 years of grazing. Establishing forest cover around Polipoli Spring, which at the time was considered the only permanent source of water on the southern end of Haleakalā, was one of the underlying reasons for creating Kula Forest Reserve (Hosmer 1912).

The Kahikinui Forest Reserve was established by Governor's Proclamation on December 22, 1928. In the report that preceded the establishment of Kahikinui FR, the Territorial Forester described how the majority of the boundary was already protected by existing fence lines constructed on neighboring leased and private lands that were being managed by cattle ranchers, and also by natural barriers that limited the ingress of ungulates. He further describes the significant number of goats and the few cattle that were in Kahikinui at the time. The intention was to remove the wild goats and cattle and "give the extensive existing grove of koa (*Acacia koa*) trees on Nakula and Nuu a chance to expand," (Judd 1928, p. 177). There were also stands of māmane that they hoped would expand through natural recruitment. The overarching goal for Kahikinui FR was to improve the vegetative cover in the area to "prevent excessive runoff and make available for use in the intervening dry periods water on the lower lands, where it is almost always at a premium," (Judd 1928, p. 177).

DOFAW's current management activities within Kula Forest Reserves and the Papa'anui Tract of Kahikinui Forest Reserve are weed management (monitor, map, and control), access road and infrastructure maintenance, boundary fence and rare plant exclosure maintenance, native and threatened and endangered (T&E) outplanting, native plant seed collection and storage (seed banking), firebreak/fuelbreak maintenance, Nā Ala Hele trail maintenance, water unit maintenance for game bird species, predator control (mongoose, rat, and cats), and game habitat management, which includes but is not limited to black wattle (*Acacia mearnsii*) and invasive species removal.

Forest reserve management priorities are divided into eight categories and ranked on a qualitative basis, taking into consideration the natural and cultural resources and public use opportunities of the reserves (see Table 12 for forest reserve management priorities). Summary of management goals for the Kula FR and Papa'anui are as follows:

- Watershed Values – Increase land holding protected under the Forest Reserve System; erosion reduction and prevention; monitoring forest composition; maintain active role in watershed partnerships; and climate change adaptation.
- Resource Protection – Fire presuppression and mitigation; forest health monitoring (Rapid 'Ōhi'a Death, insects and diseases), and monitor weather conditions as they pertain to fire and environmental conditions.
- Game Animal Management – Promote and regulate public hunting through Chapter 122 and 123, Hawai'i Administrative Rules.
- T&E Species Management – Protection and recovery of rare and endangered plants and animals.
- Native Ecosystems – Determine landscape level needs; re-evaluate DOFAW 2001 Draft Management Guidelines; and ungulate control.
- Invasive Species Control – Reduce impact of invasive species; and manage incipient and established invasive plants and animals.
- Access, Trails and other Public Uses – Maintain public access, infrastructure and recreational fruit collection; and increase public information and awareness.
- Commercial Activity – Generate income from suitable commercial activities in the reserves; and provide opportunities for wood-based forest product collection.

Details of specific tactical goals and action items can be found in Table 13 on page 48 of this plan. 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 or additional objectives such as wildfire prevention projects and/or improving access and facilities for Kula FR and Papa'anui.

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KULA FOREST RESERVE AND THE PAPA'ANUI TRACT OF KAHIKINUI FOREST RESERVE MANAGEMENT PLAN SIGNATURE PAGE

Maui District certification: This plan was prepared by a team of Division of Forestry and Wildlife (DOFAW) staff to provide a management framework for Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve.

_____ _____

Scott Fretz – DOFAW Maui District Manager Date

DOFAW 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 Kula Forest Reserve and the Papa'anui Tract of Kahikinui 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 Statues, 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 _____, 2017

DEVELOPMENT PROCESS TIMELINE

Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve, Maui

Stage of Development	Date Achieved	Comments
District review	May 2015	Incorporated
DOFAW review	August 2016	Incorporated
Partner agency consultation	March 2017	Incorporated
Public consultation	August 2017	Incorporated
DOFAW approval	September 2017	None
BLNR approval		

I. INTRODUCTION

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.

Each district office of DOFAW will have a comprehensive management plan that addresses overall Forest Reserve System issues, goals and objectives for that district. In addition, 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 Kula Forest Reserve and the Papa'anui Tract of Kahikinui Forest Reserve (Papa'anui), which fits under the comprehensive forest reserve management plan for Maui District. It addresses concerns and strategies only on the public lands within these forest reserves.

This management plan for Kula Forest Reserve and Papa'anui was developed using a variety of methods. Initial development consisted of reviewing and analyzing DOFAW historic and current files (found at the Administrative and Maui District office). Documents were also obtained from other state agencies including the Department of Land and Natural Resources Land Division and Bureau of Conveyances, the Department of Accounting and General Services (DAGS) Survey Division, as well as the State Archives. 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 Reserves 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 Division 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, this Management Plan for Kula Forest Reserve and Papa'anui 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.

II. FOREST RESERVES DESCRIPTION

A. Location and Description: Kula Forest Reserve (FR) is comprised of approximately 4931.35 acres of public land (Table 1) and it is located on the leeward slopes of Haleakalā (Figure 1). Kula FR is bordered primarily by privately owned land with the exception of the mauka boundary which is adjacent to state lands of Papa'anui, and a small portion of its northeastern boundary that borders Haleakalā National Park. This forest reserve is generally characterized by three ecosystem types: montane mesic forest and shrublands, subalpine dry shrubland and grassland, and alpine desert. The lower slopes of Kula FR are dominated by non-native vegetation and the upper slopes contain native shrubland. Communities in close proximity to this forest reserve include Kēōkea – Waiohuli Homesteads, 'Alae 3-4 Homesteads, Waiakoa Homesteads, Kealahou Homesteads, Pūlehu Iki Kamehame Iki Homestead, and Ōma'opio Homestead. Kula FR is included in the Leeward Haleakalā Watershed Restoration Partnership, which was formed in 2003.

Papa'anui is comprised of approximately 713.57 acres of public land (Table 2) and it is located on the ridge top adjacent to Kula FR (Figure 1). Papa'anui is bordered almost entirely by other state owned lands with the exception of one privately owned parcel on its northern boundary. This forest reserve is generally characterized by two ecosystem types: subalpine dry shrubland and grassland, and alpine desert. Almost half of Papa'anui is sparsely vegetated to unvegetated, and the rest of the area is covered by a mixture of native shrublands and alien grasses. The communities in close proximity to this forest reserve include Kēōkea – Waiohuli Homesteads, 'Alae 3-4 Homesteads, Waiakoa Homesteads, Kealahou Homesteads, Pūlehu Iki Kamehame Iki Homestead, and Ōma'opio Homestead. Kahikinui FR is also included in the Leeward Haleakalā Watershed Restoration Partnership.

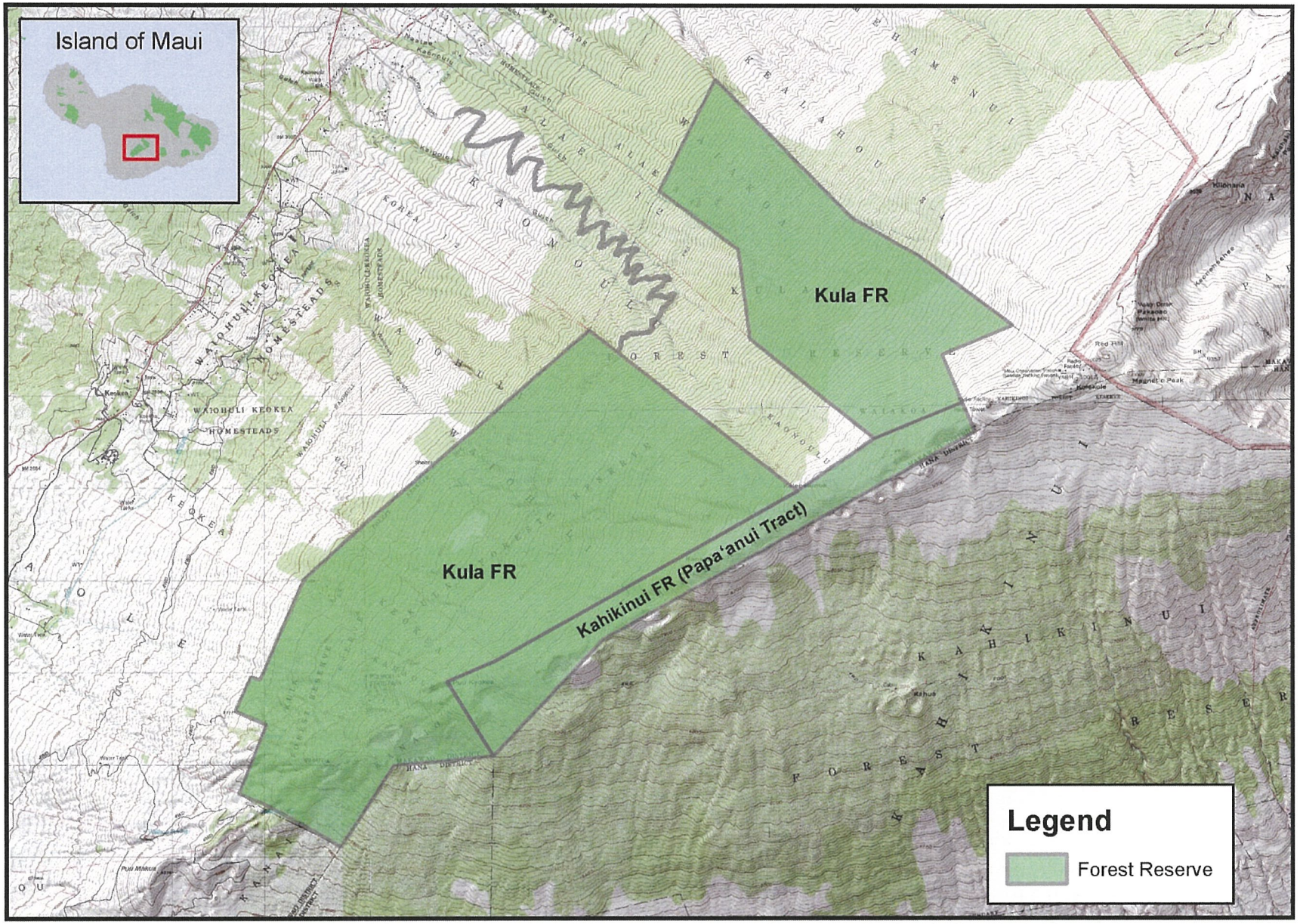
Table 1. Government Tax Map Key (TMK) parcels currently comprising public lands of Kula Forest Reserve. Some TMKs have areas both inside and outside the FR boundary.

TMK Number	Owner	Tax Acres (entire TMK)	GIS Acres (entire TMK)	GIS Forest Reserve Acres
222007001	State of Hawai'i	5865.87	5610.12	4896.54
222007003	State of Hawai'i	2.43	3.51	3.51
222006999	State of Hawai'i	N/A	43.90	20.26
222007999	State of Hawai'i	N/A	11.04	11.04
			TOTAL	4931.35

Table 2. Government TMK parcels currently comprising public lands of the Papa'anui Tract of Kahikinui Forest Reserve.

TMK Number	Owner	Tax Acres (entire TMK)	GIS Acres (entire TMK)	GIS Forest Reserve Acres
222007001	State of Hawai'i	5865.87	5610.12	713.57
			TOTAL	713.57

Figure 1. Current extent of public lands of Kula Forest Reserve (FR) and the Papa'anui Tract of the Kahikinui FR



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B. Geographic Site Data: The island of Maui consists of two volcanoes: Haleakalā, an active volcano dating from approximately 1.1 million years ago that formed east Maui, and an extinct volcano dating from approximately 1.6 million years ago that forms Mauna Kahalawai (West Maui Mountains). The two volcanoes are separated by a low, flat plain. Haleakalā last erupted as recently as 1790 (Juvik and Juvik 1998). Maui is a part of Maui Nui, which is made up of several volcanoes that once formed a single island. Moloka'i, Maui, Lāna'i, and Kaho'olawe were all a part of this large island until sea levels began to rise about 400,000 years ago (Hawaiian Volcano Observatory 1998).

C. Physical Site Data: Kula Forest Reserve and Papa'anui currently occupy land in the ahupua'a of Kanaio, Papa'anui, Kama'ole, Kēōkea, Waiohuli, Ka'ono'ulu, 'Alae 3-4, and Waiakoa. Elevation and rainfall vary through the reserves. The highest elevation reaches up to approximately 9,500 feet and lower regions slope down to 5,000 feet at the forest line and 3,800 feet at the bottom of the access road. Average rainfall ranges from approximately 33 to 40 inches annually (Figure 2), with fog and cloud interception contributing significantly to total precipitation. Precipitation received in the Kula FR and Papa'anui charge the Kama'ole aquifer. The United States Department of Agriculture's Natural Resource Conservation Service has mapped nine soil types in Kula FR and Papa'anui (Figure 3). This agency provides online soil maps and data at https://websoilsurvey.sc.egov.usda.gov. The majority of the area is covered by Andisol soils, which formed from volcanic ash and cinder. The prominent geological features located within Kula FR and Papa'anui are Polipoli Spring, Pu'ukeōkea, and Kanahau.

D. Pre-Reserve and Early Use History:

Kula

The moku (district) of Kula occupies most of the central plains of Maui and is a dry and arid region. The word "kula" itself means plain or open country and is also used as a term to describe dry arid lands. It is believed that kalo (*Colocasia esculenta*) was not grown in Kula, but fishing was good along the coast. The region was also known for its 'uala (*Ipomoea batatas*), which was the staple crop. These resources supported a considerable population along the lower western slopes of Leeward Haleakalā (Handy and Handy 1991).

Starting in the late 1880's, crown and government lands in Kula were leased for pasture purposes to Cornwell Ranch. According to a report that preceded the Kula FR designation, prior to being leased the Kula district contained "a belt of heavy forest with dense undergrowth," (Hosmer 1912, p. 275). The original forest cover was likely dominated by koa (*Acacia koa*), 'ōhi'a (*Metrosideros polymorpha*), māmane (*Sophora chrysophylla*), 'a'ali'i (*Dodonaea viscosa*) and pūkiawe (*Leptecophylla tameiameiae*). After decades of cattle ranching, Hosmer described how the forest practically disappeared due to grazing. Māmane was harvested in larger numbers for utilization as fence posts up until 1910, after which māmane post were still salvaged from dead trees.

Figure 2: Hydrological features of Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR

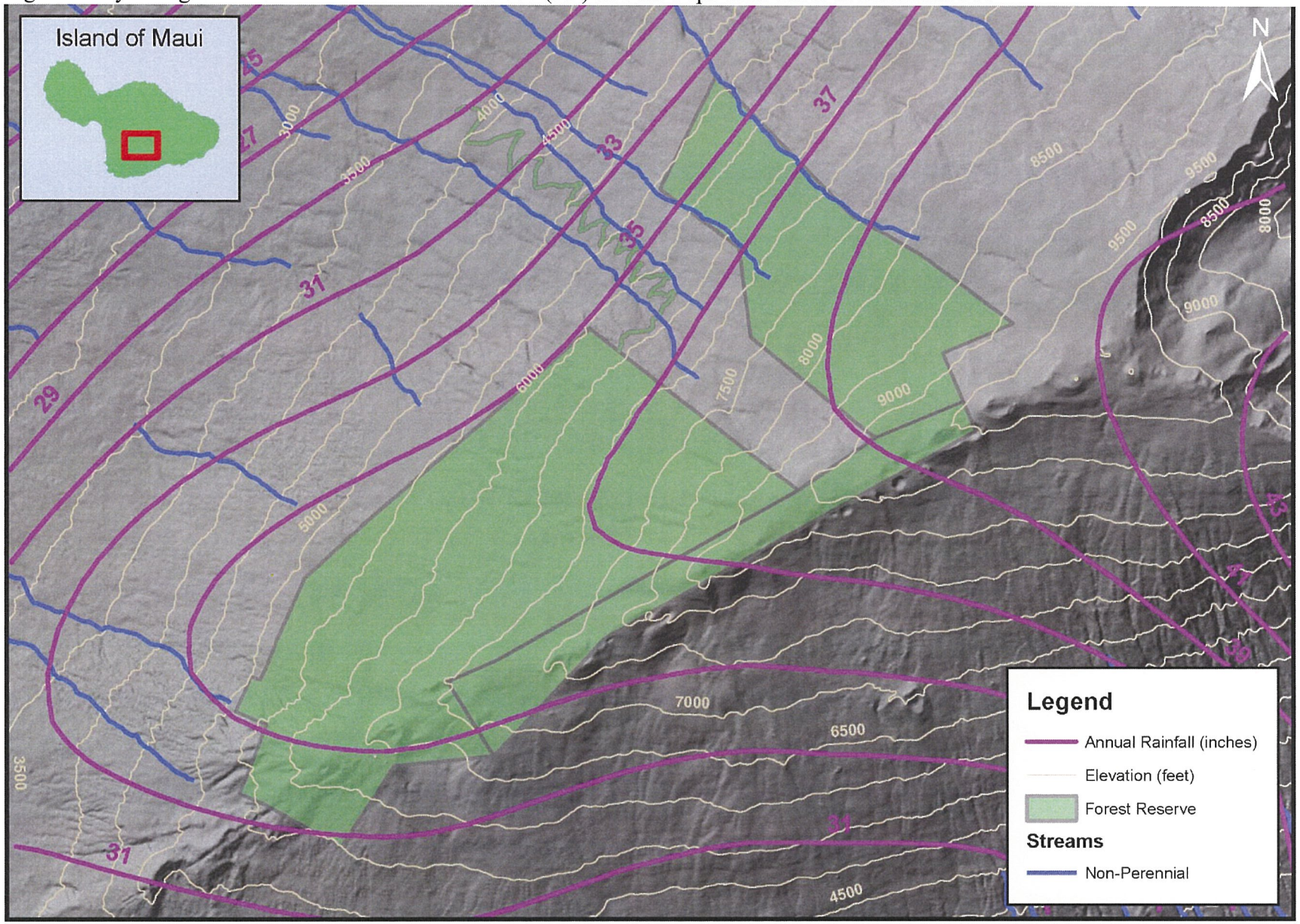

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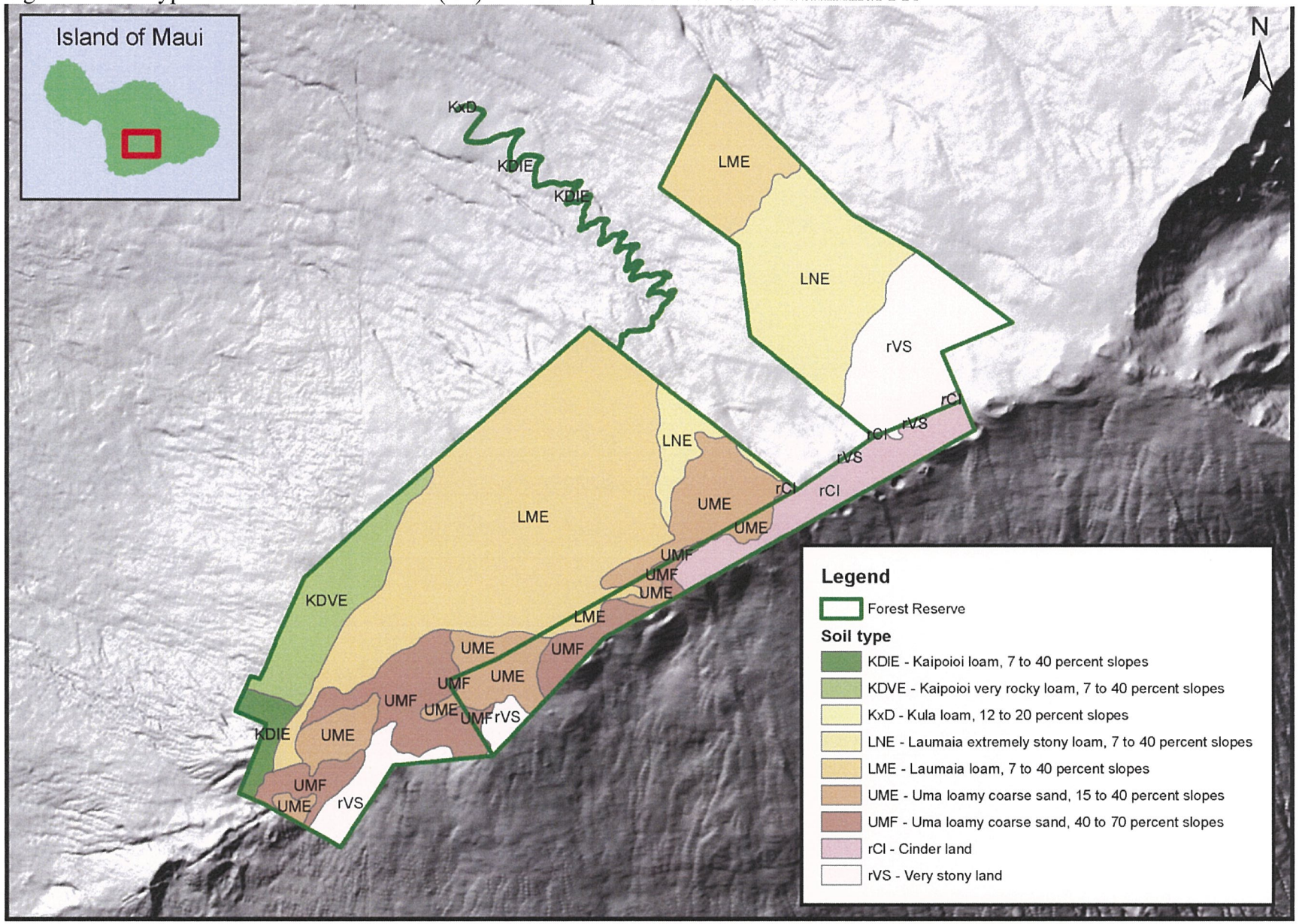
Figure 3: Soils types of Kula Forest Reserve (FR) and the Papa‘anui Tract of the Kahikinui FR



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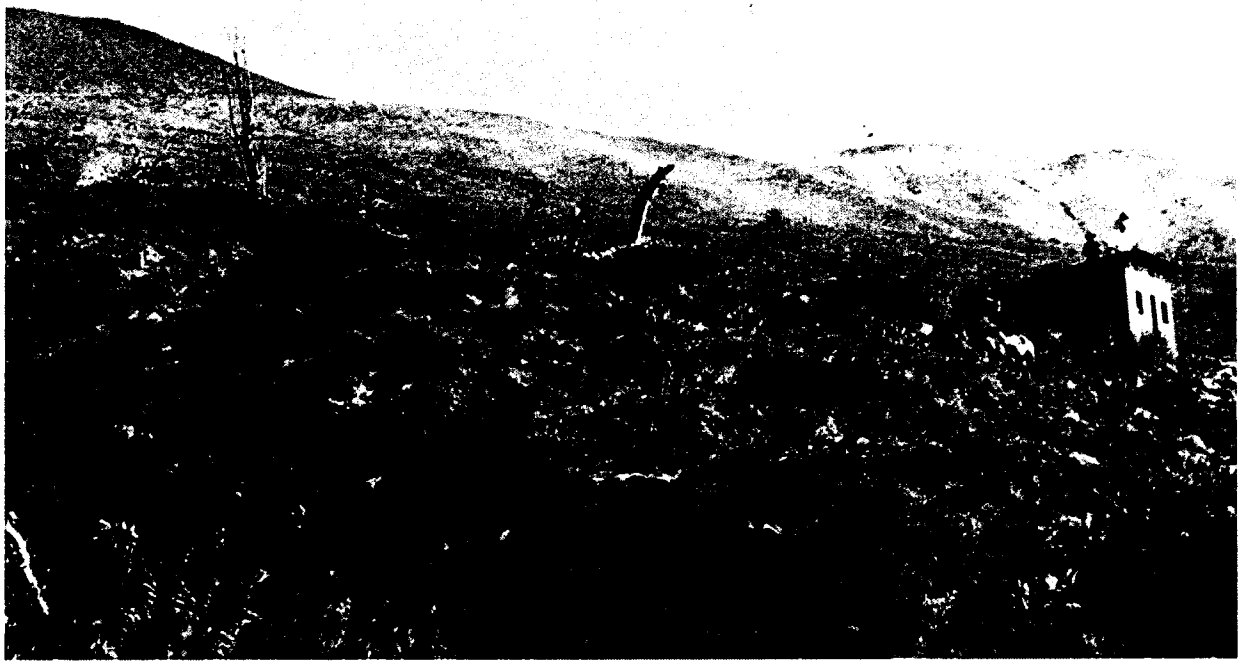


Figure 4. Old ranger cabin in Kula Forest Reserve before reforestation

By 1912, the former extent of the forest was still evident by the "dead stubs, small groups of trees in certain steep-sided gulches where they are protected from cattle, and scattered groves of Mamane," (Hosmer 1912, p. 275). The forest was replaced by a dense ground cover of grass. In 1911, the grazing leases on these government lands were set to expire, and it was decided that it was "best again to lease the strip of grazing land above the corn belt, but that the higher slopes should be reserved," (Hosmer 1912, p. 275).

Kula Forest Reserve was created by Governor's Proclamation in 1912. There was subsequent addition and withdrawal of land since it was established, as documented in Table 3 and Figure 6. When forest reserves were first being established, private lands were also included in these designations to encourage landowners to manage their lands for watershed values. Even though these privately owned parcels were included in the FR boundary, they are not subject to the rules and statutes established for the public lands in the Forest Reserve System. 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). For this reason, privately owned parcels located within the FR boundary were not considered during the management planning process.

Kula Forest Reserve differed from most other reserves at that time, because it was essentially an area in which the forest cover needed to be re-established. It was decided early on that introduced trees of high economic value would be used to create a forest resource that could potentially be harvested in the future. It was also hoped that increasing the forest cover in an area that was considered to have a scarcity of natural supplies of water would help to secure the fresh water resource provided by the springs that occurred in the district. Establishing forest cover on the area adjacent to Polipoli Spring was one of the underlying reasons for the designation of Kula FR (Hosmer 1912).

An intensive planting program for Kula FR was initiated around 1924, and in the 1930's the Civilian Conservation Corp (CCC) planted stands of tropical ash (*Fraxinus uhdei*), sugi (*Cryptomeria japonica*), redwood (*Sequoia sempervirens*), maritime pine (*Pinus pinaster*), Monterey pine (*Pinus radiata*) and Monterey cypress (*Cupressus macrocarpa*).

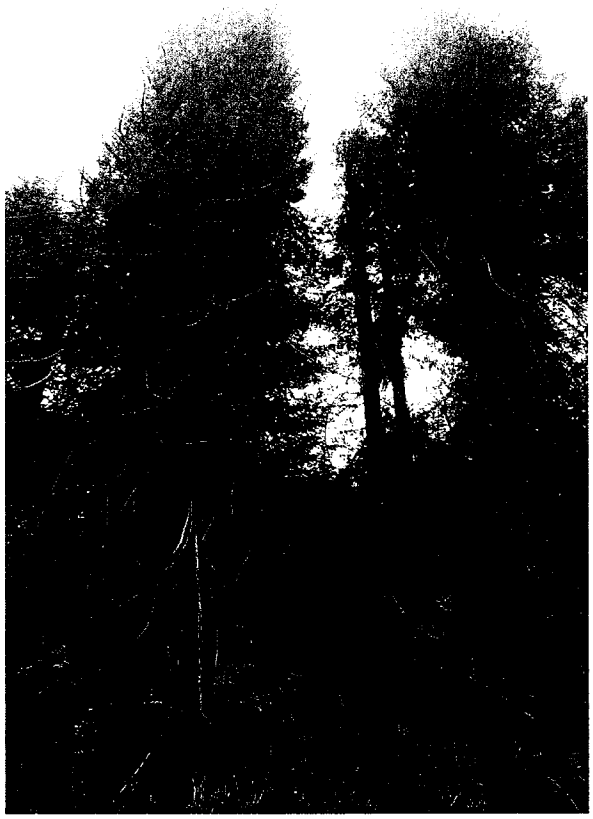
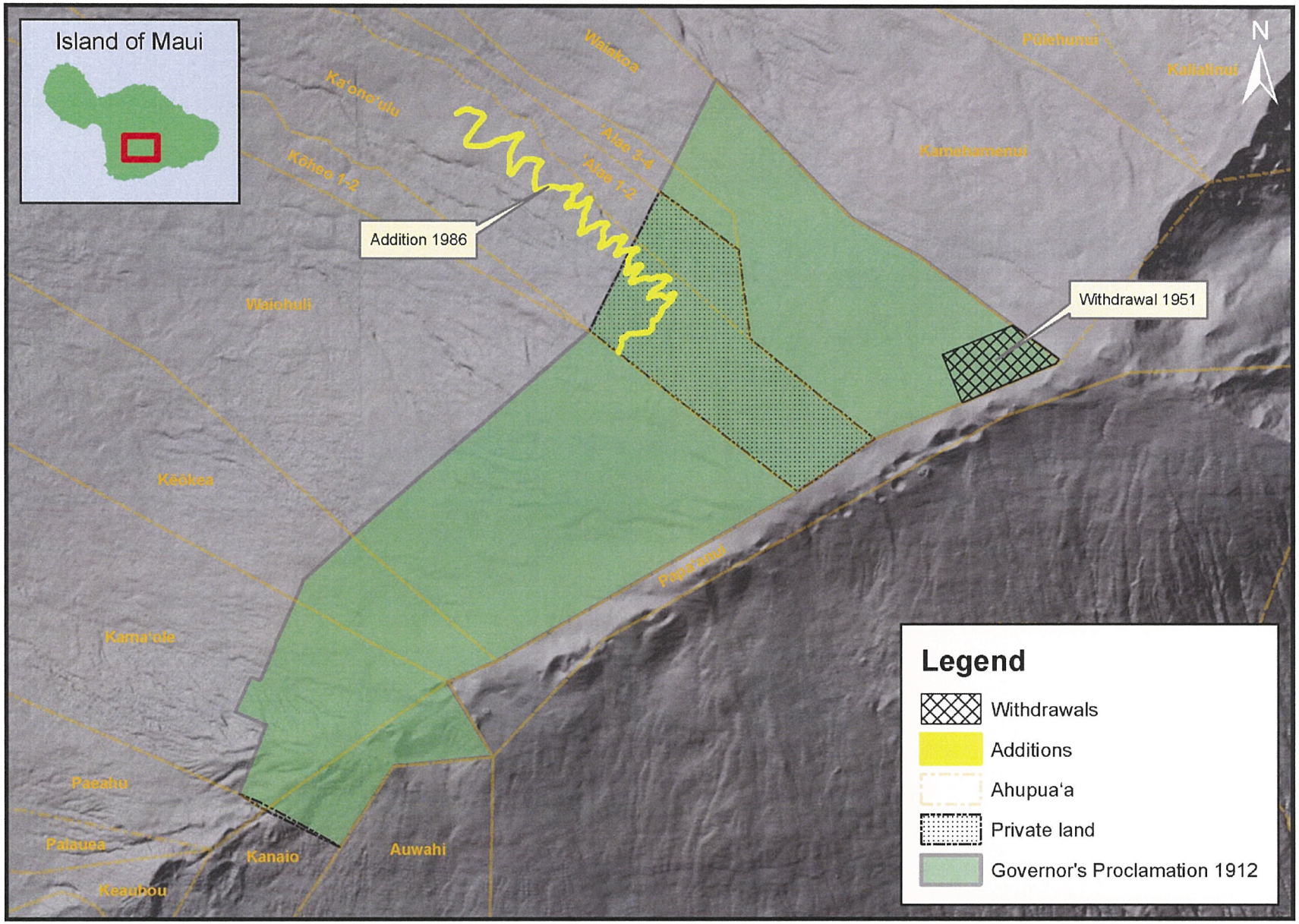


Figure 5. Redwoods of Kula FR

Table 3. Summary of lands added and withdrawn (A/W) from Kula Forest Reserve. See Figure 6 for map descriptions. Portions of TMKs are denoted with (por.). Data relating to these items are filed at the DOFAW Administrative Office and the DAGS State Survey Office

Action	Date	A/W	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Governor's Proclamation	11-Sept-1912	A	Land set aside for establishment of Kula FR	6004.815	2300	222007001 222007003 222007006 222007015
Executive Order 1411	17-Jan-1951	W	Withdrawal of Government lands at Waiakoa for a Repeater and Telephone Station Site	136.50	11116	222007006 222007015
Executive Order 3339	1-July-1986	A	Addition of Polipoli access road at Ka'ono'ulu	33.904	20371	222007999 222006999 (por.)

Figure 6. Historical changes to Kula Forest Reserve with the year of addition/withdrawal indicated



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Kahikinui

Figure 7. Kahikinui Forest Reserve (5000 ft elevation)

In the past, the moku of Kahikinui supported scattered isolated communities close to the shoreline or slightly inland and within proximity of fresh water. It is believed that dry kalo and other resources were grown and harvested from the forest, which came down much lower than it does today. Like Kula, decades of cattle grazing resulted in large scale deforestation in the region (Handy and Handy 1991).

The Kahikinui Forest Reserve, which includes Papa‘anui, was established by Governor’s Proclamation in 1928. There were significant withdrawals of land from Kahikinui FR, and they are documented in Table 4 and Figure 8. Only portions of the Papa‘anui and Nakula ahupua‘a are still included within Kahikinui FR. The Papa‘anui Tract will be addressed in this management plan due to its adjacency to Kula FR. The remaining majority of Kahikinui FR (Nakula) will be addressed in a separate plan at a later date.

In the report that preceded the establishment of Kahikinui FR, the Territorial Forester described how the majority of the boundary was already protected by existing fence lines constructed on neighboring leased and private lands that were being managed by cattle ranchers, and also by natural barriers that limited the ingress of ungulates. He also goes on further to describe the significant number of goats and the few cattle that were in Kahikinui at the time. They planned to remove the wild goats and cattle to “give the extensive existing grove of koa trees on Nakula and Nuu a chance to expand,” (Judd 1928, p. 177). There were also stands of māmane that they also hoped would expand through natural recruitment. The overarching goal for Kahikinui FR was to improve the vegetative cover in the area to “prevent excessive runoff and make available for use in the intervening dry periods water on the lower lands, where it is almost always at a premium,” (Judd 1928, p. 177).

The Papa‘anui Tract of Kahikinui FR has always been sparsely vegetated due to environmental conditions. While records of a lease on Papa‘anui to a private entity could not be located, it was surrounded by private and leased pasture lands and was likely affected by these activities. There are many correspondences between Forestry staff and the neighboring ranchers over cattle in the FR and fence construction and maintenance issues.

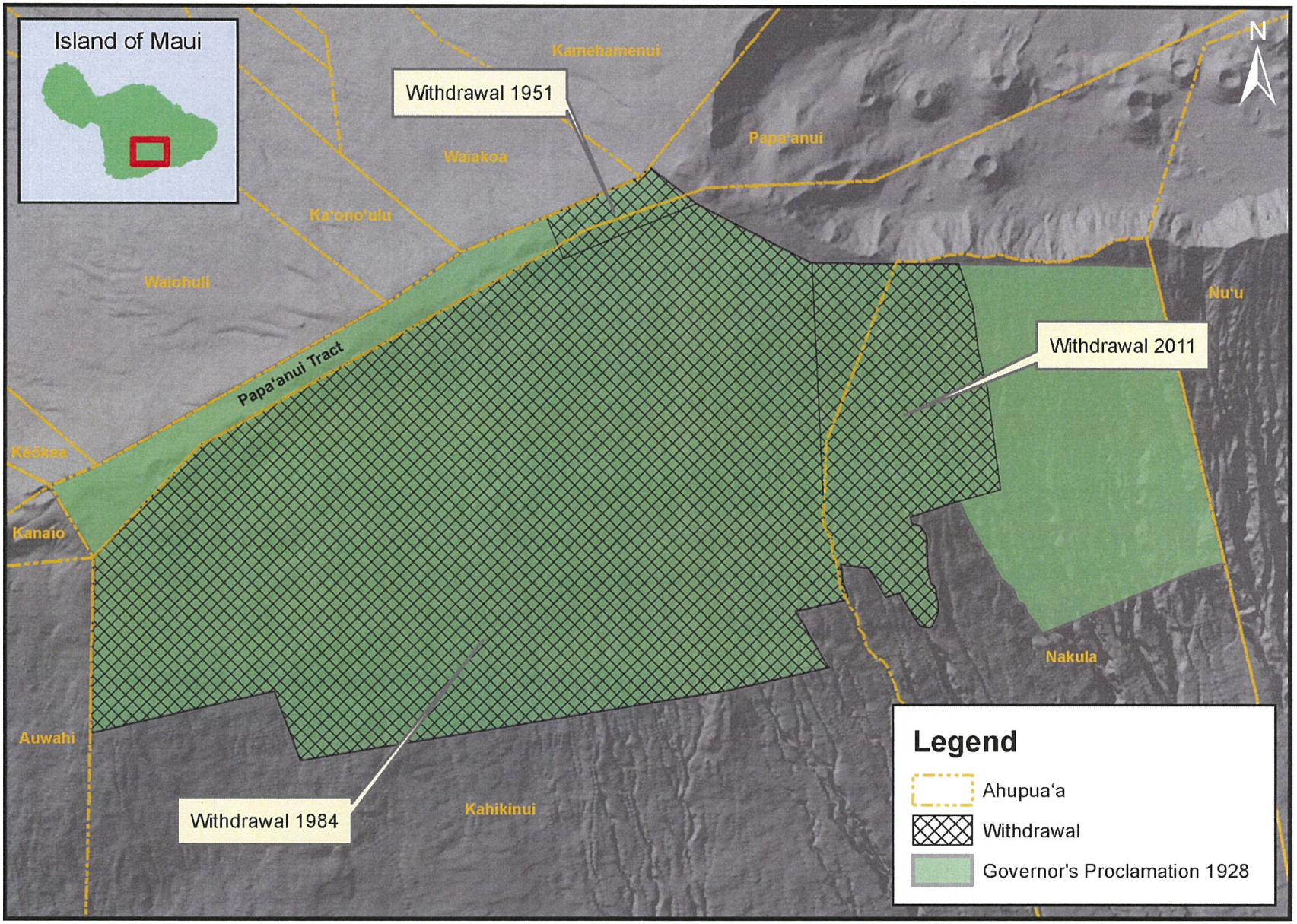
In the 1930's, during intensive reforestation efforts in Kula, there was a relatively flat clearing (believed to be a naturally occurring geological feature) in Papa'anui on Skyline Road where the CCC crew would gather to play baseball and softball during their breaks. To this day this area is still referred to as Ballpark. There are astronomy facilities on the eastern end of Papa'anui, but the site was withdrawn from the FR in 1951.

Table 4. Summary of lands added and withdrawn (A/W) from Kahikinui FR. See Figure 8 for map descriptions. Portions of TMKs are denoted with (por.). Data relating to these items are filed at the DOFAW Administrative Office and the DAGS State Survey Office

Action	Date	A/W	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Governor's Proclamation	22-Dec-1928	A	Land set aside for establishment of Kahikinui FR	16,013	4902	218001006 218001009 219001003 (por.) 219001007 219001011 222007001 (por.) 222007005 222007007 222007008 (por.) 222007009 222007011 222007012 222007013 222007014 222007016 222007017
Executive Order 1411	17-Jan-1951	W	Withdrawal of Government lands at Papa'anui and Kahikinui for a Repeater and Telephone Station Site	184.20	11117	222007005 222007007 222007008 (por.) 222007009 222007011 222007012 222007013 222007014 222007016 222007017
Executive Order 3270	27-Dec-1984	W	Withdrawal of Government lands at Kahikinui which were set-aside as Hawaiian home lands	8,747	N/A	219001003 (por.) 219001007 219001011
Executive Order 4364	25-Mar-2011	W	Withdrawal of land at Nakula for the establishment of a Natural Area Reserve	1420.4	25,037	218001006 (por.) 218001009

Kuleana Parcels: None.

Figure 8. Historical changes to Kahikinui Forest Reserve with the year of addition/withdrawal indicated



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Documented Activities/Leases/Deeds/Permits: Information on the historical land use agreement issued for Kula FR are listed in Table 5. Documentation could not be found of land use agreements issued for the Papa'anui Tract of Kahikinui FR.

Table 5. Historical land use agreements in Kula FR.

Type of Action	Action Number	Duration	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Lease	N/A	? to 1-Nov-1911	Lease to Cornwell Ranch for grazing purposes	N/A	N/A	N/A
Land License	GL533	12-Aug-1901 to 11-Aug-1921	Henry Waterhouse Trust Co. Ltd., as trustees for James H. Raymond & Phoebe K. Raymond to conduct surplus water from Polipoli Spring to private holdings	N/A	N/A	N/A
Lease	GL542	20-Sept-1902 to 19-Sept-1922	Henry Waterhouse Trust Co. Ltd., as trustees for James H. Raymond & Phoebe K. Raymond granting access to Government lands at Kamaole to construct and maintain water infrastructure	N/A	N/A	N/A
Right of Way	No. 1363	24-Aug-1921 to 23-Aug-1936	ROW issued to J.H. Raymond, C.D. Lufkin & D.H. Case granting them access across Government lands at Kamaole, to construct and maintain water infrastructure to remove water from Polipoli Spring	N/A	N/A	N/A
Lease	GL2518	13-Nov-1936 to 13-Nov-1957	Lease issued to Ulupalakua Ranch, Ltd for a pipeline right of way	2.43	8080	222007003
Permit	RP2412	13-Nov-1957 to 31-Mar-2010	Permit issued to Ulupalakua Ranch, Ltd for a pipeline right of way	2.43	8080	222007003
Permit	RP7581	01-Apr-2010 to Current	Permit issued to Ulupalakua Ranch, Inc. for a pipeline right of way	2.43	8080	222007003

E. Vegetation: According the Hawai'i Gap Analysis Program (GAP), Kula FR and Papa'anui are dominated by non-native forest (42% of total land cover) and native shrubland (42% of total land cover; Figure 9). Given that reforestation was an underlying reason for designation of Kula FR it is not surprising that the lower elevations are primarily composed of non-native plantation timber that was planted with the intention of developing a resource base for possible future harvest.

Figure 9: Vegetation cover of Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR (Hawai‘i GAP 2005)

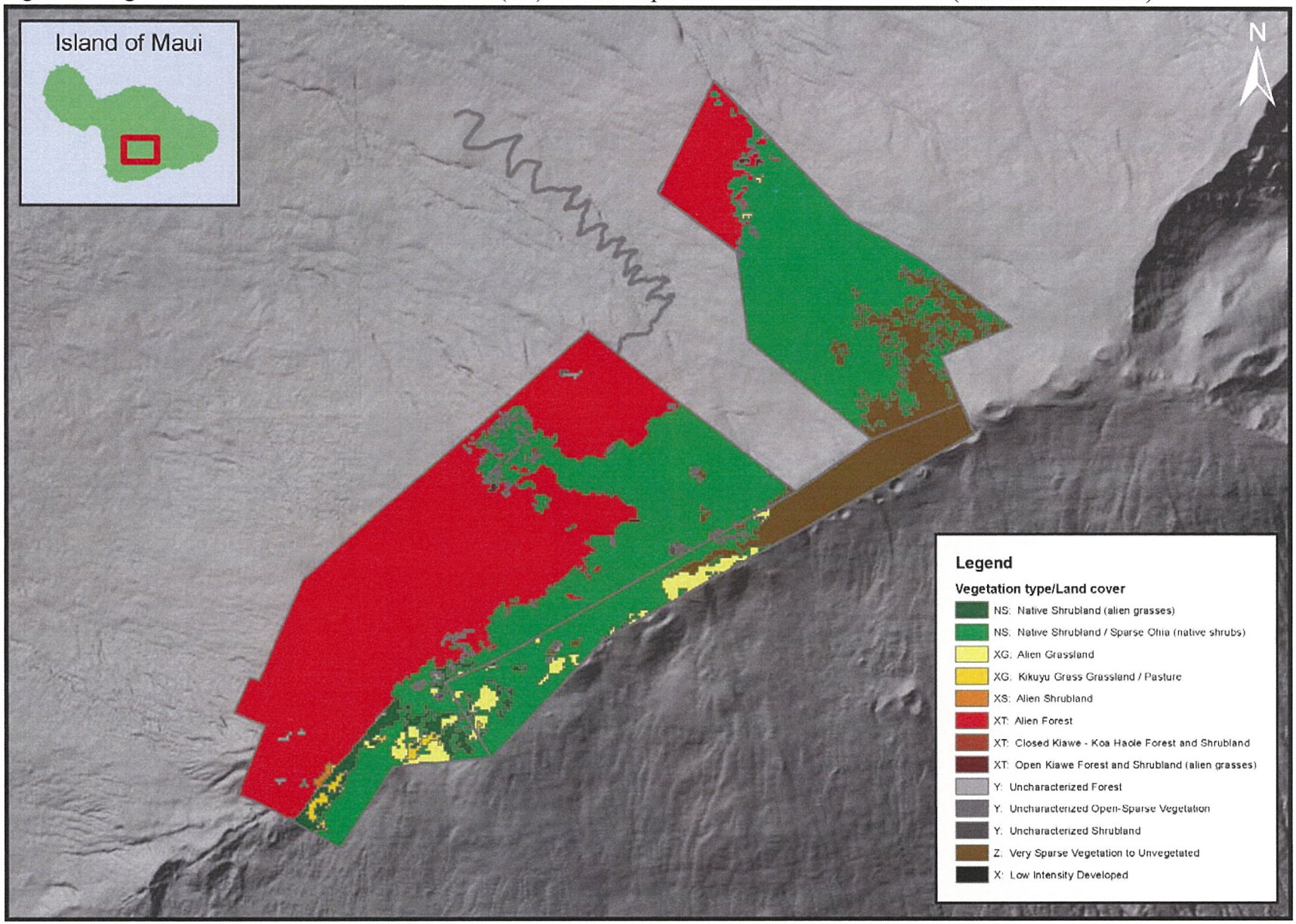

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Figure 10. Native shrublands of Kula FR

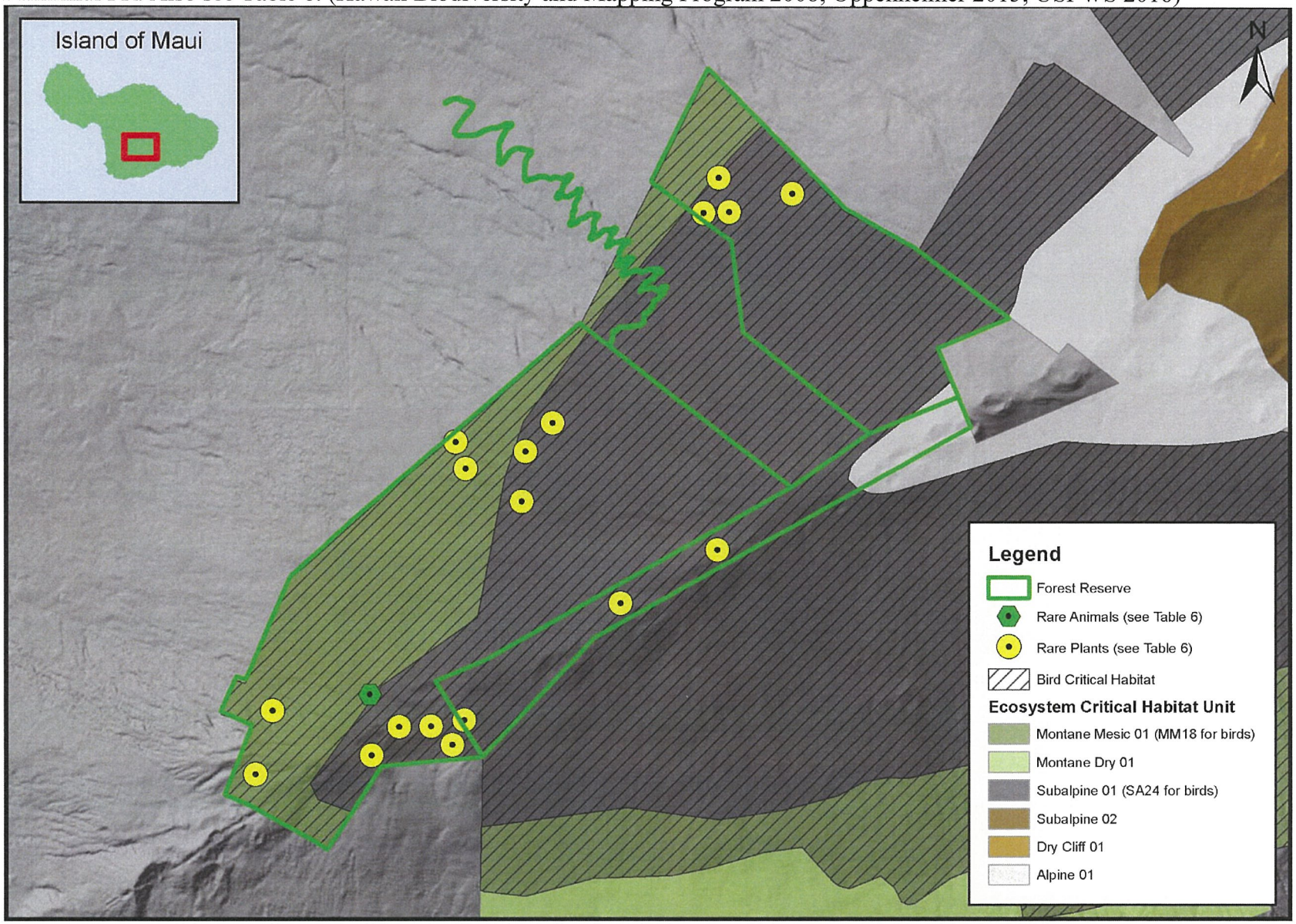
The upper slopes are dominated by native shrublands which are composed primarily of māmane, ʻaʻaliʻi (*Dodonaea viscosa*), pūkiawe (*Leptecophylla tameiameiae*), ʻōhiʻa and koa. Draft DOFAW management guidelines for the native shrubland areas will prevent activities or intensities of use that result in the degradation of native plant or animal communities. The highest reaches of Papaʻanui on the other hand is sparsely vegetated to unvegetated (10% of the total land cover) due to environmental conditions. For a more detailed list of plant species found in both reserves see Appendix A.

Rare and Endangered Plants: There is one threatened and four endangered plant species currently known to exist in Kula FR and Papaʻanui (Table 6 and Figure 11). Rare and endangered species in Hawaiʻi are listed under and protected by the Federal Endangered Species Act (ESA) and the State Endangered Species Law, Chapter 195D, HRS. Three of these plants species are managed by the Plant Extinction Prevention Program (PEPP) of Hawaiʻi. The mission of PEPP is to protect the rarest native Hawaiian plants from extinction. PEPP works to reverse the trend toward extinction by managing existing populations, collecting seeds and establishing new populations with a focus on species that have fewer than 50 plants remaining in the wild. Members of the Hawaiʻi Rare Plant Restoration Group, of which DOFAW is a founding member, provide oversight to PEPP and botanical expertise when necessary. PEPP regularly collaborates with over 60 conservation partners and landowners to protect PEPP species under their jurisdiction.

Table 6. Rare and endangered plants and animals observed within Kula FR (HBMP 2008 and Oppenheimer 2015). Observation are considered historical if it occurred more than 30 years ago.

	Species	Current/ Historical	ESA	PEP Species
Plants	*Argyroxiphium sandwicense* subsp. *macrocephalum*	Current (outplanted)	Threatened	No
	Asplenium dielerectum (*Diellia erecta*)	Current	Endangered	Yes
	Bidens micrantha subsp. *kalealaha*	Current	Endangered	No
	Cystopteris douglasii	Current		No
	Diplazium molokaiense	Current	Endangered	Yes
	Dubautia platyphylla	Current		No
	Geranium arboreum	Current	Endangered	Yes
	Phyllostegia ambigua	Current		No
	Sanicula sandwicensis	Current		No
	Sicyos cucumerinus	Current		No
	Stenogyne microphylla	Current	Candidate	No
Animals	*Lasirus cinereus semotus*	Current	Endangered	N/A
	Branta sandvicensis	Current	Endangered	N/A

Figure 11. Threatened and Endangered Species and Critical Habitat in Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR. Also see Table 6. (Hawaii Biodiversity and Mapping Program 2008; Oppenheimer 2015; USFWS 2016)



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Plant Critical Habitat: As outlined by the ESA, 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). The entire Kula Forest Reserve (4931 acres) has been designated as Critical Habitat and contains three ecosystem units that protect a total of 26 plant species. Papa'anui has also been designated as Critical Habitat (714 acres) and contains two ecosystem units that protects a total of eight plant species (Table 7 and Figure 11).

Table 7. Ecosystem Critical Habitat Designation in Kula FR and Papa'anui (USFWS 2016)

Species name	**Critical Habitat Ecosystem Unit**		
Plants	**Montane Mesic 1**	**Subalpine 1**	**Alpine 1**
Argyroxiphium sandwicense ssp. *macrocephalum*	x	x	x
Asplenium dielerectum	x		
Asplenium peruvianum var. *insulare*	x	x	
Bidens campylotheca ssp. *pentamera*	x		
Bidens micrantha ssp. *kalealaha*	x	x	
Clermontia lindseyana	x		
Cyanea glabra	x		
Cyanea hamatiflora ssp. *hamatiflora*	x		
Cyanea horrida	x		
Cyanea kunthiana	x		
Cyanea mceldowneyi	x		
Cyanea obtusa	x		
Cyrtandra ferripilosa	x		
Cyrtandra oxybapha	x		
Diplazium molokaiense	x		
Geranium arboreum	x	x	
Geranium multiflorum	x	x	
Huperzia mannii	x		
Melicope adscendens	x		
Neraudia sericea	x		
Phyllostegia bracteata	x	x	
Phyllostegia mannii	x		
Santalum haleakalae var. *lanaiense*	x		
Schiedea haleakalensis		x	
Wikstroemia villosa	x		
Zanthoxylum hawaiiense	x	x	
Birds	**Montane Mesic 18**	**Subalpine 24**	**N/A**
Palmeria dolei	x	x	
Pseudonestor xanthophrys	x	x	

Timber Species: The first commercial forest product industry in Hawai'i started in 1791, with the harvesting of sandalwood. Sandalwood is prized for its fragrant wood and is a valuable commodity in international trade. There are six endemic species of sandalwood or 'iliahi (*Santalum* spp.) and by the 1830's they were depleted from the forests of Hawai'i (Merlin et al. 1990). Since the sandalwood trade, a sustainable wood-based export market has not developed in Hawai'i due to less expensive forest products that are available from the Pacific Northwest and Southeast Asia.

Figure 12. 'Iliahi (Kula FR)

There are a number of mid to large-scale timber plantations both on public and private lands throughout the state. In the late 1800's, ranchers and sugar plantations began replanting efforts to replace the forests that were lost due to fire, cattle grazing, and harvesting for fence posts and fuel wood for whaling ships and sugar mills. The Territorial Government also had a tree planting program in which they utilized both introduced and native trees species. Reforestation was primarily done to protect and replenish fresh water resources, but was also done with commercially valuable timber species planted with the intention of developing a resource base for possible future harvest. In the 1930's, the CCC greatly expanded watershed reforestation efforts on Maui (Wong et al. 1969). By the 1960's, Kula Forest Reserve had 63 plantation plots encompassing approximately 1819.12 acres (Figure 14). There are no timber plantation plots in Papa'anui. Species that were planted and are still present in Kula FR include:

- *Chamaecyparis lawsoniana* (Port Orford cedar)
- *Cryptomera japonica* (sugi)
- *Cunninghamia lanceolata* (China fir)
- *Cupressus macrocarpa* (Monterey cypress)
- *Eucalyptus globulus* (bluegum)
- *Eucalyptus* spp.
- *Fraxinus uhdei* (tropical ash)
- *Paraserianthes lophantha* subsp. *montana* (plume albizia)
- *Pinus patula* (patula pine)
- *Pinus pinaster* (maritime pine)
- *Pinus radiata* (Monterey pine)
- *Sequoia sempervirens* (redwood)
- *Thuja plicata* (western red cedar)

Figure 13. Salvage harvest of Monterey pine (Pinus radiata) in Kula FR

DOFAW's Draft Management Guidelines classify Forest Product Management into four categories: Large Scale Commercial (F-1), Small Scale Commercial (F-2), Personal Use (F-3), and Restricted (F-4). Kula FR contains two of the four possible Forest Product Management categories (Figure 15). Approximately 2,395 acres are classified as F-2, where limited small-scale (no more than 5% of the total F2 acreage for each forest reserve, annually) commercial timber harvesting or salvage is allowed. Harvesting of non-timber forest products is also allowed. Approximately 2,506 acres are classified as F-4, where forest products are not a

Figure 14. Plantation timber stands in Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR (Klingensmith 1969)

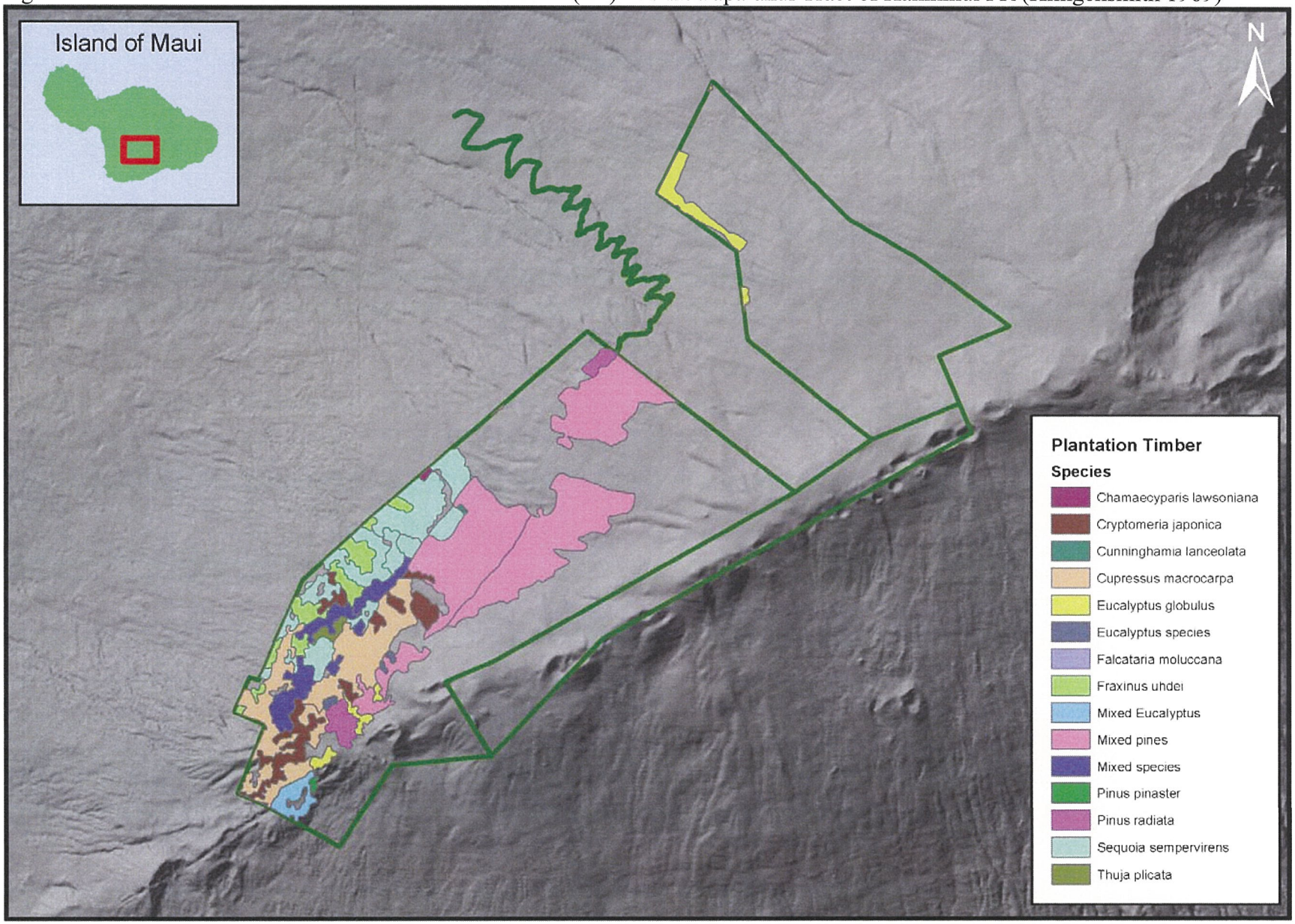

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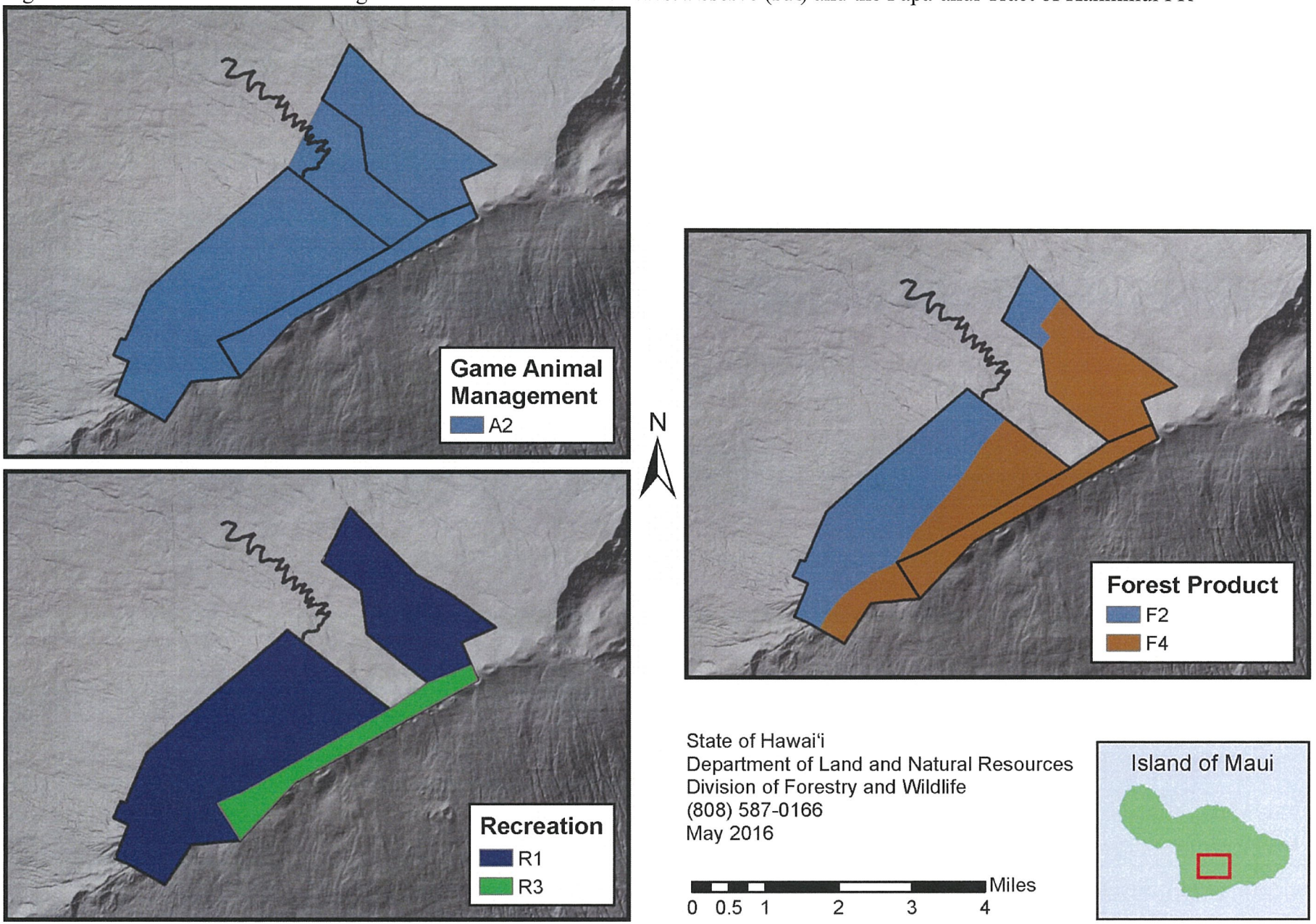
Figure 15. DOFAW 2001 Draft Management Guidelines for Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR



primary objective. Harvesting of timber products is not allowed. Harvesting of non-timber forest products is generally not allowed and will be considered on a case by case basis for improving forest health, watershed protection, cultural uses and conservation efforts. All of Papa'anui (714 acres) is also classified as F-4 (Figure 15). All classification levels have restrictions regulated by DOFAW and require appropriate permits and/or licenses. DOFAW is currently in the process of updating its Management Guidelines.

The Division does not have any current plans for large scale timber harvesting in Kula FR or Papa'anui, but may issue commercial salvage permits for the purpose of purchasing and removing dead or hazardous trees. Each application for a commercial salvage permit shall be considered on its own merits, including its effect on the premises, natural resources and the public's use and enjoyment of the forest reserve. 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. The Division currently has no plans for any large-scale species replaced of non-native timber.

F. Wildlife:

Figure 16. nēnē (left); 'ōpe'ape'a (right)

Native Wildlife: Two endangered animal species that are protected by both state and federal regulations have been documented to occur in Kula FR and Papa'anui (Table 6, Figure 11), the endangered Hawaiian hoary bat 'ōpe'ape'a (*Lasirus cinereus semotus*) and the nēnē or Hawaiian goose (*Branta sandvicensis*). Four additional native forest birds were documented in Kula FR (Table 8) during a comprehensive forest bird survey (Motyka 2013; Appendix B) that was completed in 2013, the Maui 'alauahio (*Paroreomyza montana newtoni*), 'apapane (*Himatione sanguinea*), i'iwi (*Vestiaria coccinea*), and the Hawai'i 'amakihi (*Chlorodrepanis virens*). Other

species of Hawaiian birds that have been observed in Kula FR are the pueo (*Asio flammeus sandwichensis*) and the kōlea (*Pluvialis fulva*). The ʻapapane, Hawaiʻi ʻamakihi, and kōlea are also know to occur in Papaʻanui (Table 9).

The endangered ʻuaʻu, or Hawaiian petrel (*Pterodroma phaeopygia sandwichensis*) is one of two seabirds that are endemic to Hawaiʻi. Nesting colonies are known to occur in remote montane habitats, and ʻuaʻu require dark corridors as they transit to and from the ocean. Artificial lighting causes disorientation, collision, and increased predation when birds are grounded. While there are no documented sightings or nesting colonies of ʻuaʻu within Kula FR and Papaʻanui, given the proximity to existing populations, the availability of suitable habitat and anecdotal accounts of hearing ʻuaʻu calls at Ballpark (Papaʻanui) it is highly probable that they are present in the FR.

Three species of endemic fruit flies (family Tephritidae) in the genus *Trupanea* (*T. crassipes, T. cratericola and T. limpidapex*) have recently been documented to occur in Papaʻanui. Larvae and pupae of these native flies are commonly found in the seed heads, shoot tips, and stem gall of plants in the Asteraceae family. Native Tephritid surveys in 2010 and 2011, found that the native sub-alpine habitat of East Maui contained the largest population on the island, and four plant genera served as hosts for these native flies, *Artemisia*, *Bidens*, *Dubautia* and *Argyroxiphium*. Native Tephritid flies seem to be restricted to areas with intact native ecosystems and seem to have vanished from the lowlands (Starr 2011).

Figure 17: Trupanea cratericola on Haleakalā silversword flowers

Animal Critical Habitat: There is currently critical habitat for two species of forest birds, the ʻākohekohe (*Palmeria dolei)* and the kiwikiu (*Pseudonestor xanthophrys*) in Kula FR and Papaʻanui (Table 7 and Figure 11).

Non-Native Wildlife: A wide variety of introduced birds exist across the island of Maui. Twenty-one non-native forest and game birds (Table 8 and Table 9) are known to occur in Kula FR and Papaʻanui. There are a total of nine non-native mammals that have been documented in these reserves and are listed below in Table 8 and Table 9.

Table 8. Wildlife found in Kula FR

Species	Common name	Native/Non-native	Game species
Birds			
Acridotheres tristis	common myna	Non-native	No
Alauda arvensis	(Eurasian) Skylark	Non-native	No
Alectoris chukar	Chukar	Non-native	Yes
Asio flammeus sandwichensis	pueo	Native	No
Branta sandvicensis	nēnē	Native	No

Table 8. continue

Species	Common name	Native/Non-native	Game species
Callipepla californica	California quail	Non-native	Yes
Cardinalis cardinalis	Northern cardinal	Non-native	No
Chlorodrepanis virens	Hawai'i 'amakihi	Native	No
Columbia livia	rock dove	Non-native	No
Francolinus francolinus	black francolin	Non-native	Yes
Francolinus pondicerianus	gray francolin	Non-native	Yes
Garrulax canorus	melodious laughing thrush	Non-native	No
Geopelia striata	barred dove	Non-native	No
Haemorhous mexicanus	house finch	Non-native	No
Himatione sanguinea	'apapane	Native	No
Horornis diphone	Japanese bush warbler	Non-native	No
Leiothrix lutea	red-billed leiothrix	Non-native	No
Lonchura punctulata	nutmeg mannikin	Non-native	No
Meleagris gallopavo	wild turkey	Non-native	No
Mimus polyglottos	Northern mockingbird	Non-native	No
Paroreomyza montana newtoni	Maui 'alauahio	Native	No
Phasianus colchicus	common "ring-necked" pheasant	Non-native	Yes
Pluvialis fulva	Pacific golden plover	Native	No
Spilopelia chinensis	spotted dove	Non-native	Yes
Tyto alba	barn owl	Non-native	No
Vestiaria coccinea	'i'iwi	Native	No
Zenaida macroura	mourning dove	Non-native	No
Zosterops japonicus	Japanese white-eye	Non-native	No
Mammals			
Axis axis	axis deer	Non-native	Yes
Capra hircus	goat	Non-native	Yes
Felis catus	cat	Non-native	No
Herpestes auropunctatus	mongoose	Non-native	No
Lasirus cinereus semotus	'ōpe'ape'a	Native	No
Mus musculus	House mouse	Non-native	No
Rattus rattus	Black rat	Non-native	No
Rattus exulans	Polynesian rat	Non-native	No
Sus scrofa	pig	Non-native	Yes

Table 9. Wildlife found in Papa'anui

Species	Common name	Native/Non-native	Game species
Birds			
Alauda arvensis	(Eurasian) Skylark	Non-native	No

Table 9. continue

Species	Common name	Native/Non-native	Game species
Alectoris chukar	Chukar	Non-native	Yes
Branta sandvicensis	nēnē	Native	No
Callipepla californica	California quail	Non-native	Yes
Chlorodrepanis virens	Hawai'i 'amakihi	Native	No
Haemorhous mexicanus	house finch	Non-native	No
Himatione sanguinea	'apapane	Native	No
Mimus polyglottos	Northern mockingbird	Non-native	No
Phasianus colchicus	common "ring-necked" pheasant	Non-native	Yes
Pluvialis fulva	kōlea	Native	No
Zosterops japonicus	Japanese white-eye	Non-native	No
Mammals			
Capra hircus	goat	Non-native	Yes
Felis catus	cat	Non-native	No
Herpestes auropunctatus	mongoose	Non-native	No
Lasirus cinereus semotus	'ōpe'ape'a	Native	No
Mus musculus	House mouse	Non-native	No
Rattus rattus	Black rat	Non-native	No
Rattus exulans	Polynesian rat	Non-native	No
Sus scrofa	pig	Non-native	Yes

G. Access: There is public access to the majority of Kula FR and Papa'anui (Figure 18).

Vehicular Access: Polipoli Access Road (also known as Waipoli Access Road) crosses through private land and provides legal public access through the majority of Kula FR, ending at Kanahau Gate (also known as Yellow Gate). Only street legal 4x4 vehicles are allowed past the FR entrance gate.

Trails: Nā Ala Hele, the State of Hawai'i trail and access program (HawaiiTrails.org) has twelve interconnecting trails that provide additional public access in and around Kula FR and Papa'anui; Boundary Trail, Redwood Trail, Plum Trail, Tie Trail, Haleakalā Ridge Trail, Skyline Trail, Waiakoa Loop Trail, Upper Waiohuli/Waiakoa Trail, Lower Waiohuli Trail, Māmane Trail, and Polipoli Trail (Figure 18).

Boundary Trail is 4.4 miles long, and begins from the Polipoli Access Road (Waipoli Access Road) near the second cattle guard. The trail descends via switchbacks to the lower boundary of the reserve. It then contours above the fence line, and ends at the CCC camp located at a three-way junction with the Redwood and Plum Trail. Bicycles are allowed on Boundary Trail.

Figure 18. Public access routes to Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR

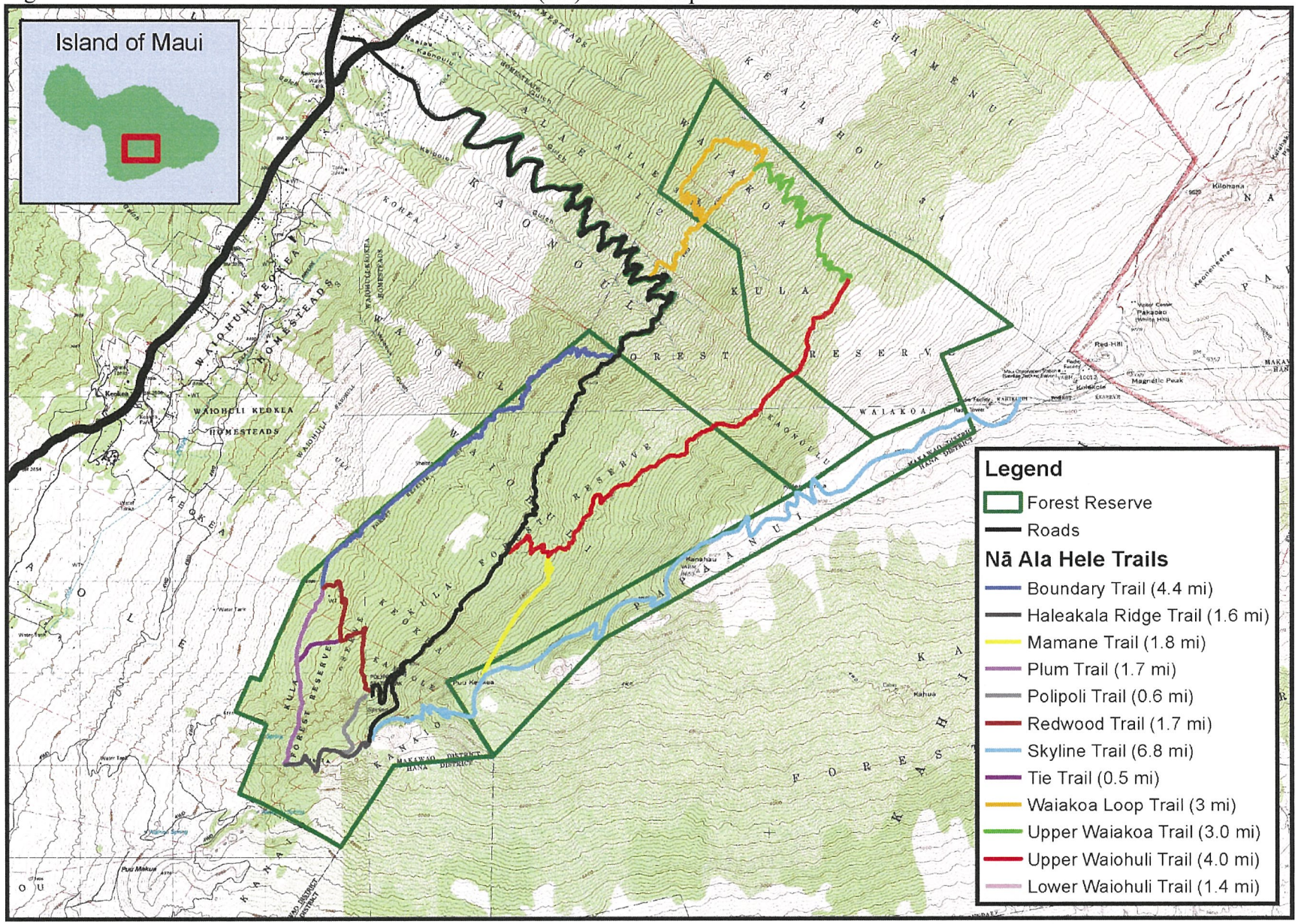


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Figure 19. Nā Ala Hele – Redwood Trail

Redwood Trail is 1.7 miles long, and starts at Polipoli Spring State Recreation Area. It winds through stands of redwoods and other conifers ending at the old CCC camp at a three-way junction with Plum and Boundary Trail. Bicycles are allowed on this trail.

Plum Trail is 1.7 miles long, and starts at the old CCC camp at the three-way junction with Redwood and Boundary Trail. It gradually climbs across the mountain passing through numerous plum trees that bear fruit during the summer. The trail ends when it hits the Haleakalā Ridge Trail. This trail is only approved for pedestrian use.

Haleakalā Ridge Trail starts at the end of Plum Trail. It heads west for 1.6 miles and ends where it connects to Skyline Trail. This trail is only approved for pedestrian use.

Skyline Trail is 6.8 miles long and begins along the Science City Access Road past Haleakalā National Park, and crosses the length of Papa‘anui. There are two locked gates along the trail and it ends where it connects to the Haleakalā Ridge Trail. The terrain is rugged and vegetation is sparse as it passes several cinder cones and craters along the length of the rift. Bicycles are allowed on this trail.

Waiakoa Loop Trail is 3 miles long and begins from Polipoli Access Road at the Hunter’s check-in station near the top of the switchbacks. There is a 4-wheel drive only road (which may be impassible) that contours for 0.75 miles to a gate where the loop trail starts.

Upper Waiohuli/Waiakoa Trail is 7 miles long, and begins along Polipoli Access Road at about 6500 feet in elevation. From there it traverses across the mountain side through pine plantations and scrub vegetation. It crosses the private lands of Kaonoulu into Waiakoa, ending where it joins up with the Waiakoa Loop Trail. Bicycles are allowed on these two trails.

Lower Waiohuli Trail is 1.4 miles long and begins along Polipoli Access Road at about 6500 feet in elevation near the Upper Waiohuli/Waiakoa trailhead. The trail proceeds downslope and ends where it connects to the Boundary Trail. This trail is only approved for pedestrian use.

Māmane Trail is 1.8 miles long and passes though mixed native sub-alpine vegetation. To access this trail, take the Upper Waiohuli/Waiakoa Trail, and travel about ½ mile upslope to the trail junction. The trail ends where it connects to Skyline Trail. Bicycles are allowed on this trail.

Polipoli Trail begins at Polipoli Springs State Recreation Area. It passes through plantation stands of cypress, cedars and pines for 0.6 miles and ends where it joins up with Haleakalā Ridge Trail. This trail is only approved for pedestrian use.

With the growth of ecotourism in Hawai‘i, there is an increasing demand for commercial environmental tours that allow visitors to experience the natural resources of Hawai‘i through activities such as hiking. In accordance with Chapter 13-104-14, Hawai‘i Administrative Rules, suitable Nā Ala Hele program trails or accesses may be designated and approved for commercial

tour activities by the BLNR upon recommendation by DOFAW in consultation with the respective Trail and Access Advisory Council. Tour operators must obtain a permit from DOFAW to conduct any commercial activities on designated trails. There are eleven trails (Table 10) within Kula FR that are designated for commercial activity.

Table 10. Designated commercial trails in Kula FR and their established limits

Trail / Access Road	Allowed Activity	Maximum Number of Groups	Maximum Group Size
Boundary Trail	Pedestrian	3	12
Redwood Trail	Pedestrian	3	12
Plum Trail	Pedestrian	3	12
Tie Trail	Pedestrian	3	12
Haleakalā Ridge Trail	Pedestrian	3	12
Waiakoa Loop Trail	Pedestrian	2	12
Upper Waiohuli Trail	Pedestrian	2	12
Upper Waiakoa Trail	Pedestrian	2	12
Lower Waiohuli Trail	Pedestrian	1	12
Māmane Trail	Pedestrian	1	12
Polipoli Trail	Pedestrian	3	12

Designated Helicopter Landing Zones: None

Restricted Watershed: There are no restricted watershed areas on the island of Maui.

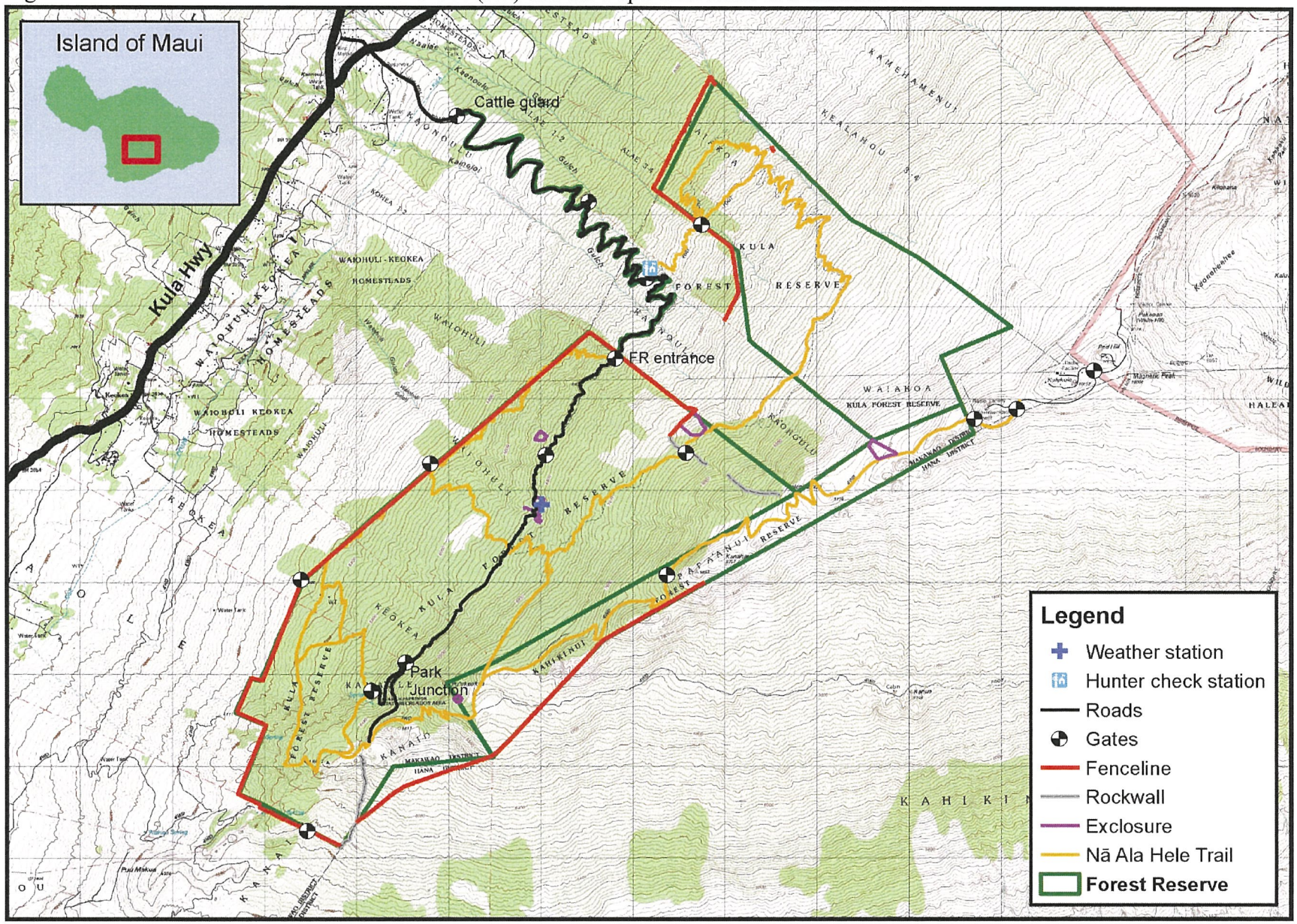
H. Infrastructure:

Figure 20. Cabin at Polipoli Spring State Recreation Area

Infrastructure in Kula FR and Papa'anui (Figure 21) are primarily for public access and recreation. There is a well-developed system of trails and a main access road (Polipoli Access Road) that ends at Kanahau gate (Yellow gate). There are a total of fifteen gates, a hunter check station, a weather station, and many miles of fence line along the FR boundary. There are also a few smaller rare plant exclosures located in both Kula FR and Papa'anui. The main road also provides access to the Polipoli Spring State Recreation Area, which is managed and maintained by the Division of State Parks. Facilities at the State Park include a cabin, camping facilities, flushing toilets and non-potable water.

I. Archaeological and Historical Sites: There are no documented archaeological sites in either Kula FR or Papa'anui (DOFAW lands only). There are some rock walls that were built by cattle ranchers more than 50 years ago that are located within the forest reserve. Some of the walls

Figure 21. Infrastructure of Kula Forest Reserve (FR) and the Papa‘anui Tract of Kahikinui FR



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0 0.25 0.5 1 1.5 2 Miles

Polipoli Access Road - Distance

Cattle guard to hunter check station	4 mi
Hunter check station to FR entrance	1.3 mi
FR Entrance to Park Junction	2.9 mi
Park Junction to Cabin	0.6 mi

were also built by the forest ranger along the boundary in the early 1920's to keep cattle out of the forest reserve. These structures meet the definition of "historic property" as defined in Section 6E-2, HRS, and 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.

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 [AMP] or a preservation plan [PP]) 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.

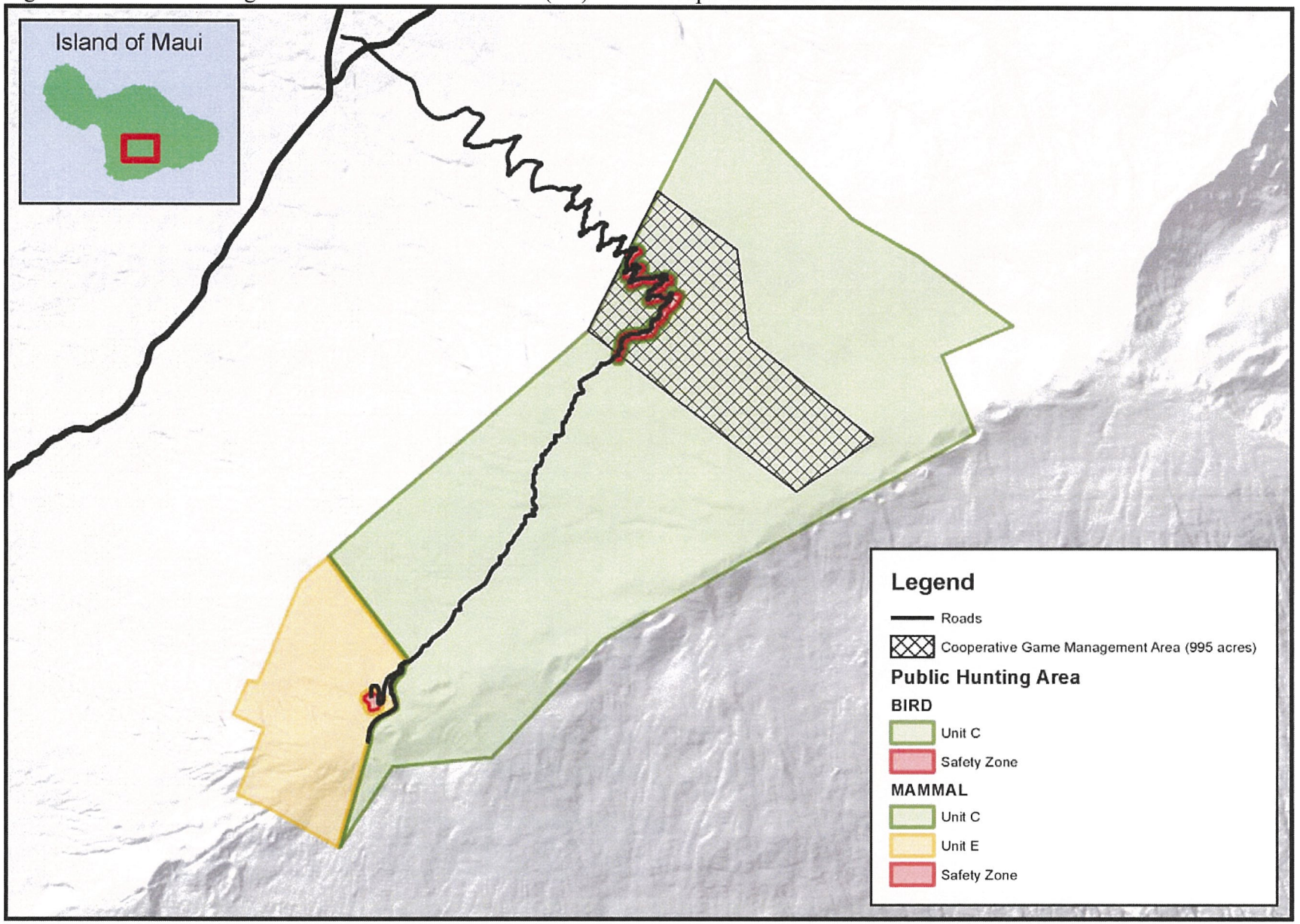
J. Public Use Opportunities:

Figure 22. Chukar (left); goats (right)

Hunting: DOFAW manages public hunting on all forest reserve lands on Maui and regulates hunting days, seasons, bag limits, and means of take. The Division of Conservation and Resources Enforcement (DOCARE) enforces hunting regulations found in Chapter 121, HAR Rules Regulating the Hunting of Wildlife on Public Lands and Other Lands, Chapter 122, HAR Rules Regulating Game Bird Hunting, and Chapter 123, HAR Rules Regulating Game Mammal Hunting.

The state lands that comprise Kula FR are separated into two non-contiguous pieces by privately held land (Figure 23) that is currently owned by Kaonoulu Ranch. In 1955, an agreement was negotiated with the ranch to allow public hunting on the approximately 994 acres of tax map keys (2) 2-2-007:002 and (2) 2-2-007:010. On September 11, 1998, the Board approved a Cooperative Game Management Agreement (CGMA) for the subject area, replacing the original agreement that had expired by that time. DOFAW continues to manage the area as a CGMA.

Figure 23. Public Hunting Area in Kula Forest Reserve (FR) and the Papa‘anui Tract of the Kahikinui FR



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Kula Forest Reserve, Papa'anui, and the Kaonoulu CGMA are all part of hunting unit C, and a small portion of Kula FR is included within unit E (Figure 23). Game mammals found within these hunting units consist of feral pigs (*Sus scrofa*), goats (*Capra hirca*), and axis deer (*Axis axis*). Game birds in hunting unit C include: Common pheasant (*Phasianus colchicus*), black francolin (*Francolinus francolinus*), chukar partridge (Alectoris chukar), gray francolin (Francolinus pondicerianus), California quail (*Callipepla californica*), barred doves (*Geopelia striata*), and spotted dove (*Streptopelia chinensis*).

DOFAW's 2001 Draft Management Guidelines separate Game Animal Management into four categories: Game Production (A-1), Mixed Game and Other Uses (A-2), Game Control (public) (A-3), and Game Control (supervised) (A-4). All lands within Kula FR (4931 acres), Papa'anui (714 acres), and the CGMA (994) are classified as A-2, where game management is an objective integrated with other uses (Figure 15). DOFAW is currently in the process of updating its Management Guidelines.

General Recreation: DOFAW's 2001 Draft Management Guidelines consist of four categories for Recreation Management: R-1 (Heavy Use Areas), R-2 (Medium Use Areas), R-3 (Light Use Areas), and R-4 (Restricted Areas). The entire Kula Forest Reserve is designated as R-1 (4931 acres); these are areas where outdoor recreation is a primary objective (Figure 15). R-1 areas may have highly developed recreational facilities such as check-in stations, camp sites, utilities and parking lots. Kula Forest Reserve is a popular day use area on Maui; it is easily accessible and has trails that are that are appropriate for all age levels. Papa'anui is designated as R-3 (714 acres); these are areas where recreation would be limited to certain areas, or occasional levels of use due to impacts on resources programs (Figure 15). Trails would be the main recreational feature, and their use may be restricted. DOFAW is currently in the process of updating its Management Guidelines.

Camping: Camping is only allowed at the Polipoli Spring State Recreation Area, which is managed by the DLNR Division of State Park. Camping permits for the state park are available online at https://camping.ehawaii.gov/.

Figure 24. Camping grounds at Polipoli Spring State Recreation Area

Fishing: No fishing opportunities are available in Kula FR or Papa'anui.

Hiking: There are twelve Nā Ala Hele hiking trails in Kula FR and Papa'anui. See section G: Access above for more details.

Horseback Riding: Horseback riding is not permitted in Kula FR or Papa'anui. See section G: Access above for more details.

Dirt Bikes, All Terrain Vehicles (ATVs) and Mountain Bikes: Starting from the FR Entrance gate (Figure 21), only street legal 4WD vehicles are allowed on Polipoli Access Road through Skyline trail up until Kanahau Gate; non-motorized mountain bikes may be used on Boundary Trail, Māmane Trail, Redwood Trail, Skyline trail, Waiakoa Loop Trail and Upper Waiohuli/Waiakoa Trail.

Non-Timber Forest Product Collection: Non-timber forest products may be collected within the Reserves. Examples include but are not limited to:

a. Ferns
b. Flowers
c. Fruits
d. Guava poles (*Psidium* spp.)
e. Bamboo shoots and stalks
f. Greenery
g. Pine boughs

Figure 25. Pine cones (Kula FR)

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, 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.

http://dlnr.hawaii.gov/forestry/files/2013/09/Forest-Product-Price-List.pdf\

Collection of:

1. Listed threatened, endangered, or other rare species, or
2. Common invertebrate species, or
3. Any migratory bird species,

are 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 Maui office. Both addresses follow:

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

Maui District Manager
Division of Forestry and Wildlife
1955 Main St. Rm 301
Wailuku, HI 96793
Phone (808) 984-8100

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. In the Constitution of the State of Hawai'i, Article XII, Section 7, "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 Forestry Manager at the DOFAW Maui Office:

Forestry Manager
Division of Forestry and Wildlife
1955 Main St. Rm 301
Wailuku, HI 96793
Phone (808) 984-8100

K. Threats:

Plants: Invasive plants are non-native species that can invade natural areas, grow and reproduce rapidly, reduce biodiversity and alter ecosystem functions. Invasive plant species that are present in Kula FR and Papa'anui that have the potential to disrupt the ecosystem are listed in below in Table 11. For a brief description of each species, their statewide distribution and impacts see Appendix C. Based on potential impacts, distribution in the FR, and available control methods, DOFAW has set a management objective (control, containment or eradication) for each species.

Figure 26. Fireweed (Kula FR)

Invasive plant management objectives:

- Control – Reduce populations and/or the vigor of individuals
- Containment – Stops or minimizes population growth and geographic spread
- Eradication – Elimination of populations within geographic area

Many of these species are also designated as a noxious weed 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.

Table 11: Invasive plants species that occur in Kula FR and Papa'anui

Species	**Common name**	**DOFAW Objective**	**Regulatory Status**
Acacia mearnsii	black wattle	Containment	Hawai'i Noxious Weed List
Bocconia frutescens	tree poppy	Eradication	Hawai'i Noxious Weed List
Cortaderia jubata	pampas grass	Eradication	Hawai'i Noxious Weed List
Cotoneaster pannosa	silverleaf cotoneaster	Control	None
Morella faya	fire tree	Control	Hawai'i Noxious Weed List
Passiflora tarminiana	banana poka	Eradication	Hawai'i Noxious Weed List
Rubus argutus	blackberry	Control	Hawai'i Noxious Weed List
Rubus niveus	Mysore raspberry	Control	Hawai'i Noxious Weed List
Senecio madagascariensis	fireweed	Control	Hawai'i Noxious Weed List
Sphaeropteris cooperi	Australian tree fern	Eradication	None
Ulex europaeus	gorse	Eradication	Hawai'i Noxious Weed List

Animals: Non-native animals that are present in Kula FR and Papa'anui and have the potential to disrupt the ecosystem include:

- *Axis axis* (axis deer) - Cause vegetation damage/erosion.
- *Canis lupus familiaris* (dogs) - Predate on native birds, game mammals and game birds. Threat to public safety.
- *Capra hircus* (goats) - Cause vegetation damage/erosion.
- *Culex* spp. (mosquitoes – especially *Culex quinquefasciatus*) - Vectors for diseases that are a threat to public safety and native wildlife.
- *Felis catus* (cats) - Predate on native and game birds and are vectors of toxoplasmosis, a zoonotic disease
- *Herpestes auropunctatus* (mongoose) - Predate on native and game birds.
- *Rattus* spp. (rats) - Predate on native plant fruits/seeds and native and game birds.
- *Sus scrofa scrofa* (pigs) - Cause trail and vegetation damage.
- *Tyto alba* (barn owl) - Predate on native and game birds.

Insects & Disease: Introduction of insects and disease are a serious threat to the natural areas of Hawai'i. Of particular concern are those that could cause widespread dieback of predominant forest canopy species such as koa and 'ōhi'a. With globalization and an increased dependence on imports, approximately 20 insect species become established in Hawai'i every year (DOFAW 2010).

Recent notable introduction of insects and disease include a rust species (*Puccinia psidii*) that decimated stands of rose apple (*Sygyzium jambos*) and has severely impacted the endangered plant species nīoi (*Eugenia koolauensis*). The erythrina gall wasp (*Quadrastichus erythrinae*) infested introduced and native populations of *Erythrina* or wiliwili to varying degree across the state. Koa wilt (*Fusarium oxysporum* f.sp *koae*) is a soil borne disease that is causing dieback and decline of koa primarily in lowland plantation stands on former agricultural land.

The Eurasian pine aphid (*Pineus pini*) was accidentally introduced and first documented at Waiki'i on the island of Hawai'i in 1970. Infestations were known to weaken and sometimes kill various pine species. Pines were used in reforestation efforts throughout Hawai'i, and concerns of widespread mortality triggered a statewide control effort by state and federal agencies. The Eurasian pine aphid was found at Makawao on Maui in 1971 during population distribution surveys. In 1973, two additional infestations were found at Waihou Spring FR and Kula FR. Aerial application of insecticides were initiated until strong public opposition halted these efforts. Three biological control agents were subsequently introduced to control the pine aphid (*Leucopis nigraluna*, *L. tapiae* and *Scymnus suturalis*). Several of the releases were done at "Polipoli" in Kula FR. Correlation analysis of population densities indicate that *L. tapiae* successfully controlled pine aphid populations to below economically significant levels (Culliney et al. 1988).

The most recent epidemic that has caused major concern is rapid 'ōhi'a death (ROD). ROD is caused by a fungus (*Ceratocystis fimbriata*) and currently has only been confirmed to occur on the island of Hawai'i. Hundreds of thousands of 'ōhi'a trees have been killed by this disease spanning across 75,000 acres of forest. Thus far ROD has not been detected on neighboring islands. An aerial survey for ROD has been completed for the island of Maui (*Figure 27*). Based on the results of the aerial survey the Division is currently collecting samples from targeted areas

to determine if ROD is present on the island. Visit the ROD website http://www.rapidohiadeath.org for more information on what can be done to help prevent the spread.

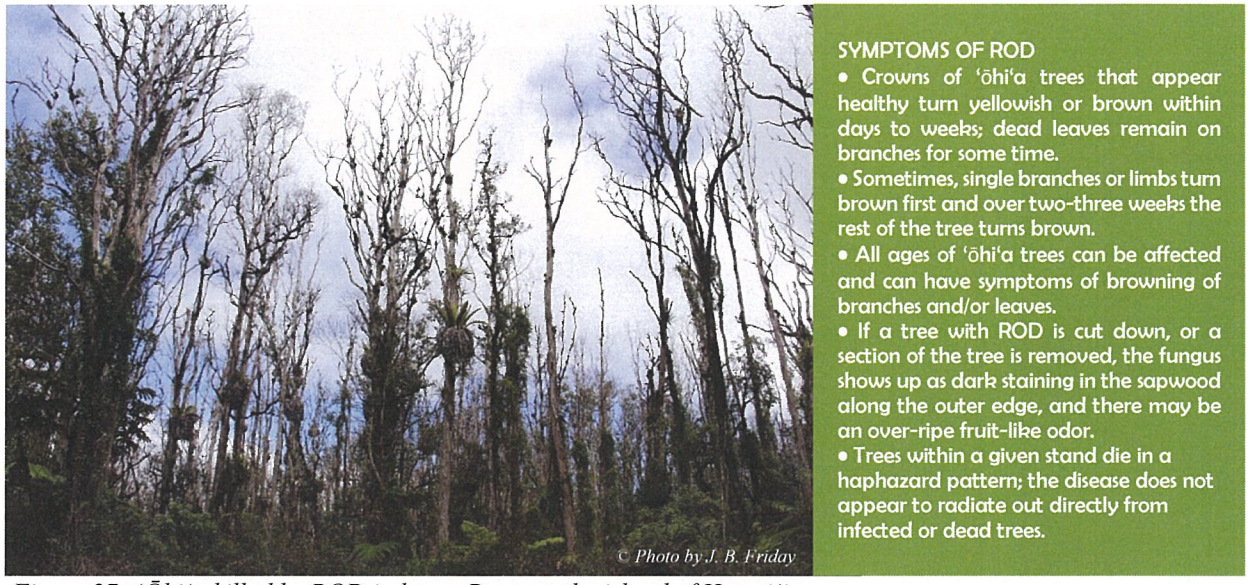


Figure 27: ʻŌhiʻa killed by ROD in lower Puna on the island of Hawaiʻi

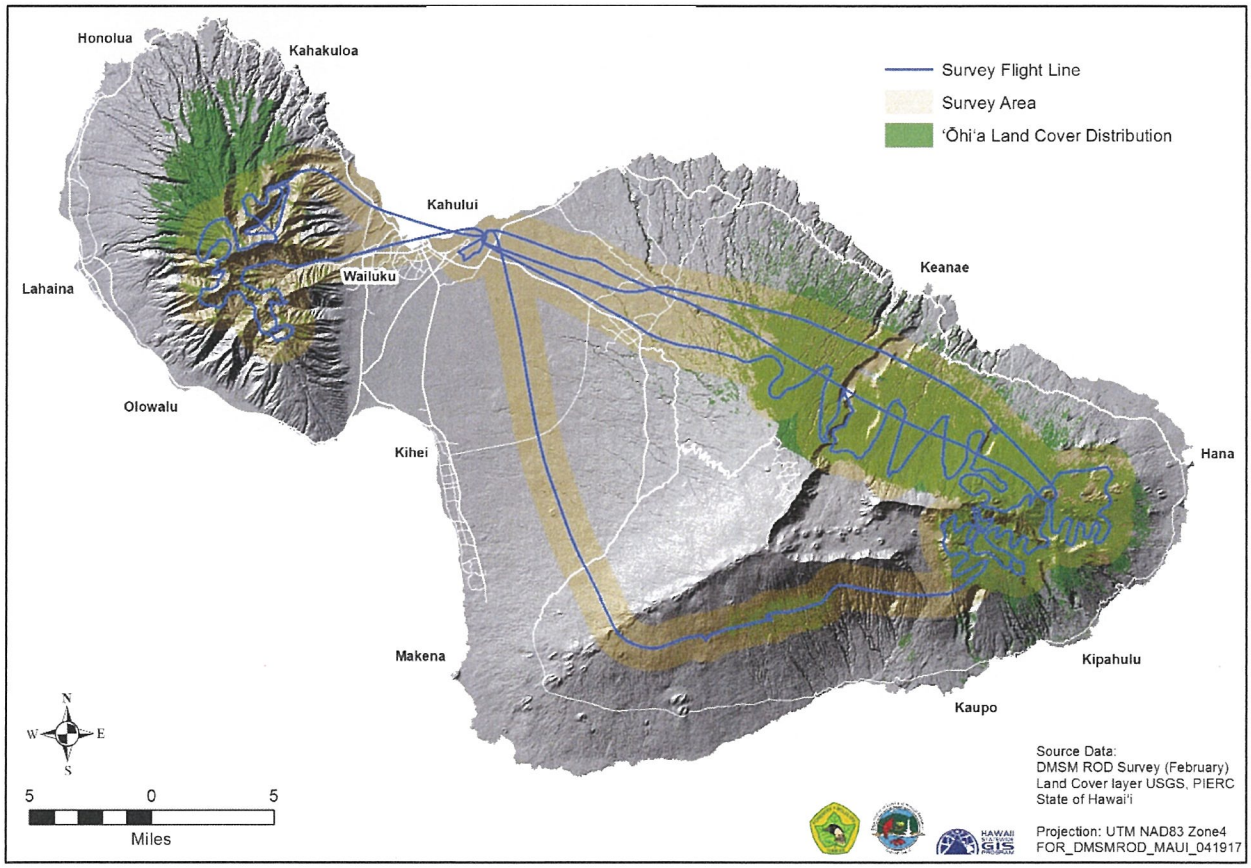


Figure 27. Maui Rapid ʻŌhiʻa Death Aerial Surveys (February 2017)

Fire: Native ecosystems in Hawai'i are not adapted to wildfire with the majority of plant species not being able to regenerate after a fire. Introduced fire adapted grasses and shrubs now cover 25% of the total land mass in Hawai'i (Trauernicht 2014). Combined with an increase in human caused ignition, this has resulted in a fourfold increase of area burned annually by wildfires in Hawai'i (Trauernicht and Pickett 2016). Wildfires are a serious threat to human safety and property, and impact native ecosystems, watersheds and near shore coastal resources statewide. Given that Kula FR is highly used by the public, and much of the vegetation consists of non-native forest and grasslands, fire risk for the area is high. There have been large fires in Kula FR in 1954, 1984, and 2007, that burned significant portions of the forest reserve.

Figure 28. Aftermath of 2007 Kula FR wildfire showing burned area and associated soil erosion

Flooding: Road conditions can become hazardous due to damage caused by flooding.

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), changes in species distributions, increasing ocean surface temperature and changing ocean chemistry.

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.

The primary mitigation for climate change involves actions to reduce emissions and enhance sinks of greenhouse gases. Maintaining and ideally increasing carbon storage within our forests will help decrease atmospheric carbon. 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.

Even with the above mitigation actions, forest ecosystems in Hawaii will face new climatic 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. The Pacific Island Climate Change Cooperative (PICCC) has started climate vulnerability assessment for Hawaii species, but additional information is needed at local scales to determine impacts within individual watersheds and forest reserves.

Other: There has been an ongoing problem of fenceline, gate (locks) and sign vandalism. Timber theft is infrequent but does take place in Kula FR. Illegal skateboarding that occurs along the Polipoli Access Road is also a problem and safety concern. Additionally, illegal off-road vehicle activity in Kula FR has been damaging the natural resources in this area. Illegal fire pits are being lit at night along the Polipoli Access Road and are an extreme fire hazard.

L. 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."

Commercial permits for non-timber forest products and small scale salvaging of dead or down timber are issued for Kula FR. There are other potential sources of future revenue that are under consideration. All trails in Kula FR except Skyline Trail are approved for commercial use. Permits are required for all commercial tour operations. There are no current revenue sources within Papa'anui.

III. MANAGEMENT

A. Past Planning: The Division of Forestry completed the first management plan for Kula Forest Reserve in 1971. The overarching goals of the 1971 management plan were: (1) to retard the rapid run-off of storm flows, prevent soil erosion, improve water quality, prolong periods of stream flow, and aid in recharging underground aquifers, (2) to produce forest products to the extent possible while maintaining conditions favorable for water conservation, recreation, and protection of native flora and fauna, (3) to develop and maintain a favorable environment and necessary facilities for outdoor recreation and wildlife habitat.

B. Related Plans: Plans that contain relevant information on the resources and management strategies pertinent to the management of Kula FR and Papa'anui are listed below.

- Leeward Haleakalā Watershed Restoration Partnership (LHWRP) Management Plan
- Hawai'i's State Wildlife Action Plan
- DOFAW Forest Action Plan
- Nā Ala Hele Program Plan

- DOFAW Draft Management Guidelines
- Maui Invasive Species Committee Strategic Plan
- USFWS Endangered Species Recovery Plans

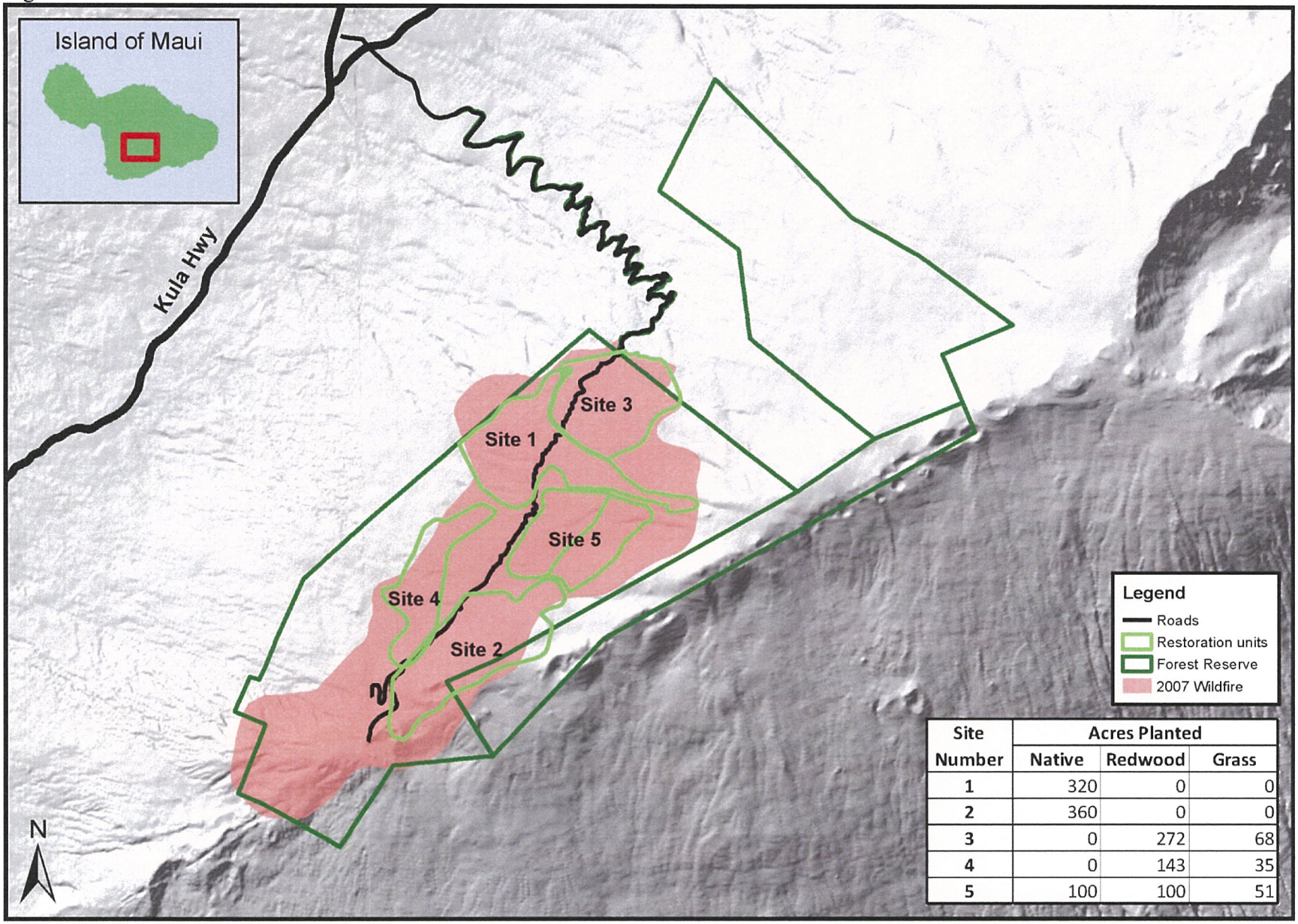
C. Summary of Existing Management Activities: Current management activities within Kula FR and Papa'anui are weed management (monitor, map, and control), biological surveys and monitoring, access road and infrastructure maintenance, boundary fence and rare plant exclosure maintenance, native and T&E outplanting, native plant seed collection and storage (seed banking), firebreak/fuelbreak maintenance, Nā Ala Hele trail maintenance, water unit maintenance for game bird species, predator control (mongoose, rat, and cats), and game habitat management which includes but not limited to black wattle (*Acacia mearnsii*) and invasive species removal.

Figure 29. Papa'anui silversword exclosure and outplanting

In 2007, a large wildfire burned approximately 2,300 acres of forested lands in Kula FR (Figure 30). The burned unit was dominated by mature forests comprised primarily of pines, cypress, and redwoods. This was the most devastating fire to have occurred in Hawai'i for many decades, and in response DOFAW planned and implemented a hazard reduction and reforestation operation in the aftermath of the Upper Waiohuli wildfire. On February 27, 2007, Governor Linda Lingle signed an Emergency Proclamation to help expedite DOFAW's mitigation and reforestation efforts.

As a result of the mitigation and restoration effort, DOFAW felled and chipped all hazardous standing or downed trees or debris along Polipoli Access Road from the FR entrance to Polipoli Spring State Recreation Area; repaired 6 miles of damaged fence line; hydromulched 2.9 miles of roadside to stabilize soils with a slurry of annual rye grass (*Lolium perenne*) and orchardgrass (*Dactylis glomerata*) seeds (species were selected based on recommendations by the USFWS); aerial broadcasted the same seed mixture for soil stabilization across 154 acres; planted 780 acres with native tree and shrub species, and planted 515 acres with redwoods to replace the plantation stands that were lost during the fire. A total of 212,000 trees and shrubs were outplanted during reforestation efforts.

Figure 30. Kula Forest Reserve 2007 Wildland Fire and Restoration Effort



Site Number	Acres Planted		
	Native	Redwood	Grass
1	320	0	0
2	360	0	0
3	0	272	68
4	0	143	35
5	100	100	51

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On August 7-9, 2014, Tropical Storm Iselle passed through the Hawaiian Islands, which caused extensive damage to the natural resources and infrastructure in Kula FR. The storm knocked over stands of trees that damaged approximately 3 miles of fence line, 2.5 miles of the Polipoli Access Road, and approximately 7 miles of Nā Ala Hele trails. Repair and hazard mitigation was completed in April 2015, and the forest reserve has since been reopened for public use.

D. Management Objectives and Goals: In the Draft Comprehensive Management Plan for each district of the Division, 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 eight categories (listed below) and shall be used to guide management activities within the forest reserve.

- Watershed Values (aquifer recharge and erosion control)
- Native Ecosystems (landscape level protection)
- Resource Protection (fire, insects, and disease)
- Invasive Species Control (incipient and established plants and animals)
- Threatened and Endangered (T&E) Species Management (Federally listed, State listed, and rare plants and animals)
- Access, Trails, and other Public Uses (non-income generating uses, such as recreation, cultural activities, personal gathering, educational or research activities, and events among others)
- Game Animal Management (areas managed for public hunting and/or habitat enhancement for game animals)
- Commercial Activity (income generating activities such as timber, tours, etc.)

Based on the natural and cultural resources and public use opportunities of the reserves, each category has been ranked on a qualitative scale of 1 to 8 with 1 as higher priority and 8 as lower priority. Table 12 is an excerpt from the Maui Forest Reserves Draft Comprehensive Management Plan and lists qualitative rankings of the management priority categories for Kula FR and Papa'anui.

Table 12. Kula Forest Reserve and Papa'anui associated management priority categories

Forest Reserve Section Name	Resource Protection	Watershed Values	Invasive Species Control	T&E Species Mgmt.	Native Ecosystems	Game Animal Mgmt.	Commercial Activity	Access, Trails, and other Recreational Uses
Kula	2	1	7	5	6	3	8	4
Papa'anui	6	1	2	3	5	4	8	7

Table 13 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. As the two Forest Reserves are in close proximity to each other and they have similar management priorities, they are treated as one in the following table.

Table 13. Management objectives and associated plans for Kula FR and Papa'anui. Estimated cost refers to State funds.

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
Watershed Values	Increase land holdings protected under the Forest Reserve System	Acquire or negotiate lease for neighboring properties.	Initiate discussions with parcel owners to acquire parcels for possible Forest Reserve designation. TMK (2) 2-3-005:002	Staff & mgmt. costs; market value
	Reduce the threat and impact of erosion on reserve resources	Maintain forest cover on watershed lands to provide high quality water for residents	Re-establishment of appropriate vegetative cover	$10K/year + staff costs
		Control ungulate populations at levels consistent with watershed protection needs	Encourage public hunting through outreach	Staff & mgmt. costs only
			Identify sensitive areas suitable for natural resource protection through ungulate exclusion fencing projects	Staff & mgmt. costs only
		Maintain ground cover	Regulate illegal timber and non-timber product harvesting,	Staff & mgmt. costs only
		Post fire mitigation	Collect and store seed stock for various native plant species to be used for post-fire mitigation work	$5K/year
			conduct post-fire mitigation such seed scatter, aerial broadcast, weed control, soil conditioning and reforestation.	TBD
		Exclude cattle from FR	Maintain boundary fences to comply with HRS Chapter 183	TBD
			Locate and remove cattle with owner's assistance	TBD
			Conduct staff controlled operations for non-game mammal species	Staff & mgmt. costs only
	Monitor forest composition over time to determine landscape level needs	Determine permanent systematic monitoring protocol	Establish survey plots and transects.	$30K/year
	Maintain DOFAW's partner role in the East Maui Watershed Partnership (EMWP) and LHWRP.	Improve communication and coordination between agencies	Establish regular communications, schedules, and protocols with WPs	Staff & mgmt. costs only
			Participate in WPs quarterly meetings	Staff & mgmt. costs only
			Annual renewal of Special Use Permits for EMWP and LHWRP	Staff & mgmt. costs only

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
	Climate Change Adaptation	Keep current on the latest available information for climate change, modeling and adaptation.	Participate in climate change seminars, meeting and workshops.	Staff & mgmt. costs only
Resource Protection	Fire presuppression and mitigation	Fire presuppression	Development of fire management and fuel reduction plans targeting fire prone and fire adapted plant species.	Staff & mgmt. costs only
			Seek opportunities and technical assistance regarding "small cable yarder" system; Initiate discussions and consultation with system experts to see if viable for fuel loads and terrain in FR	$7K/year
			Implement fuelbreak/firebreak maintenance projects along access road corridor	$100K/year
		Fire prevention	Work with State Parks Division to identify defensible spaces especially near camp sites and cabin facilities for programs such as Firewise and Ready Set Go.	Staff & mgmt. costs only
			Post Smokey Bear fire prevention signs at entrances/access point of Kula FR during high fire preparedness level.	Staff & mgmt. costs only
			Conduct traffic stops at entrance/access point into Kula FR during extreme fire preparedness level.	Staff & mgmt. costs only
			If ground conditions present extreme fire threat based on fire preparedness level, staff will conduct fire patrols once a week to extinguish smoldering pits and remove discarded excess fuels (pallets) from illegal fires.	Staff & mgmt. costs only
			If ground conditions present extreme fire threat based on fire preparedness level, DOFAW will close Kula Forest Reserve.	Staff & mgmt. costs only
		Public education and outreach	Participate in specific target outreach activities as appropriate based on fire preparedness levels.	Staff & mgmt. costs only

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
	Forest Health	Forest health monitoring and implementation of forest management practices	Conduct monthly forest health surveys. Compose and submit annual survey report to Forest Health Coordinator.	Staff & mgmt. costs only
			Rapid response to mitigate forest health issue.	Staff & mgmt. costs only
		Rapid ʻŌhiʻa Death (ROD) Early Detection and Management	Collaborate with partners to secure essential technical information and understanding of the threat	Staff & mgmt. costs only
			Assist and collaborate with partners to secure new information on mode of transmission	Staff & mgmt. costs only
			Conduct aerial surveys and trail user information surveys for early detection	$10K/year
			Based on the results of the aerial survey notify landowners and request access and or work with landowner to collect samples to test for ROD	TBD
			Document and report any sightings of dead or dying ʻōhiʻa trees in the field during routine operations	TBD
			Adopt sanitation procedures proven to be effective	$1K/year
			Develop and implement biosecurity measures in the event that ROD is detected in Maui Nui	Staff & mgmt. costs only
			Include ROD sanitation and prevention procedures in all permits designated for Kula FR	Staff & mgmt. costs only
		Increase public information and awareness for Rapid ʻŌhiʻa Death	Sign installation and replacement as needed	$5K/year + staff costs
	Monitor weather conditions	Maintain Remote Automated Weather Station (RAWS)	Contract site inspection and instrument rehab annually or as needed	$2K/year
		Use data to determine district fire preparedness levels	Implement fire preparedness level activities	Staff & mgmt. costs only
		Use data to monitor environmental conditions relating to forest health	Implement appropriate forest management activities	Staff & mgmt. costs only
Game Animal Management	Promote public hunting through Chapter 122 &	Improve hunter access	Acquire land and/or easements see above	$7K staff cost

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
	123, HAR and implement game management actions as provided in the PR Game Management Plan (2016)	Review existing long term strategic goals	Update 2001 DOFAW Animal Management Guidelines	$10K staff cost
		Determine population trends of game mammals	Conduct annual aerial and ground animal population surveys, harvest surveys and hunter participation surveys. Train incoming staff to collect information.	10K staff and helicopter time
		Public education	Continue hunter education program, other public outreach as required	$2K staff cost and materials
		Regulate hunting as per Chapter 122 ad 123, HAR	Manage bird and mammal hunting seasons.	Staff & mgmt. costs only
			Conduct pine control in the CGMA to maintain open area for game bird hunting.	Staff & mgmt. costs only
			Sustain game bird populations: construct, maintain, and inspect game bird water units.	$5000/year
T&E Species Management	Protection and recovery of listed rare plants and animals	Implement management and recovery of T&E species consistent with management guidelines and 2015 SWAP	PEPP staff and state botanists to conduct botanical surveys	Staff & mgmt. costs only
			Conduct surveys and monitoring efforts to obtain baseline data that will be used to help determine specific areas and to protect species of interest	Staff & mgmt. costs only
		Cooperate with PEPP, MFBRP, USFWS, SEPP, MNSRP, and other agencies to prioritize species protection	Build fence and maintain exclosures around wild populations of rare plants. Outplant T&E species into exclosures. Conduct predator and ungulate control as needed.	$10K each
			Build and maintain exclosures around wild populations of rare animal species. Conduct predator and ungulate control as needed.	$10K each
			Continue ongoing monitoring, surveys for presence, location, and population estimates of rare animals including Seabirds (Hawaiian petrel) and Hawaiian Hoary Bat	$10K/year
		Maintain infrastructure for all plant exclosures located within the FR	Inspect and maintain fence exclosure twice per year or as needed. Conduct predator and ungulate control as needed.	$5K and Staff & mgmt. cost.

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
Native Ecosystems	Determine landscape level needs	Native ecosystem restoration.	Common native outplanting (low priority action).	$10K/acre
	Re-evaluate DOFAW's 2001 Draft Management Guidelines regarding V-classifications	Consult with USFWS, TNC, HDOA, EMWP, LHWRP, and other agencies	Work with other agencies and institutions to identify research projects that would address native species management needs specific to FRs	Staff & mgmt. costs only
		Modify boundaries for vegetation classes in updated Management Guidelines	Participate in DOFAW's planning meetings to update Management Guidelines	Staff & mgmt. costs only
	Ungulate control	Remove ungulates from remote, inaccessible areas; unit areas located within ungulate proof fences designated for zero tolerance	Ground control and aerial control work as needed	TBD
Invasive Species Control	Reduce the impact of invasive species/noxious weeds on the Forest Reserve and surrounding areas	Continue to work with cooperating agencies, including MISC, TNC, NRCS, HDOA, UH-CTAHR, EMWP, LHWRP, USFWS, and other cooperators	Invasive species technician and support staff to work with cooperators to monitor and control invasive species in the FR	$125K/year
		Support biological control efforts in FR and adjacent lands	Support applied research for potential biocontrol agents, including labor and helicopter time	TBD
		Create "weed free" buffer corridor between Kula FR/Kahikinui FR (Papaanui Tract) and leeward Haleakala watershed area (DHHL and Haleakala National Park)	Conduct aerial and ground surveys	$20K/year
			Conduct aerial and ground control work to remove invasive species from area and prevent further spread to leeward Haleakala	$50K/year
	Manage incipient and established invasive plants and animals	Invasive species monitoring and control	Collaborate and support partner research and invasive species control	$50K/year
			Manual, chemical and mechanical control.	$50K/year
		Write a comprehensive weed plan	Hire a Protection Forester	$60K
Access, Trails, and other Public Uses	Maintain public access to the FRs	Maintain and update (as needed) historical access agreements with adjacent landowners	Meet with FAA to formalize agreement as appropriate for Skyline road access	Staff & mgmt. costs only
	Maintain recreational fruit collection	Maintain current level of management for plum tree areas	Weed, fertilize and additional plum tree planting.	$2000/year

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
			Install Signage for plum area	$1000
	Increase public information and awareness	Update and install informational signage	Sign installation and replacement as needed	$10K/year + staff costs
	Infrastructure management	Maintain road infrastructure	Grading and repairs road as needed, and maintain other road features	$35K/year
		Maintain trails and other trail infrastructure in accordance to NAH program standards and plans	Maintain and repair trails, shelters and parking lot areas.	$400K
			Conduct risk assessment for all trails to determine mitigation needs	
		Increase enforcement of Forest Reserve Rules and applicable HAR to protect DOFAW infrastructure.	Secure additional funding for additional night time survey and patrol.	$30K/year
Commercial Activity	Generate income from suitable commercial activities in the Forest Reserve	Determine future income possibilities – commercial tour permits, collection and commercial harvest permits and film industry.	Determine protocol to manage fee collection	Staff & mgmt. costs only
			Finalize land use agreements for existing commercial activity on Polipoli Access Road (Waipoli Road).	Staff & mgmt. costs only
	Provide opportunities for wood-based forest product collection	Identify potential locations and species	Issue commercial harvest permits for forest products	Staff & mgmt. costs only
		Promote forest product revenue base including biomass sales	Work with Hawai'i Forest Industry Association, local woodworker groups, USFS, and others	Staff & mgmt. costs only

E. 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 that may be applicable to Kula FR and Papa'anui include:

- Number of volunteer service projects
- Acres of noxious plants controlled
- Acres of fire protection area
- Miles of fence constructed
- Miles of fence maintained

- Acres of exclosure developed
- Acres of exclosure maintained
- Acres of native forest restored
- Number of rare, threatened, or endangered plant/animal species protected
- Number of cultural resources protected
- Number of commercial leases/licenses/permits issued
- Number of signs replaced
- Number of appurtenant features maintained
- Number of miles of trails maintained
- Number of visitors
- Number of game species harvested (game birds, game mammals)

IV. FUTURE RECOMMENDATIONS

A. Desired Outcome for the Forest Reserves:

- Protection and enhancement of watershed quality and quantity.
- Stable populations of threatened and endangered species and native ecosystems.
- Protection of cultural resources.
- Maintain and enhance public access, activities, and recreational experience.
- Stable harvest levels of game birds and mammals.

B. Future Recommendations:

- Continue to pursue land acquisitions to increase area for public hunting, watershed protection, and natural resource conservation.
- Re-align sections of trails that are fall-line ridge trails to increase trail sustainability.
- Integrate Hawai'i Outdoor Developed Area Accessibility Guidelines standards to meet established ADA requirements.
- Long term funding sources are needed to support fire mitigation projects such as the installation of water/dip tanks to support aerial fire suppression; fuel mitigation along access corridors; and the development of landscape fuel reduction projects such as stand thinning in non-native plantation units.
- 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 of personnel and equipment resources to ensure successful implementation of management plans

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VI. APPENDICES

Appendix A: Kula and Papa'anui Tract of Kahikinui Forest Reserve Plant List

Appendix B: The Native Forest Birds of the Kula Forest Reserve 2013 Field Report

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

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Angiosperm	Fabaceae	*Acacia koa* A. Gray	*Koa*	Endemic	
Angiosperm	Fabaceae	*Acacia mearnsii* De Wild.	Black Wattle	Introduced	
Angiosperm	Fabaceae	*Acacia melanoxylon* R. Br. ex Aiton	Australian Blackwood	Introduced	
Pteridophyte	Pteridaceae	*Adiantum hispidulum* Sw.	Rough Maidenhair Fern	Introduced	
Angiosperm	Asteraceae	*Ageratina adenophora* (Spreng.) R. King & H. Robinson	*Maui Pāmakani, Pāmakani Haole*	Introduced	
Angiosperm	Poaceae	*Agrostis sandwicensis* Hillebr.		Endemic	
Angiosperm	Poaceae	*Anthoxanthum odoratum* L.	Vernalgrass, Sweet Vernalgrass	Introduced	
Angiosperm	Asclepiadaceae	*Asclepias physocarpa* (E. Mey.) Schltr.	Butterfly Flower, Milkweed, Balloon Plant	Introduced	
Pteridophyte	Aspleniaceae	*Asplenium adiantum-nigrum* L.	*'Iwa'iwa*	Indigenous	
Pteridophyte	Aspleniaceae	*Asplenium aethiopicum* (Burm. f.) Bech.		Indigenous	
Pteridophyte	Aspleniaceae	*Asplenium dielerectum* Viane		Endemic	Endangered
Pteridophyte	Aspleniaceae	*Asplenium macraei* Hook. & Grev.	*'Iwa'iwa Lau Li'i*	Endemic	
Pteridophyte	Aspleniaceae	*Asplenium monanthes* L.		Indigenous	
Pteridophyte	Aspleniaceae	*Asplenium trichomanes* L. subsp. *densum* (Brack.) W.H. Wagner	*'Oāli'i*	Endemic	
Pteridophyte	Athyriaceae	*Athyrium microphyllum* (J. Sm.) Alston	*'Ākōlea*	Endemic	
Angiosperm	Asteraceae	*Bidens alba* (L.) DC		Introduced	
Angiosperm	Asteraceae	*Bidens micrantha* Gaudich. subsp. *kalealaha* Ganders & Nagata	*Ko'oko'olau, Kōko'olau*	Endemic	Endangered
Angiosperm	Papaveraceae	*Bocconia frutescens* L.	Plume Poppy, Tree Poppy, Tree Celandine	Introduced	
Angiosperm	Brassicaceae	*Brassica nigra* (L.) W. D. J. Koch	*Mākeke,* Black Mustard	Introduced	
Angiosperm	Poaceae	*Bromus catharticus* Vahl	Rescue Grass	Introduced	
Angiosperm	Brassicaceae	*Cardamine flexuosa* With.	Wavy Bittercress	Introduced	
Angiosperm	Cyperaceae	*Carex alligata* Boott		Endemic	
Angiosperm	Cyperaceae	*Carex macloviana* Dum. d'Urv. subsp. *subfusca* (W. Boott) T. Koyama		Indigenous	
Angiosperm	Cyperaceae	*Carex wahuensis* C.A. Mey. subsp. *wahuensis*		Endemic	
Angiosperm	Fagaceae	*Castanea dentata* (Marsh.) Borkh.	American Chestnut	Introduced	
Angiosperm	Poaceae	*Cenchrus clandestinus* (Hochst. ex Chiov.) Morrone	Kikuyu Grass	Introduced	
Angiosperm	Gentianaceae	*Centaurium erythraea* Raf. subsp. *erythraea*	European Centaury	Introduced	
Angiosperm	Caryophyllaceae	*Cerastium fontanum* Baumg. subsp. *triviale* (Link) Jalas	Big Chickweed	Introduced	
Angiosperm	Araliaceae	*Cheirodendron trigynum* (Gaudich.) A. Heller subsp. *trigynum*	*'Ōlapa*	Endemic	
Pteridophyte	Cibotiaceae	*Cibotium* sp.	*Hāpu'u*	Endemic	
Angiosperm	Asteraceae	*Cirsium vulgare* (Savi) Ten.	Thistle, Bull Thistle	Introduced	
Angiosperm	Campanulaceae	*Clermontia kakeana* Meyen	*Hāhā, 'Ō hā, 'Ōhāwai*	Endemic	

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Pteridophyte	Pteridaceae	*Coniogramme pilosa* (Brack.) Hieron.	*Lo'ulu*	Endemic	
Angiosperm	Asteraceae	*Conyza bonariensis* (L.) Cronq.	*Ilioha, Pua Mana, Lani Wela (Ni'ihau),* Hairy Horseweed	Introduced	
Angiosperm	Rubiaceae	*Coprosma ernodeoides* A. Gray	*'Aiakanēnē, Kūkaenēnē, Leponēnē, Pūnēnē Pilo*	Endemic	
Angiosperm	Rubiaceae	*Coprosma foliosa* A. Gray	*Pilo*	Endemic	
Angiosperm	Rubiaceae	*Coprosma montana* Hillebr.	*Pilo*	Endemic	
Angiosperm	Rubiaceae	*Coprosma ochracea* W. Oliver	*Pilo*	Endemic	
Angiosperm	Poaceae	*Cortaderia jubata* (Lemoine ex Carrière) Stapf	Pampas Grass	Introduced	
Angiosperm	Rosaceae	*Cotoneaster frigida* Lindl.		Introduced	
Angiosperm	Rosaceae	*Cotoneaster pannosa* Franch.	Cotoneaster, Silverleaf Cotoneaster	Introduced	
Gymnosperm	Taxoidiaceae	*Cryptomeria japonica* (L.f.) D. Don	Sugi	Introduced	
Gymnosperm	Cupressaceae	*Cupressus macrocarpa* Hartweg ex Gordon	Monterey Cypress	Introduced	
Pteridophyte	Thelypteridaceae	*Cyclosorus cyatheoides* (Kaulf.) Farw.	*Kikawaiō, Kikawaiōa, Pakikawaiō*	Endemic	
Pteridophyte	Thelypteridaceae	*Cyclosorus sandwicensis* (Brack.) Copel.	*Hō'i'o Kula*	Endemic	
Angiosperm	Cyperaceae	*Cyperus hillebrandii* Boeck. var. *hillebrandii*		Endemic	
Angiosperm	Gesneriaceae	*Cyrtandra* cf *grayi* C.B. Clarke	*Ha'iwale*	Endemic	
Angiosperm	Gesneriaceae	*Cyrtandra hashimotoi* Rock		Maui	
Pteridophyte	Dryopteridaceae	*Cyrtomium caryotideum* (Wall.) C. Presl		Indigenous	
Pteridophyte	Athyriaceae	*Cystopteris douglasii* Hook.		Endemic	
Angiosperm	Poaceae	*Dactylis glomerata* L.	Cocksfoot	Introduced	
Pteridophyte	Athyriaceae	*Deparia petersenii* (Kunze) M. Kato		Introduced	
Angiosperm	Poaceae	*Deschampsia nubigena* Hillebr.		Endemic	
Angiosperm	Poaceae	*Deschampsia caespitosa* (L.) P. Beauv. subsp. *beringensis* (Hultén.) W.E.		Introduced	
Pteridophyte	Athyriaceae	*Diplazium molokaiense* W. J. Rob		Endemic	Endangered
Pteridophyte	Athyriaceae	*Diplazium sandwichianum* (C. Presl) Diels	*Hō'i'o, Pohole (Maui)*	Endemic	
Angiosperm	Sapindaceae	*Dodonaea viscosa* Jacq.	*'A'ali'i, 'A'ali'i Kū Ma Kua, 'A'ali'i Kū Makani*	Indigenous	
Pteridophyte	Dryopteridaceae	*Dryopteris fusco-atra* (Hillebr.) W.J. Rob. var. *fusco-atra*		Endemic	
Pteridophyte	Dryopteridaceae	*Dryopteris glabra* (Brack.) Kuntze var. *glabra*	*Hohiu*	Endemic	
Pteridophyte	Dryopteridaceae	*Dryopteris hawaiiensis* (Hillebr.) W.J. Rob.		Endemic	
Pteridophyte	Dryopteridaceae	*Dryopteris rubiginosa* (Brack.) Kuntze		Endemic	
Pteridophyte	Dryopteridaceae	*Dryopteris subbipinnata* W.H. Wagner & Hobdy		Endemic	
Pteridophyte	Dryopteridaceae	*Dryopteris unidentata* (Hook. & Arn.) C. Chr.	*'Akole*	Endemic	

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Pteridophyte	Dryopteridaceae	*Dryopteris wallichiana* (Spreng.) Hyl.	*'I'o Nui*	Indigenous	
Angiosperm	Asteraceae	*Dubautia menziesii* (A. Gray) D. Keck	*Na'ena'e*	Haleakala endemic	
Angiosperm	Asteraceae	*Dubautia plantaginea* Gaudich. subsp. *plantaginea*	*Na'ena'e*	Endemic	
Angiosperm	Asteraceae	*Dubautia platyphylla* (A. Gray) D. D. Keck	*Na'ena'e*	Haleakala endemic	
Angiosperm	Poaceae	*Ehrharta erecta* Lam.	Panic Veldtgrass	Introduced	
Pteridophyte	Lomariopsidaceae	*Elaphoglossum paleaceum* (Hook. & Grev.) Sledge	*Māku'e*	Indigenous	
Angiosperm	Onagraceae	*Epilobium billardierianum* Ser. subsp. *cinereum* (A. Rich.) Raven & Engelhorn	Aboriginal Willowherb	Introduced	
Angiosperm	Onagraceae	*Epilobium ciliatum* Raf.	Fringed Willowherb	Introduced	
Angiosperm	Asteraceae	*Erigeron karvinskianus* DC.	Fleabane, Daisy Fleabane	Introduced	
Angiosperm	Rosaceae	*Eriobotrya japonica* (Thunb.) Lindl.	Loquat	Introduced	
Angiosperm	Myrtaceae	*Eucalyptus globulus* Labill. subsp. *globulus*	Bluegum	Introduced	
Angiosperm	Euphorbiaceae	*Euphorbia peplus* L.	Spurge, Petty Spurge	Introduced	
Angiosperm	Poaceae	*Festuca rubra* L.	Fescue, Red Fescue	Introduced	
Angiosperm	Apiaceae	*Foeniculum vulgare* Mill.	Sweet Fennel	Introduced	
Angiosperm	Rosaceae	*Fragaria chiloensis* (L.) Duchesne subsp. *sandwicensis* (Decne.) Staudt	*'Ōhelo Papa*	Endemic	
Angiosperm	Oleaceae	*Fraxinus uhdei* (Wenzig) Lingelsh.	Ash, Tropical Ash	Introduced	
Angiosperm	Onagraceae	*Fuschia magellanica* Lam.	*Kulapepeiao* , Hardy Fuchsia	Introduced	
Angiosperm	Geraniaceae	*Geranium arboreum* A. Gray	*Nohoanu, Hinahina*	Haleakala endemic	Endangered
Angiosperm	Geraniaceae	*Geranium dissectum* L.		Introduced	
Angiosperm	Geraniaceae	*Geranium homeanum* Turcz.		Introduced	
Angiosperm	Rosaceae	*Heteromeles arbutifolia* (Lindl.) M. Roem.	Toyon	Introduced	
Angiosperm	Poaceae	*Holcus lanatus* L.	Velvet Grass, Common Velevet Grass, Yorkshire Fog	Introduced	
Angiosperm	Hydrangeaceae	*Hydrangea macrophylla* (Thunb.) Ser.	French Hydrangea	Introduced	
Angiosperm	Asteraceae	*Hypochoeris radicata* L.	Cat's Ear, Gosmore, Hairy Cat's Ear	Introduced	
Angiosperm	Aquifoliaceae	*Ilex anomala* Hook. & Arn.	*Kāwa'u, 'Aiea (Kaua'i)*	Indigenous	
Angiosperm	Rubiaceae	*Kadua axillaris* (Wawra) W.L. Wagner & Lorence	*Manono*	Endemic	
Angiosperm	Viscaceae	*Korthalsella complanata* (Tiegh.) Engl.	*Hulumoa, Kaumahana*	Indigenous	
Angiosperm	Asteraceae	*Lapsana communis* L.	Common Nipplewort	Introduced	
Pteridophyte	Polypodiaceae	*Lepisorus thunbergianus* (Kaulf.) Ching	*'Ēkaha 'Ā kōlea, Pākahakaha, Pua'akuhinia*	Indigenous	

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Angiosperm	Epacridaceae	*Leptecophylla tameiameiae* (Cham. & Schltdl.) C.M. Weiller	*Pūkiawe, 'A'ali'i Mahu, Kanehoa, Kāwa'u (Lana'i), Maiele, Pūpūkiawe*	Indigenous	
Angiosperm	Myrtaceae	*Leptospermum scoparium* J.R. Forster & G. Forster	New Zealand Tea Tree, Tea Tree	Introduced	
Angiosperm	Brassicaceae	*Lobularia maritima* (L.) Desv.	Sweet Alyssum	Introduced	
Angiosperm	Poaceae	*Lolium perenne* L.	Ryegrass, Perennial Ryegrass	Introduced	
Angiosperm	Juncaceae	*Luzula hawaiiensis* Buchenau var. *glabrata* (Hillebr.) O. Deg. & I. Deg.		Endemic	
Angiosperm	Primulaceae	**Lysimachia arvensis* (L.) U. Manns & Anderb.	Scarlet Pimpernel	Introduced	
Angiosperm	Lythraceae	*Lythrum maritimum* Kunth	*Ninika, Pukamole,* Purple Loosestrife	Introduced	
Angiosperm	Rosaceae	*Malus sylvestris* (L.) Mill.	European Crab Apple	Introduced	
Angiosperm	Fabaceae	*Medicago lupulina* L.	Black Medick	Introduced	
Angiosperm	Rutaceae	*Melicope volcanica* (A. Gray) T. G. Hartley & B. C. Stone	*Alani*	Endemic	
Angiosperm	Myrtaceae	*Metrosideros polymorpha* Gaud. var. *incana* (H. Lev.) St. John	*'Ōhi'a, 'Ōhi'a Lehua*	Endemic	
Angiosperm	Myrtaceae	*Metrosideros polymorpha* Gaud. var. *glaberrima* (H. Lev.) St. John	*'Ōhi'a, 'Ōhi'a Lehua*	Endemic	
Pteridophyte	Dennstaedtiaceae	*Microlepia strigosa* (Thunb.) C. Presl var. *strigosa*	*Palapalai*	Indigenous	
Angiosperm	Myricaceae	*Morella faya* (Aiton) Wilbur	Firetree	Introduced	
Angiosperm	Cyperaceae	*Morelotia gahniaeformis* Gaudich.		Endemic	
Angiosperm	Myoporaceae	*Myoporum sandwicense* A. Gray	*Naio*	Indigenous	
Angiosperm	Myrsinaceae	*Myrsine lessertiana* A. DC	*Kōlea*	Endemic	
Angiosperm	Onagraceae	*Oenothera stricta* Ledeb. ex Link subsp. *stricta*	Chilean Evening Primrose	Introduced	
Angiosperm	Oleaceae	*Olea europaea* L. subsp. *europaea*	Olive	Introduced	
Angiosperm	Rosaceae	*Osteomeles anthyllidifolia* (Sm.) Lindl.	*'Ū lei, Eluehe (Moloka'i)*	Indigenous	
Angiosperm	Oxalidaceae	*Oxalis corniculata* L.	*'Ihi*, Creeping Woodsorrel	Introduced	
Angiosperm	Fabaceae	*Paraserianthes lophantha* (Willd.) I. Nielsen subsp. *montana* (Jungh.) I. Nielsen	Plume Albizia	Introduced	
Angiosperm	Passifloraceae	*Passiflora tarminiana* Coppens & Barney	Banana Poka	Introduced	
Pteridophyte	Pteridaceae	*Pellaea ternifolia* (Cav.) Link	*Kalamoho*	Indigenous	
Angiosperm	Piperaceae	*Peperomia cookiana* C. DC	*'Ala'ala Wai Nui*	Endemic	
Angiosperm	Piperaceae	*Peperomia macraeana* C. DC	*'Ala'ala Wai Nui*	Endemic	
Angiosperm	Piperaceae	*Peperomia membranacea* Hook. & Arn.	*'Ala'ala Wai Nui*	Endemic	
Angiosperm	Lamiaceae	*Phyllostegia ambigua* (A. Gray) Hillebr.		Endemic	
Angiosperm	Solanaceae	*Physalis peruvian* a L.	*Pohā, Pa'ina (Hawai'i), C* ape Gooseberry	Introduced	
Angiosperm	Phytolaccaceae	*Phytolacca octandra* L.	Red Inkplant, Pokeweed	Introduced	

* *Anagallis arvensis* (L.) U. Manns & Anderd. (synonym)

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Gymnosperm	Pinaceae	*Pinus patula* Schiede ex Schltdl. & Cham.	Patula Pine	Introduced	
Gymnosperm	Pinaceae	*Pinus pinaster* Ait.	Maritime Pine	Introduced	
Gymnosperm	Pinaceae	*Pinus radiata* D. Don	Monterey Pine	Introduced	
Angiosperm	Urticaceae	*Pipturus albidus* (Hook. & Arnott) A. Gray	*Māmaki*	Endemic	
Angiosperm	Plantaginaceae	*Plantago lanceolata* L.	Narrow-leaved Plantain	Introduced	
Angiosperm	Plantaginaceae	*Plantago major* L.	*Laukahi, Kūhēkili* , Common Plantain	Introduced	
Angiosperm	Poaceae	*Poa annua* L.	Annual Bluegrass	Introduced	
Angiosperm	Caryophyllaceae	*Polycarpon tetraphyllum* (L.) L.	Fourleaf Manyseed	Introduced	
Angiosperm	Polygalaceae	*Polygala paniculata* L.		Introduced	
Pteridophyte	Polypodiaceae	*Polypodium pellucidum* Kaulf. var. *pellucidum*	*'Ae, 'Ae Lau Nui*	Endemic	
Angiosperm	Araliaceae	*Polyscias kavaiensis* (H. Mann) Lowry & G. M. Plunkett	*'Ohe'ohe*	Endemic	
Pteridophyte	Dryopteridaceae	*Polystichum bonseyi* W.H. Wagner & Hobdy		Endemic	
Pteridophyte	Dryopteridaceae	*Polystichum haleakalense* Brack.		Endemic	
Pteridophyte	Dryopteridaceae	*Polystichum hillebrandii* Carruth.	*Ka'upu, Papa'oi*	Endemic	
Angiosperm	Lamiaceae	*Prunella vulgaris* L.		Introduced	
Angiosperm	Rosaceae	*Prunus cerasifera* Ehrh. x P. salicina Lindl.		Introduced	
Angiosperm	Rosaceae	*Prunus persica* (L.) Batsch var. *nucipersica* (Suckow) C.K. Schneider		Introduced	
Angiosperm	Rosaceae	*Prunus persica* (L.) Batsch var. *persica*		Introduced	
Angiosperm	Asteraceae	*Pseudognaphalium sandwicensium* (Gaudich.) A. Anderb.		Endemic	
Pteridophyte	Thelypteridaceae	*Pseudophegopteris keraudreniana* (Gaudich.) Holttum		Endemic	
Pteridophyte	Psilotaceae	*Psilotum nudum* (L.) P. Beauv.	*Moa, Moa Nāhelehele, Moa Nahele, Pipi*	Indigenous	
Pteridophyte	Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn subsp. *decompositum* (Gaudich.) Lamoureux ex J. A. Thomson	*Kīlau a Pueo, Kīlau Pueo, Pa'i*	Endemic	
Pteridophyte	Pteridaceae	*Pteris cretica* L.		Indigenous	
Pteridophyte	Pteridaceae	*Pteris terminalis* Wallich ex J. Agaardh	*Waimakanui*	Indigenous	
Pteridophyte	Pteridaceae	*Pteris irregularis* Kaulf.	*Mānā, 'Iwa Pua Kea, 'Iwa Puakea*	Endemic	
Pteridophyte	Pteridaceae	*Pteris hillebrandii* Copel.		Endemic	
Angiosperm	Rosaceae	*Pyracantha angustifolia* (Franch.) C.K. Schneid.		Introduced	
Angiosperm	Poaceae	*Rhytidosperma pilosum* (R. Br.) Connor & Edgar	Hairy Wallaby Grass	Introduced	
Angiosperm	Rosaceae	*Rubus argutus* Link	Blackberry	Introduced	
Angiosperm	Rosaceae	*Rubus hawaiensis* A. Gray	*'Ākala, 'Ākalakala*	Endemic	
Angiosperm	Rosaceae	*Rubus niveus* Thunb.	Mysore Raspberry	Introduced	

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Angiosperm	Rosaceae	*Rubus rosifolius* Sm.	Thimbleberry	Introduced	
Angiosperm	Polygonaceae	*Rumex acetosella* L.	Sheep Sorrel	Introduced	
Pteridophyte	Blechnaceae	*Sadleria cyatheoides* Kaulf.	*'Ama'u*	Endemic	
Angiosperm	Apiaceae	*Sanicula sandwicensis* A. Gray		Endemic	
Angiosperm	Santalaceae	*Santalum haleakalae* Hillebr. var. *haleakalae*	*'Iliahi*	Haleakala endemic	
Pteridophyte	Selaginellaceae	*Selaginella arbuscula* (Kaulf.) Spring	*Lepelepe a Moa*	Indigenous	
Angiosperm	Asteraceae	*Senecio madagascariensis* Poir.	Fireweed	Introduced	
Angiosperm	Asteraceae	*Senecio sylvaticus* L.	Wood Groundsel	Introduced	
Gymnosperm	Taxoidiaceae	*Sequoia sempervirens* (D. Don) Endl.	Redwood	Introduced	
Angiosperm	Cucurbitaceae	*Sicyos cucumerinus* A. Gray	*'Ānunu, Panunu Kuahiwi*	Endemic	
Angiosperm	Caryophyllaceae	*Silene gallica* L.	Common Catchfly, Small-flowered Catchfly	Introduced	
Angiosperm	Caryophyllaceae	*Silene struthioloides* A. Gray		Endemic	
Angiosperm	Smilacaceae	*Smilax melastomifolia* Sm.	*Hoi Kuahiwi, Aka'awa*	Endemic	
Angiosperm	Solanaceae	*Solanum americanum* Mill.	*Pōpolo, Polopolo,* Glossy Nightshade	Indigenous	
Angiosperm	Asteraceae	*Sonchus oleraceus* L.	*Pualele,* Sow Thistle	Introduced	
Angiosperm	Fabaceae	*Sophora chrysophylla* (Salisb.) Seem.	*Māmane*	Endemic	
Pteridophyte	Cyatheaceae	*Sphaeropteris cooperi* (Hook. ex F. Muell.) R.M. Tryon	Australian Tree Fern	Introduced	
Angiosperm	Poaceae	*Sporobolus africanus* (Poir.) Robyns & Tournay	African Dropseed, Rattail Grass	Introduced	
Angiosperm	Caryophyllaceae	*Stellaria media* (L.) Vill.	Common Chickweed	Introduced	
Angiosperm	Lamiaceae	*Stenogyne microphylla* Benth.		Endemic	
Angiosperm	Asteraceae	*Taraxacum officinale* W. W. Weber ex F. H. Wigg.	Laulele, Common Dandelion	Introduced	
Angiosperm	Fabaceae	*Trifolium arvense* L. var. *arvense*	Rabbit-foot Clover	Introduced	
Angiosperm	Fabaceae	*Trifolium repens* L. var. *repens*	White Clover	Introduced	
Angiosperm	Fabaceae	*Ulex europaeus* L.	Gorse	Introduced	
Angiosperm	Urticaceae	*Urera glabra* (Hook. & Arn.) Wedd.	*Ōpuhe*	Endemic	
Angiosperm	Ericaceae	*Vaccinium calycinum* Sm.	*'Ōhelo*	Endemic	
Angiosperm	Ericaceae	*Vaccinium dentatum* Sm.	*'Ōhelo*	Endemic	
Angiosperm	Ericaceae	*Vaccinium reticulatum* Sm.	*'Ōhelo*	Endemic	
Angiosperm	Verbenaceae	*Verbena littoralis* Kunth	Seashore Vervain	Introduced	
Angiosperm	Scrophulariaceae	*Veronica arvensis* L.	Corn Speedwell	Introduced	
Angiosperm	Fabaceae	*Vicia sativa* L. subsp. *nigra* (L.) Ehrh.	Vetch	Introduced	
Angiosperm	Campanulaceae	*Wahlenbergia marginata* (Thunb.) A. DC	Southern Rockbell	Introduced	

Appendix A: Kula and Papa'anui Section of Kahikinui Forest Reserve Plant List

Compiled by Hank Oppenheimer, Maui Nui PEPP Coordinator

Taxonomic Group	Family	Taxon Name	Common Name	Status	FedStat
Angiosperm	Thymelaeaceae	*Wikstroemia monticola* Skotts.	*'Ākia*	Haleakala endemic	
Angiosperm	Asteraceae	*Youngia japonica* (L.) DC	Oriental Hawksbeard	Introduced	

The Native Forest Birds of the Kula Forest Reserve

2013 Field Report

A native Maui Alauahio delivers spider silk to its nest in a non-native Monterey cypress tree

Peter Motyka

Northern Arizona University

Maui Forest Bird Recovery Project

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SUMMARY

During the 2013 season, we conducted point transect surveys for birds and vegetation at 127 points throughout the Kula Forest Reserve on the island of Maui, Hawaii. We measured bird density using distance sampling methods consistent with the Hawaiian Forest Bird Survey (Scott et al. 1986). These surveys also provided presence/absence data that we used to examine the distribution of the birds and plants. At each point, we measured the percent cover of each plant species present in five height classes. Our goal was to investigate correlations of forest structure and composition with bird densities and occupancy.

We also observed smaller scale habitat associations of one native Hawaiian Honeycreeper, Maui Alauahio (*Paroreomyza montana*). By investigating how these birds use this habitat for foraging and nesting, we sought to explain the ecological interactions between the native birds and the non-native habitat.

With three observers, we surveyed each of our 127 points 4 times between March and July of 2013. With repeated surveys, we aimed to minimize observer bias and maximize the statistical rigor of our data. Our 2013 surveys yielded 6588 individual bird detections of 24 different species. The species with the most detections were Hawaii Amakihi (1210), Red-billed Leoithrix (1043), Apapane (962), House Finch (719), Japanese White-eye (632), I'iwi (478), and Maui Alauahio (434).

We found the most birds in the western and southern portions of the forest in habitats adjacent to the Haleakala Ridge Trail, Plum Trail, Tie Trail, and Waiohuli Trail. These parts of the forest may have been more resilient to the fire of 2007 and maintain a relatively diverse ecosystem. Our research plots (Figure 1) represent what we suspect to be the highest quality bird habitat in the reserve.

Our preliminary density estimates for the four native honeycreepers in the forest reserve are: Maui Alauahio 326 birds/km², Iiwi 102 birds/km², Apapane 400 birds/km², and Hawaii Amakihi 421 birds/km². Stratified per point estimates were highly variable, yet they allowed us to compare the habitat characteristics of points with higher or lower densities. Further analyses are needed for more reliable estimates.

Hawaii Amakihi feeds on nectar from mountain albizia (*Paraserienthes lopantha*)

We observed the native honeycreepers using the non-native vegetation as foraging and nesting habitat. The birds acquire nectar mostly from eucalyptus trees (*Eucalyptus* spp), mountain albizia (*Paraseriaenthes lopantha*), and black wattle (*Acacia mearnsii*), and we observed gleaning of arthropods from many species, but mostly in shrubby understories of mountain albizia, black wattle, and tropical

ash. We found Maui Alauahio nests in a variety of substrates including Monterey cypress (*Cupressus macrocarpa*), redwood (*Sequioia sempervirens*), and fire tree (*Morella faya*).

Future research will include another year of sampling , which will increase the precision and accuracy of our density estimates, and better explain the habitat associations that we have observed.

INTRODUCTION

A variable suite of non-native trees and shrubs dominate the Kula Forest Reserve on the island of Maui, yet four native Hawaiian forest birds occupy the area. With forested habitat ranging from 1500m to 2100m in elevation, the Kula Forest Reserve provides crucial habitat to these birds with minimal threat from mosquito-borne diseases. Disease-free forested habitat is limited in Hawaii and is vital to the persistence of the native forest birds (Pratt et al. 2009). Despite the high conservation value that this forest offers, the birds here are not well-studied. We will contribute to a better understanding of the birds' status in the forest reserve and also how these native birds are using this non-native habitat. We used sampling methods consistent with established protocols for surveying birds in Hawaii with the goal of contributing to the larger database used by state and federal agencies for the conservation of Hawaii's forest birds.

This project is being conducted as a master's thesis by Peter Motyka at Northern Arizona University under the advisement of Dr. Jeff Foster. We also receive logistical support from the Maui Forest Bird Recovery Project. This is a summary of data collected from our first field season in 2013. The second field season will commence in the spring of 2014.

OBJECTIVES

1. Observe the four native Hawaiian Honeycreepers in the Kula Forest Reserve and document their densities, distribution, and use of non-native habitat.

2. Investigate habitat characteristics that may influence the distribution and density of the birds.

3. Identify and map areas within the Kula Forest Reserve that offer the highest quality habitat to the native honeycreepers.

4. Document the foraging and nesting substrates used by Maui Alauahio in non-native vegetation.

5. Contribute towards a better understanding of ecological dynamics within the Kula Forest Reserve and inform potential management of the forest.

6. Evaluate the Kula Forest Reserve as a site for active conservation of native Hawaiian forest birds.

METHODS

We conducted distance sampling surveys for birds at 127 systematically random points within and throughout the Kula Forest Reserve. Each point was surveyed four times between March and July of 2013. These included 51 points that were surveyed in 1980 for the original Hawaii Forest Bird Survey. A survey consists of an observer standing at the point for 8 minutes and recording each bird detected along with detection method and distance from observer to the bird, which was measured using a range finder. We collected data on every bird species observed, including non-natives, but they were not considered in the analysis at this time.

At each of these 127 transect points, we also conducted a vegetation survey. In each of five height classes (0-0.5m, 0.5-2m, 2-5m, 5-10m, and >10m), we estimated the percent cover of each plant species present within a 50m radius of the point.

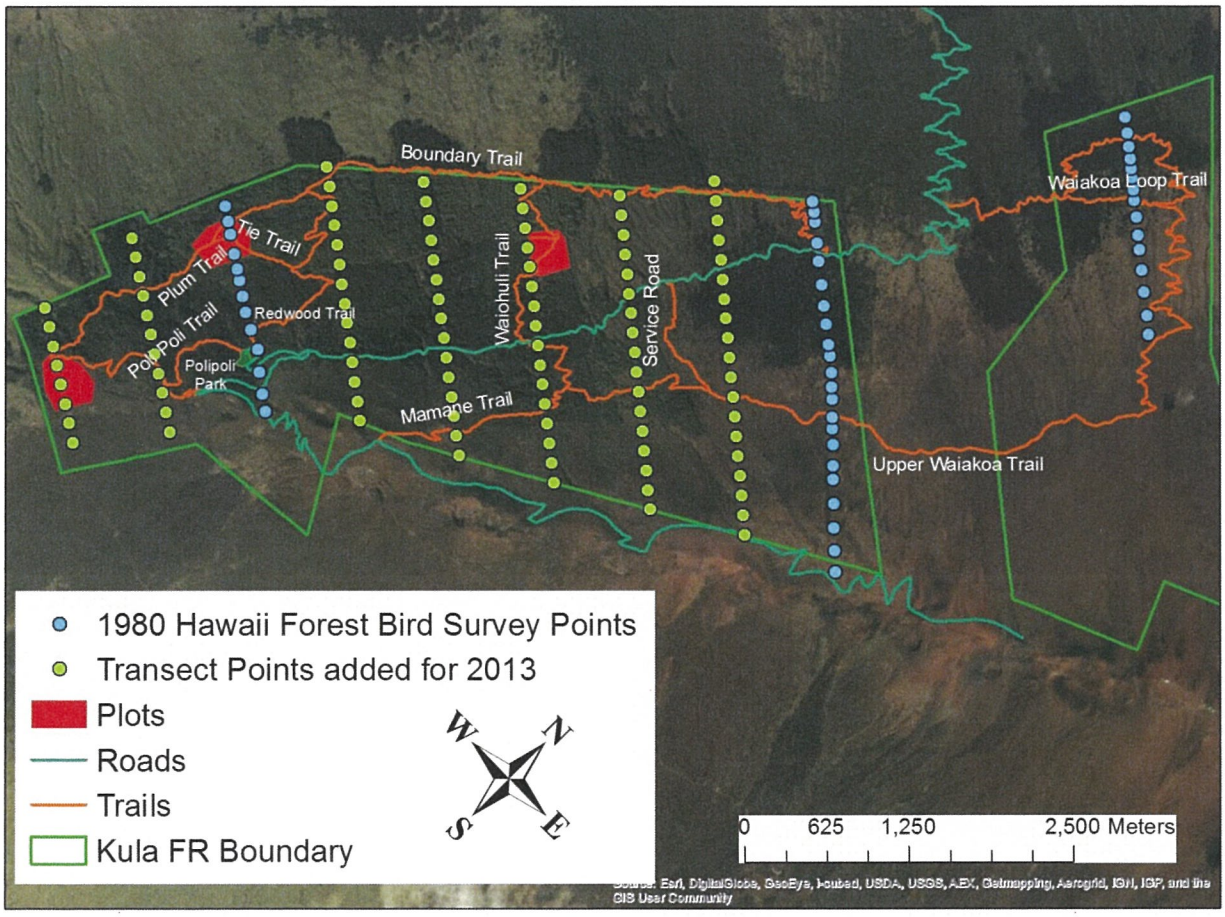


Figure 1: This map of the Kula Forest Reserve shows our transect points and research plots relative to the trails, roads, and other landmarks within the reserve. The blue dots represent transect 29, 30, and 31 from the Hawaii Forest Bird Survey, which were last surveyed in 1980. In 2013, we surveyed these again, plus seven additional transects within the reserve.

Our density estimates were calculated in Program Distance 6.0. A global detection function for each species was derived by pooling untruncated distance measurements from the four surveys (Survey effort = 4). We ran four models to determine the detection function and selected one based on the lowest AIC value. The four models we compared were: hazard-rate simple polynomial, hazard-rate cosine, half-normal simple polynomial, and half-normal hermite. We then post-stratified by sample to obtain point-specific density estimates. Future analyses will account for observer bias and effective detection radius.

We mapped the birds' distribution (Figure 2) using a binary detection matrix for each species, in which each point was designated a 1 (species was detected) or a 0 (species was not detected) for each of the four surveys. We took the number of surveys that detected the species for each point and plotted the values on maps using ArcGIS 10.1. Points where we detected species in four surveys will have a higher probability of occupancy than points where we detected the species in only one survey.

We also observed smaller scale habitat use by Maui Alauahio, and collected data on nesting, foraging, and home ranges. Using mist-nets, we captured, color-banded, and released 63 Maui Alauahio. For each marked bird resighted, observers recorded a GPS location, substrate, height, and general behavior (foraging, courting, etc.). We also searched for Maui Alauahio nests. For each nest found, we recorded the GPS location, nest fate, and small-scale habitat characteristics of the nest site.

In 2013, the majority of our Maui Alauahio observations were concentrated in one 10ha plot on the southwestern edge of the reserve. We will expand our efforts in 2014 and include two additional plots of similar size (Figure 2). Each plot represents a distinct forest type and our goal will be to investigate any disproportionate use of the different foraging and nesting substrates available in each area.

RESULTS AND DISCUSSION

Vegetation

The Kula Forest Reserve hosts a wide variety of habitats from forest to shrubland to bare lava rock with only scattered vegetation. We recorded over 50 different plant species on our surveys which included trees, shrubs, and some dominant forbs. After reviewing the vegetation composition of points with the highest densities of birds, we identified 6 dominant plant species that most of these points have in common. These are mountain albizia (*Paraserianthes lopantha*), black wattle (*Acacia mearnsii*), redwood (*Sequoia*

Plant Species	Number of points where species was detected	Percentage of all points (127) occupied by species
Non-native Plants		
Mountain albizia (*Paraserianthes lopantha*)	16	13%
Black wattle (*Acacia mearnsii*)	34	27%
Tropical ash (*Fraxinus uhdei*)	23	18%
Monterey cypress (*Cupressus macrocarpa*)	30	24%
Redwood (*Sequoia sempervirens*)	33	26%
Eucalyptus (*Eucalyptus* spp)	24	19%
Monterey pine (*Pinus radiata*)	72	57%
Cluster pine (*Pinus pinaster*)	47	37%
Fire tree (*Morella faya*)	31	24%
Hill raspberry (*Rubus niveus*)	49	39%
Blackwood acacia (*Acacia melanoxylon*)	5	4%
Banana poka (*Passiflora tarminiana*)	22	17%
Native Plants		
Mamane (*Sophora chrysophylla*)	66	52%
Pukiawe (*Styphelia tameiacaeae*)	68	54%
Ohelo (*Vaccinium* spp)	57	45%
Pilo (*Coprosma montana*)	37	29%
Akala (*Rubus hawaiiensis*)	21	17%
Aalii (*Dodonaea viscosa*)	40	31%
Ohia (*Metrosideros polymorpha*)	7	6%
Koa (*Acacia koa*)	8	6%

Table 1 This table includes the native plants and the dominant non-native plants recorded during our surveys. A point was included if the plant species was detected there at all, regardless of density.

sempervirens), Monterey cypress (*Cupressus macrocarpa*), tropical ash (*Fraxinus uhdei*), and a suite of eucalyptus trees that we have pooled as *Eucalyptus* spp. Each of these non-native species occur at a quarter or less of the total number of points we surveyed (Table 1), but they appear to compose some of the best forest bird habitat available in the forest reserve.

Native shrubs are fairly common throughout the forest reserve, and the upper slopes contain some of the more intact native Hawaiian shrubland on Maui. The native mamane (*Sophora chrysophylla*) occurs throughout much of the forest reserve, and may facilitate the widespread distribution of Amakihi, but it does not occur at many of the points with higher densities of other birds. We have confirmed that all of the native birds are using the non-native plants that dominate the forested habitat. We observed the birds foraging and nesting in the non-native vegetation, and recorded them occupying areas completely void of any native plants.

We initially proposed to survey over 150 points within the forest reserve, but some areas were inaccessible due to dangerous forest conditions. Steep slopes with large downed trees and very dense thickets of young pine trees and hill raspberry rendered some areas nearly impenetrable. Escape from these areas in an emergency, such as a fire, would be very difficult. We eliminated 20 points from our initial plan because of these safety concerns. Although this habitat type is not well represented in our study, our personal observations suggest that it supports a lower density of birds than other habitats in the reserve.

Birds

We recorded 6588 bird detections during our point transect surveys. The total number of detections per species is listed in Table 2.

Our statistical analyses for density need some fine-tuning, but our current estimates seem representative of patterns we have observed in the field.

Number of Point Count Detections by Species

Maui Alauahio	**434**
Apapane	**962**
I'iwi	**478**
Hawaii Amakihi	**1210**
Japanese Bush-warbler	172
Japanese White-eye	632
House Finch	719
Red-billed Leothrix	1043
Northern Cardinal	218
Northern Mockingbird	135
Common Myna	2
Melodious Laughingthrush	6
Mourning Dove	15
Rock Dove	2
Spotted Dove	14
Zebra Dove	3
California Quail	14
Chukar	45
Ring-necked Pheasant	377
Gambel's Quail	6
Gray Francolin	11
Pacific Golden Plover	2
Sky Lark	83
Pueo	3
Unknown	2
Total # of Surveys: 4	
Total # of Points: 127	
Total # of Species: 24	
Total # of Detections: 6588	

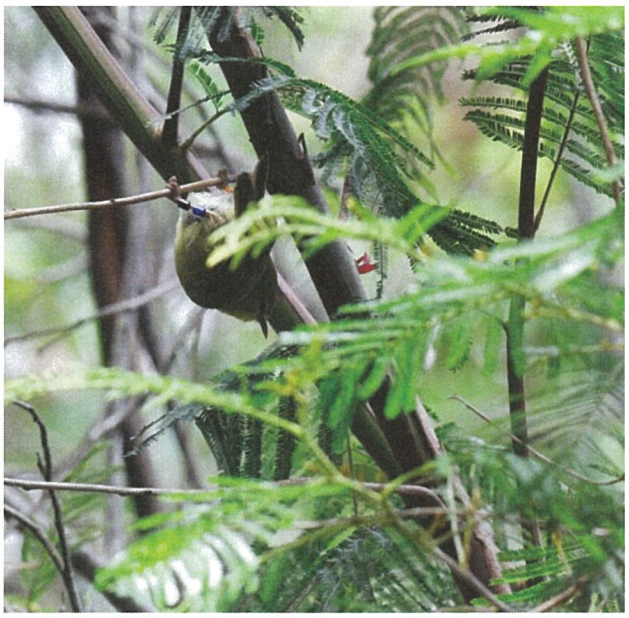
Table 2: Total number of detections per species pooled from 4 surveys. The native Hawaiian Honeycreepers are in bold.

Maui Alauahio

We estimated the average density of Maui Alauahio to be approximately 326 birds/km². Yet, point specific densities showed high variation. We detected Alauahio at 71 points out of 127 (56%). At the remaining 56 points, we detected no Alauahio, and therefore the density was calculated as 0 birds/km² at these points. Five points in the southwestern portion of the forest yielded densities of over 1300 birds/km². A short visit to any of these areas will confirm to the observer that these birds occur at high densities.

We observed 16 Maui Alauahio nests in 2013. Eleven of these were found in Monterey cypress. We also found nests in Blackwood acacia(2), Fire Tree(1), Redwood(1), and Monterey pine(1). Young birds from ten of these nests fledged successfully. The causes of failure for the other nests are unknown, except for one nest that was in a Monterey cypress that fell down around the time nest-building was being completed. The photograph on the cover of this report shows that nest, the day before the tree fell down.

We recorded 320 resights from 32 color-banded birds, with GPS locations and substrate for each. We observed Maui Alauahio in mountain albizia more than other plants. Since we conducted most of our searches in areas with high densities of Mountain albizia, we cannot infer a selective preference at this time, yet we can confirm that these birds are successfully using this plant species as foraging habitat. We observed Alauahio gleaning arthropods from most other plant species in the forest as well.



A color-banded Maui Alauahio forages in black wattle (*Acacia mearnsii*)

Home range dynamics of Maui Alauahio are highly variable and extracting any inference about habitat quality from these data would be difficult. We will contribute our data to larger datasets for further analyses in the future.

Maui Alauahio may be more sensitive to forest structure than the other native honeycreepers. High densities of birds were found in areas with a dense understory of mountain albizia, black wattle, or young trees under a tall canopy of eucalyptus, tropical ash, and/or conifers. Alauahio occurs at lower densities, or not at all, in areas that are lacking tall trees and/or a shrubby understory.

Iiwi

We estimated an average density of 102 birds/km² for Iiwi, and we detected them at 95 points out of 127 (75%). At 10 points, we found densities ranging from 250-350 birds/km². The 1980 Hawaii Forest Bird Survey, which was the only other time the Kula FR was surveyed for birds, estimated Iiwi occurring at 24 birds/km² in introduced trees (Scott et al. 1986). We hesitate to infer a trend from these data, but we are optimistic about the success of Iiwi in this non-native habitat.

Iiwi acquires much of its nectar from the blossoms of the eucalyptus trees, mountain albizia, and black wattle.

Apapane

We estimated an average density of 400 birds/km² for Apapane, and we detected them at 114 points out of 127 (90%). At 7 points, we found densities ranging from 1000-1400 birds/km².

Apapane also appears to acquire much of its nectar from the blossoms of the eucalyptus trees, mountain albizia, and black wattle.

Hawaii Amakihi

We estimated an average density of 421 birds/km² for Amakihi, and we detected them at 124 points out of 127 (98%). Amakihi showed the least variability in density and occupancy out of the native honeycreepers. Results from point-stratified analyses follow a normal distribution around the mean, with the highest points around 800 birds/km². We noted the extensive distribution of Amakihi. This generalist appears to be exploiting nearly all available habitat in the Kula Forest Reserve.

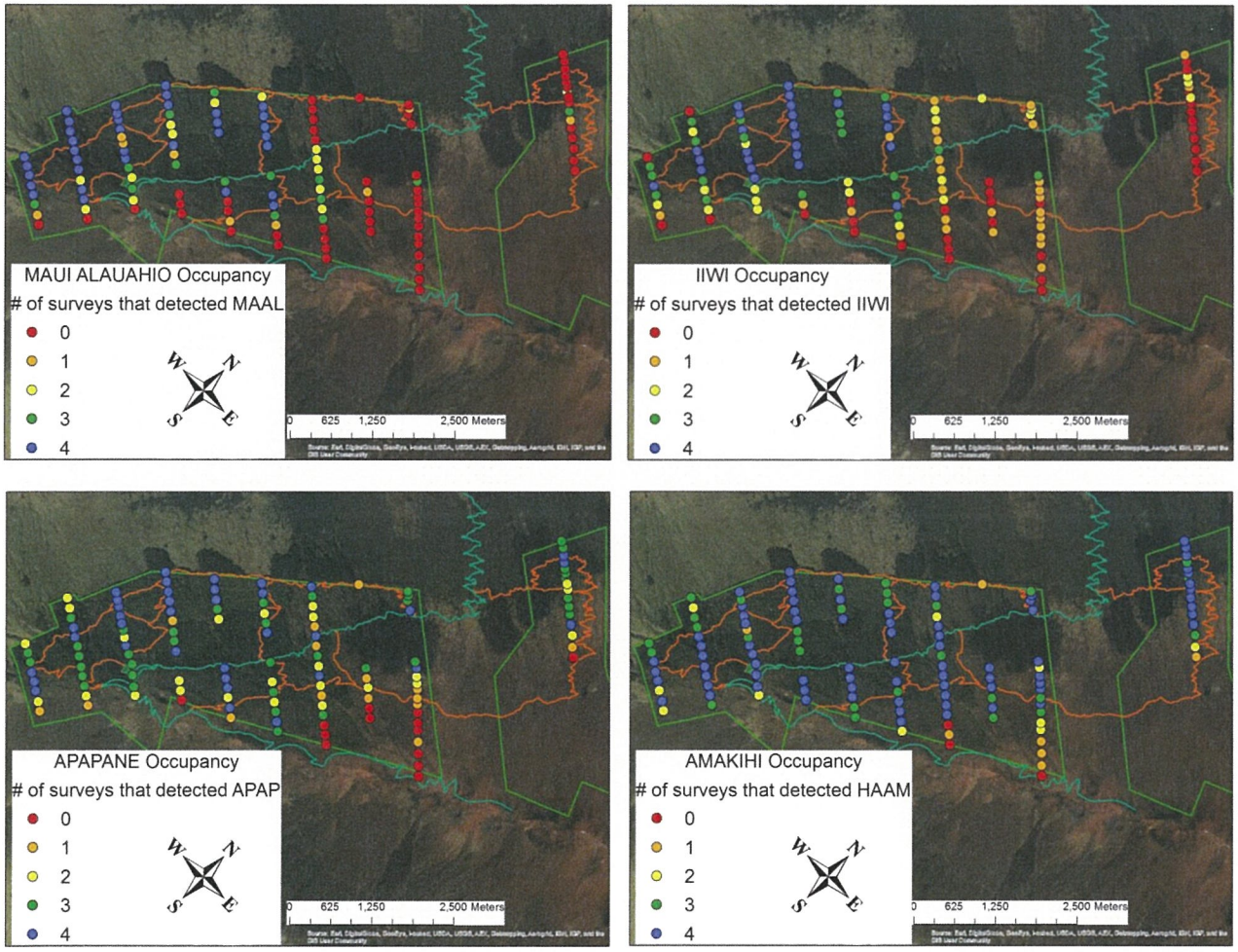


Figure 2 These maps represent the distribution of the four native honeycreepers. Birds are most likely to be found at blue dots and least likely to be found at red dots. Each point was surveyed 4 times during the field season. The different colors represent the number of those surveys in which the species was detected at that point. For example, at the blue dots, we detected the species all 4 times that point was surveyed. At red dots, we did not detect the species during any of our surveys.

FUTURE DIRECTIONS

Bird extinctions in Hawaii are a contemporary and continuing process. We have lost 10 endemic bird species in the last 30 years, and many remaining species are in decline (Pratt et al. 2009). Conservation priorities for the remaining species include mitigation of avian disease and habitat restoration (USFWS 2006). Habitat restoration will facilitate an increase in bird populations, which will in turn, mitigate against disease. Forest management in the Kula Forest Reserve could result in an increase in bird populations. Our goal is to work with managers to develop a feasible work plan to manage for the conservation of the Hawaii's native forest birds.

Non-native trees and shrubs in the Kula Forest Reserve are providing ecosystem functions that are required by the native birds. By better understanding the interactions between these birds and their non-native habitat, we can offer more effective strategies to provide the habitat characteristics that these birds require. More research is required to better explain the habitat associations that we are observing in this forest.

Future research will include more surveys and observations. Higher sample sizes will yield the most accurate density estimates, and increase our power of inference. We will repeat our vegetation surveys to incorporate some slight revisions and reduce observer bias. We will also expand our efforts to observe habitat use of Maui Alauahio, which includes banding, resighting, and nest-searching. We expect more patterns to emerge with continued observations.

There are extensive opportunities for further research in the Kula Forest Reserve. With the baseline data already acquired, we can monitor the birds' populations and their responses to any changes that may occur in the forest, whether through management or natural disturbance. Also, considering the extinction crisis that these birds face, there is a lot that we do not know. A better understanding of their ecology, including their habitat associations, spatial and temporal movement patterns, and diseases, would contribute to conservation efforts. The Kula Forest Reserve offers a rare opportunity to study and observe Hawaii's native forest birds, and this opportunity should be embraced.

ACKNOWLEDGEMENTS

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

BLACK WATTLE (Acacia mearnsii)

Hawaii Pacific Weed Risk Assessment: 15 High Risk
Regulatory Status: Hawaii Noxious Weed List
Prevention and Control Category:

Description

Fast growing tree. All parts finely hairy. Hairs of new growth is golden in color. Leaves are dark olive-green and also finely hairy, bipinnate; leaflets short (1.5 – 4mm) and crowded. Raised glands occur at and between the junctions of pinnae pairs. Flowers form in large globular clusters and are pale yellow or cream colored. Fruits are dark brown pods.

Impacts

- It threatens native habitats by competing with indigenous vegetation, replacing grass communities, and reducing native biodiversity
- Increases water loss from riparian zones due to high transpiration rates
- Long lived seeds readily germinate after fire

Distribution

Distribution in Hawaii is currently unknown

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

PLUME POPPY (*Bocconia frutescens*)

Hawaii Pacific Weed Risk Assessment: None
Regulatory Status: Hawaii Noxious Weed List (HAR 68)
Prevention and Control Category: None

Description

- Shrub to small (20 ft) tall tree
- Native to Central and South America, introduced to Hawaii as an ornamental garden plant

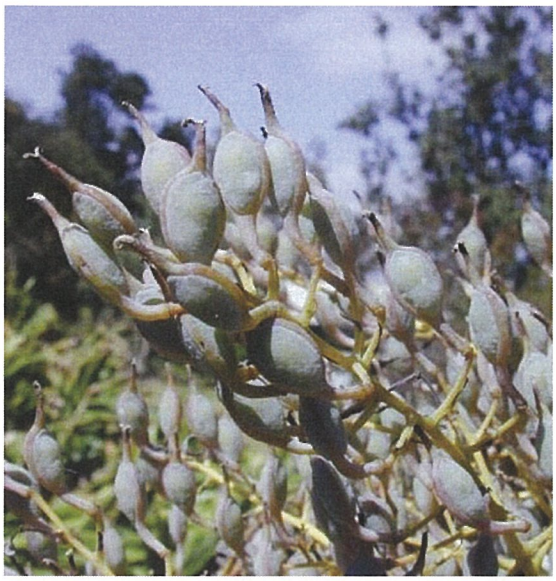
Impacts

- Aggressive invader of dry forests. Forms dense stands that crowd out and compete with native plants, keeping them from growing
- Each plant can produce thousands of seeds that are particularly attractive to birds, which spread them long distances.
- Mechanical and chemical control of this species is difficult. Plants often resprout after control and persistence is required to completely control plume poppy.

Distribution

- Kauai: Not present. Please contact KISC if you see this plant on Kauai.
- Oahu: Present, but not an OISC target. Landowners are encouraged to control this pest.

- Maui: Serious invader in native dry and mesic forests of East Maui with dense infestations from Kula to Kahikinui. It is not believed to be controllable or eradicable on an island-wide basis. Landowners are asked to control where possible.
- Molokai: None known.
- Lanai: None known.
- Kahoolawe: None known.
- Big Island: Infestations in Wood Valley, Kau Forest Reserve, Honomalino and Manuka on the Big Island. BIISC has worked to control this plant in cooperation with landowners and community groups, but has no current funding to continue work. Please call 643-PEST if you see this plant, especially in the Honomalino area.



Cabinet-level direction on invasive species issues

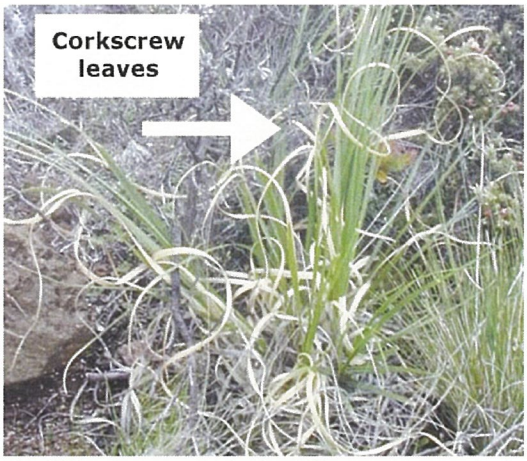
Hawaii Invasive Species Council

PAMPAS GRASS (*Cortaderia jubata, Cortaderia selloana*)

Hawaii Pacific Weed Risk Assessment Score: *C. jubata* – 26 High Risk. *C. selloana* – 24 High Risk.
Regulatory Status: Hawaii Noxious Weed (HAR 68)
Prevention and Control Category: KISC Target Species. OISC Target Species. MISC Target Species. BIISC Target Species

Description

Pampas grass is an erect giant bunch grass with long, slender, bright green, saw-toothed leaves. At its base are dried, corkscrew-shaped leaves. It has large showy flower plumes that extend 2-3′ beyond the foliage. Two species of pampas grass are found in Hawaii, Cortaderia selloana and C. jubata, which are difficult to tell apart. Both reach heights of 9-10′ and have loosely clumped pinkish-white seed heads. They flower from July through November. Spent flower stalks are sometimes persistent for several years



Impacts

Pampas grass grows rapidly, produces thousands of seeds per flower plume, and can accumulate large amounts of fire prone biomass. Seeds are viable for 4-6 months, but field evidence from Hawaii suggests viability could be greater. It can crowd out native species, impede access, degrade grazing lands, and create fire hazards.

Distribution

Native to South America, pampas grass was introduced to Hawaii as an ornamental. On Maui, this plant has escaped cultivation and spread into pristine, upland native forests. It is found in pastures, gulches, yards, along road cuts. Cortaderia are found in residential and remote areas of Maui and O‘ahu.

What you can do

If you see this species, call 643-PEST, call your local ISC, and/or visit www.reportapest.org. It is important NOT to pull and move the plant, as proper removal and disposal are essential to prevent spreading seeds and re-sprouting.

Look-alike Species

Sugarcane (*Saccharum officinarum*): is a Polynesian introduced plant that has a similar seed plume as pampas but the plume is not as dense and sugarcane does not have corkscrew leaves.

Native Hawaiian sedges (*Cyperaceae sp.*): These can be confused with young pampas grass. They do not produce corkscrew leaves, tall flowering stalks, or large showy seed plumes. Most Hawaiian sedge leaves are not as sharp.

Cabinet-level direction on invasive species issues

Hawaii Invasive Species Council

COTONEASTER *(Cotoneaster pannosus)*

Hawaii Pacific Weed Risk Assessment: 11 High Risk
Regulatory Status: Hawaii Noxious Weed List
Prevention and Control Category:

Description

Multi-stemmed shrub with arching branches. Can grow up to 10′ tall. Flowers are white with five petals. Oblong leaves are 0.5 in – 1 in long and are a green-grey color. Fruit are a dull red when ripe and contain 1-3 seeds.

Impacts

- Invades pasture lands and native rain forests. Highly adaptable and germinates readily in shade.

Distribution

- Kauai: Waimea Canyon, Koke'e State Park and Pu'u Ka Pele Forest Reserve
- Maui: East Maui, Kula, Keokea and Polipoli.

Cabinet-level direction on invasive species issues

Hawaii Invasive Species Council

FIRE TREE, FIRETREE, FAYA BUSH (*Morella faya*)

Hawaii Pacific Weed Risk Assessment: 17 High Risk
Regulatory Status: Hawaii Noxious Weed List (HAR 68)
Prevention and Control Category: None

Description

- Evergreen shrub or small tree up to 8 m tall (26 ft)
- Fruit are pink to red or blackish when mature, and appear bumpy.
- Native to the Azores, Madeira and Canary Islands, introduced to Hawaii as an ornamental and backyard food crop (berry wine) by Portuguese laborers in the 1800's and spread as a reforestation tree in the 1920's.

Impacts

- Out-competes native plant species and capable of forming dense, single-species stands, devoid of other plant life.
- Modifies forest habitat by significantly increasing nitrogen levels in the soil, which makes the area inhospitable to native plants, but more suitable for other invasive species.
- Seeds spread by animals.
- Able to colonize a wide range of habitats due to its ability to alter soil chemistry.

Distribution

- Kauai: Present in Waimea Canyon and Kokee State Park. Landowners are encouraged to control where possible.
- Oahu: Established in the southern Waianae mountains where Oahu Army Natural Resources Program controls populations. There are no known trees in the Koolau mountains.
- Maui: Present in large numbers on the slopes of Haleakala. Not considered eradicable by MISC. Landowners are encouraged to control where possible. The only known plants on West Maui have been controlled.
- Molokai: Presence/absence unknown
- Lanai: Presence/absence unknown
- Kahoolawe: None known
- Big Island: Widespread on the Big Island where hundreds of acres are already infested. Not considered eradicable by BIISC. However, landowners are encouraged to control wherever possible.

Cabinet-level direction on invasive species issues

Hawaii Invasive Species Council

BANANA POKA (*Passiflora tarminiana*)

Hawaii Pacific Weed Risk Assessment: 24 High Risk
Regulatory Status: Hawaii Noxious Weed List
Prevention and Control Category:

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 fresh water 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 mantle 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

Cabinet-level direction on invasive species issues

Hawaii Invasive Species Council

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.

Photo Credit: Forest & Kim Starr

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

Distribution

- Present on Hawaii, Maui, Molokai, Oahu, and Kauai
- Lanai: presence/absence unknown

Cabinet-level direction on invasive species issues

Hawaii Invasive Species Council

MYSORE RASPBERRY (*Rubus niveus*)

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*)

Hawaii Pacific Weed Risk Assessment: 23, High Risk.
Regulatory Status: Hawaii Noxious Weed List (HAR 68)
Prevention and Control Category: KISC Target Species. OISC Target Species. MoMISC Target Species.

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 ¼" 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 Lanai. On Kauai, known infestations from hydro-mulched areas near Halfway Bridge and in Kalihiwai were controlled by KISC and HDOA. Kauai, Oahu, and Molokai 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

AUSTRALIAN TREE FERN (*Sphaeopteris cooperi*)

Hawaii Pacific Weed Risk Assessment: 16, High Risk
Regulatory Status: None
Prevention and Control Category: MoMISC Target Species

Description

- Large tree fern up to 12 m (40ft) tall with large (up to 6m long) triangular leaves, lacy blades
- Scaly, brown stems fall off when dead, leaving oval scars
- White hairs on stalks (unlike native hapuu, which has red hairs)
- Trunk doesn't have the thick, soft fiber wrapping like the native hapuu
- Native to Australia, introduced to Hawaii as an ornamental

Impacts

- Wind spread spores can travel over 12 km (7 miles) from parent plant, as seen when plants from Hana nurseries spread to Kipahulu Valley.
- Fast growing and aggressively outcompetes native plants in the forest understory
- Displaces native ferns, including the slower growing hapuu

Distribution

- Kauai: Spreading in native forests including Hanalei, Koloa, and Kokee. Landowners are asked to plant non-invasive alternates instead.
- Oahu: Spreading in the Koolau and Waianae mountains. Landowners are asked to plant non-invasive alternates instead.
- Maui: Widely cultivated and naturalized. Infesting Kipahulu Valley, Peahi, Haiku, and areas in West Maui.

- Molokai: No infestations known in the wild, although planted in landscaped areas at several residences. MoMISC is working to educate community members to remove these plants and select non-invasive alternates.
- Lanai: Presence/absence unknown
- Kahoolawe: None known.
- Big Island: Spreading from landscaped areas in Volcano, Laupahoehoe, Kona and other areas. Landowners are asked to plant non-invasive alternatives instead of non-native tree ferns.

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

GORSE (*Ulex europaeus*)


Photo Credit: www.ctahr.hawaii.edu

Hawaii Pacific Weed Risk Assessment: 20 High Risk
Regulatory Status: Hawaii Noxious Weed List (HA 68)
Prevention and Control Category: None

Description


Photo Credit: www.earthweeds.com

- Thorny shrub, up to 2 meters (6 ft) tall, with inch-long spines
- Bright yellow flowers that smell faintly of coconut
- Native to Western Europe, introduced as food plant for sheep and as a "living fence"

Impacts

- Forms dense, impenetrable thickets that allow nothing else to grow
- Seeds can remain viable in the soil for more than 30 years
- Deep roots help this plant survive fires, and fire helps the seeds sprout

Distribution

- Kauai: Present. Not currently a KISC target for control.
- Oahu: Present. Not currently an OISC target for control.
- Maui: Infestations in higher altitude pastures and natural areas, including Haleakala. Landowners are asked to control gorse wherever possible.
- Molokai: Small population present at Kamiloloa. MoMISC is working to eradicate this from Molokai.

- Lanai: Presence/absence unknown.
- Big Island: Infests higher altitude pastures and natural areas, including Hakalau and Puu Oo. BIISC does not target this plant, but will control in some locations. Landowners are asked to control gorse on their property wherever possible.