

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife
Honolulu, Hawaii 96813

April 26, 2024

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 MANAGEMENT PLAN AND ASSOCIATED ENVIRONMENTAL ASSESSMENT FOR THE KAPĀPALA KOA CANOE MANAGEMENT AREA, AND ISSUANCE OF A FINDING OF NO SIGNIFICANT IMPACT (FONSI), TAX MAP KEY (3) 9-8-001:014, KAPĀPALA, KA'Ū, HAWAII'Ī.

SUMMARY:

This submittal requests approval by the Board of Land and Natural Resources (BLNR) for the Division of Forestry and Wildlife (DOFAW) Kapāpala Koa Canoe Management Area (KKCMA) Plan (Exhibit A) and the Kapāpala Koa Canoe Management Area Final Environmental Assessment (EA) (Exhibit B). This management plan is part of a series of site-specific plans prepared by DOFAW for forest reserves in the State of Hawai'i. These plans present a brief history of the specific forest reserve unit, a description of cultural and natural resources, and the area's current and future management actions. The associated EA outlines potential environmental impacts, mitigation measures, and analysis of management actions proposed by the Management Plan and proposes a Finding of No Significant Impact (FONSI) for the actions within the plan.

BACKGROUND:

DOFAW is conducting ongoing planning efforts to develop and update management plans for all of the forest reserves in Hawai'i. These plans vary in detail depending on several factors. Still, all represent an essential foundation for watershed protection and reforestation, cultural resource protection, public use, and forest product utilization 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. Per the executive orders and past decisions made by the BLNR regarding the purpose of the area, management within KKCMA has, in part, been focused on utilizing koa timber resources.

In the late 1980s, the Department of Land and Natural Resources (Department; DLNR) began searching for native forests on state land to designate koa management areas to expand silviculture operations. The ample koa resources on KKCMA made it an ideal location. On October 27, 1989, the BLNR approved the set-aside of approximately 1,257 acres “for commercial koa timber production, with consideration for recreation, forest bird habitat, and watershed values.” This land is still what constitutes KKCMA to this day. It is located on the southeastern slopes of Mauna Loa, between about 3,000-5,000 feet in elevation. It is covered almost entirely by a native montane forest with a canopy of koa (*Acacia koa*) and ‘ōhi‘a (*Metrosideros polymorpha*). In the 1990s, following struggles by organizations to find koa trees suitable for the construction of traditional canoes, the purpose of the area was further refined from a broad koa management designation to focus on the management and cultivation of koa resources for canoe construction.

In 2004, the 1,257-acre koa management area was officially subdivided by the County of Hawai‘i, removing it from the rest of the parcel still encumbered by a lease to Kapāpala Ranch. The Board of Land and Natural Resources approved designating the Kapāpala Koa Canoe Management Area. On June 27, 2005, Executive Order (EO) 4109 was issued, officially setting the area aside to grow and produce koa trees to make traditional Hawaiian canoes.

It was later realized that the set-aside as a “Koa Canoe Management Area” designation could jeopardize effective management due to the lack of applicable statutes and rules to enact and enforce for the area. Therefore, in 2004, the BLNR approved the cancellation of EO4109 and the issuance of a new EO incorporating the area as the Kapāpala section of the Ka‘ū Forest Reserve (FR). With this designation, the rules and statutes governing forest reserves could now be applied to KKCMA. These actions were formalized by issuing EO4427, which canceled EO4109, and EO4428, which formalized KKCMA’s inclusion into Ka‘ū Forest Reserve on February 27, 2013.

Acknowledging the need for community and expert advice and input on this project, DOFAW started a working group in 2015 comprised of critical stakeholders, including kūpuna and residents of Ka‘ū, canoe clubs and associations, cultural practitioners, canoe builders, conservationists, and adjacent landowners. Voyaging organizations were also approached to participate in the working group, but none became members. Stakeholders were invited to be a part of the working group by the DOFAW administrator, and membership has changed over time. However, the intention and makeup of what became known as the Kapāpala Koa Canoe Working Group has remained intact. The group has been meeting 1-3 times a year since 2015 to give advice and input on the plans for the Kapāpala Koa Canoe Management Area. Their input has been essential, providing a variety of perspectives and expertise in canoe building, traditional practices, local knowledge, forestry experience, and much more. DOFAW hopes to continue this partnership with the working group in the guidance and management of KKCMA moving forward.

Initial development of the KKCMA management plan consisted of reviewing and analyzing DOFAW files found at the Administrative and Hawai'i District office, all other planning documents written for the area, multiple timber and vegetation surveys, and a comprehensive 2020 forest inventory. Additional resources utilized for the development of this plan include other plans that identified the forest reserve or the general area, GIS data from the Hawai'i Biodiversity and Mapping Program (HBMP) and the Hawai'i Statewide GIS Program, the state's 2016 Hawai'i Forest Action Plan, the Hawai'i Comprehensive Wildlife Conservation Strategy, biological surveys, and others. The plan then evolved into its final iteration through discussions with DOFAW staff from all program areas at the district and administrative offices, other divisions, and state agencies, DOFAW partners, the Kapāpala Koa Canoe Working Group, and the public.

DISCUSSION:

The primary management objective of the KKCMA Management Plan is to provide a sustainable, long-term supply of koa for the traditional and cultural use of constructing koa canoes while minimizing impacts on the natural and cultural resources in the area. This parcel is the only state land in Hawai'i specifically zoned to produce koa canoe resources. Other management objectives include the protection of native forests, watershed resources, forest bird habitat, increased regeneration and restoration of koa trees and forest habitat, collaboration with educational groups and community groups, access to recreational activities, and integration of traditional Hawaiian stewardship models with western conservation practices.

A harvest plan has been developed to allow for the harvest and extraction of canoe-quality trees while regenerating koa resources in a 100-year timeframe. Current plans call for organizations to be selected to independently implement the harvest of canoe logs with the guidance of DOFAW. DOFAW will also implement stand improvement actions, such as pre-commercial and commercial thinning, that will enhance the ability of the forest to produce large, straight koa trees capable of being made into canoes. Timber resources removed during thinning operations may be sold to help fund the management of KKCMA.

KKCMA has been split into management units broadly designated for restoration, habitat protection, and forest product gathering while allowing for adaptive management. A recent timber survey of the area indicates available koa resources will likely be able to meet expected demand and maintain sustainable harvest levels.

Organizations in the State of Hawai'i may apply for a permit to harvest a canoe log. Applications will be reviewed by a group of experts consisting of cultural practitioners, voyaging and racing members, kālaiwa'a (canoe builders), forestry experts, conservationists, and community members, who will advise DLNR/DOFAW on the final allocation of canoe log permits. Details of this allocation process can be found in an accompanying board submittal.

Multiple protection measures will also be implemented to ensure that the resources in

the area are not degraded due to threats such as non-native animals, invasive plants, human impacts, climate change, and/ or erosion. There are currently no known cattle or mouflon sheep populations in the area, and there will continue to be zero tolerance for these animals as they severely impact koa trees and native forest ecosystems. Pigs are known in the area, and public hunting and staff control will be used to control pig populations and the damage they cause to koa and other resources. Invasive weeds are currently not widespread and are primarily contained in the road corridors in KKCMA. Invasive plant populations may increase as the amount of activity in the area rises; monitoring and control measures will be implemented to minimize the spread of existing species or the establishment of new species. Erosion is another concern, and roadways within the area will be maintained to sustainable forest road standards. Recontouring steep, degraded roadways is a high-priority objective of the management plan.

Mitigation measures will be implemented to minimize impacts on threatened and endangered (T&E) species and archeological and historical sites. Botanical and archeological surveys will be implemented in all areas before any silviculture actions occur in that unit. No T&E plant species are currently known within the area. Surveys for forest birds will also be implemented, and areas of higher value native forest and bird habitat will be lower priority harvest areas.

Development Process & Timeline for the KKCMA Plan

Stage of Development	Date Achieved	Comments
Branch review	11/30/2022	Incorporated
Kapāpala Koa Canoe Working Group review	11/30/2022	Incorporated
DOFAW review	01/31/2023	Incorporated
Partner agency consultation	March-August 2023	One comment, incorporated.
Public consultation	April-June 2023	<ul style="list-style-type: none"> • Saturday, April 1, 2023, Ka’ū community meeting at Ka’ū Gymnasium in Pāhala. • Posted on DOFAW website May 2023 • Press release & social media releases May 2023 • Three responses were received from members of the public, and relevant comments were incorporated.

SUMMARY OF COMMENTS AND RESPONSES:

In addition to making the draft management plan available to partner agencies and to the public for review and comment, DOFAW developed an online informational platform (<https://experience.arcgis.com/experience/dd8ec10467c94ae6b2dd7763789091f2>) to engage people in learning about the Kapāpala Koa Canoe Management Area and

receive input. This website allows interested individuals to explore virtual information guides describing the forest reserve's history, natural resources, threats, public uses, and proposed management priorities. It also contained a summary of how the public could participate in the planning process, including taking an online community survey and where to submit public comments. Press releases and social media announced the public comment period and informational platform.

DOFAW received one official response for the KKCMA plan during the partner agency consultation period and three comments during the public consultation period. Additionally, 12 individuals took the survey about management intentions for the area. Overall, comments and results of the survey supported timber harvesting but addressed specific natural or cultural resources that might be impacted by harvest actions or threats that could be introduced to the area and suggested mitigation measures. DOFAW felt these concerns were addressed in the plan, and no changes were made. A summary of the comments received, and the provided responses have been attached as Exhibit C. DOFAW has completed the Kapāpala Koa Canoe Management Area Plan and submits it for your review.

CHAPTER 343 – ENVIRONMENTAL ASSESSMENT:

Per HRS Chapter 343 regulations, an Environmental Assessment (EA) for the proposed actions within the KKCMA management plan has been created and is prepared for your review. The draft EA looked at all potential actions within the KKCMA plan and assessed their possibility of impacting natural and cultural resources in the area. Higher impact management actions identified through this analysis include potentially harvesting trees and the construction of skid roads or temporary roads to access timber resources. This EA reviewed the natural and cultural resources in the area, including but not restricted to watershed resources, threatened and endangered species, native ecosystems, and cultural practices occurring in the area, and reviewed mitigation measures proposed within the KKCMA plan to avoid impacting these resources. The draft EA determined that actions within the KKCMA management plan will not likely have a significant effect. Upon publication of the draft EA, one partner agency provided an official comment, and one public comment was also received. The partner organization (Big Island Invasive Species Committee) supported the project but wanted to highlight the importance of monitoring and treating novel invasive weed species that could be introduced. The one public comment fully supported the EA as written. Based on internal review and results of comments on the project, DOFAW is proposing issuing a notice of a Finding of No Significant Impact (FONSI).

CULTURAL IMPACT ASSESSMENT - Additionally, under Act 50 signed into law by the Governor on April 26, 2000, a Cultural Impact Assessment (CIA) was developed for the KKCMA (Exhibit D) to inform the EA as part of the Chapter 343 Environmental Review process. This CIA provided a cultural context of the project area and traditional Hawaiian canoe carving practices, a historical review of traditional practices and beliefs associated with koa harvesting and canoe making, a summary of prior archaeological and cultural studies conducted in or near the area, and a discussion of potential cultural

impacts as well as actions and strategies that may help to mitigate any identified impacts. This CIA was completed in collaboration with the development of the management plan, and the findings from the historical research and interviews from the CIA were incorporated into the management plan, ensuring traditional and cultural practices in the area were identified and protected.

Development Process & Timeline for the KKCMA Chapter 343 Process

Stage of Development	Date Achieved	Comments
DOFAW review of CIA	December 2022	Incorporated
DOFAW review of EA	March 2023	Incorporated
Partner agency consultation	April 2023	One comment received and incorporated
Public consultation	March-June 2023	<ul style="list-style-type: none"> • Posted website May 8 – June 7, 2023 • Press release & social media releases May 2023 • One response was received from the public in support of the findings of the EA.

RECOMMENDATIONS:

That the Board of Land and Natural Resources:

1. Approve the Kapāpala Koa Canoe Management Area Plan as a guiding document for managing the subject reserve.
2. Approve the Final Kapāpala Koa Canoe Management Area Environmental Assessment and issue a Finding of No Significant Impact

Respectfully submitted,



DAVID G. SMITH, Administrator
Division of Forestry and Wildlife

APPROVED FOR SUBMITTAL:



DAWN N.S. CHANG, Chairperson
Board of Land and Natural Resources

ATTACHMENTS:

EXHIBIT A: Final Kapāpala Koa Canoe Management Area Plan

EXHIBIT B: Final Kapāpala Koa Canoe Management Area Environmental Assessment

EXHIBIT C: Summary of Comments Received for the Draft KKCMA Plan and the responses provided by DOFAW.

EXHIBIT D: Cultural Impact Assessment for the Kapāpala Koa Canoe Management Area

Exhibit A

KAPĀPALA

KOA CANOE MANAGEMENT AREA

Management
Plan 2023



EXECUTIVE SUMMARY

This management plan for the Kapāpala Koa Canoe Management Area (KKCMA) 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). These plans present a brief history of the specific forest reserve or section, 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 the 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.

KKCMA consists of roughly 1,257 acres on the southeastern slope of Mauna Loa in the district of Ka‘ū and the ahupua‘a of Kapāpala. The area is covered almost entirely by a native montane koa (*Acacia koa*) and ‘ōhi‘a (*Metrosideros polymorpha*) forest at about 3,000-5,000ft in elevation. The primary management objective for the area is to provide a sustainable, long-term supply of koa for the traditional and cultural use of constructing koa canoes, while minimizing impacts on the natural and cultural resources in the area. This parcel is the only state land in Hawai‘i specifically zoned for the purpose of producing koa canoe resources. Other management objectives include native forest protection, protection of watershed resources, protection of forest bird habitat, increased regeneration and restoration of koa trees and forest habitat, collaboration with educational groups and community groups, access for recreational activities, and integration of traditional Hawaiian stewardship models with western conservation practices.

A harvest plan has been developed to allow for the harvest and extraction of canoe-quality trees while regenerating koa resources on a 100-year timeframe. Current plans call for organizations who have been selected to independently implement the harvest of canoe logs with the guidance of DOFAW. DOFAW will also implement stand improvement actions, such as pre-commercial and commercial thinning, that will enhance the ability of the forest to produce large, straight koa trees capable of being made into canoes. Some of these timber resources may be sold to help fund the management of KKCMA. KKCMA has been split into management units and areas have been prioritized for restoration, habitat protection, and forest product gathering, while allowing for adaptive management as necessary. A recent timber survey of the area indicates available koa resources will likely be able to meet expected demand and maintain sustainable harvest levels. Organizations in the state of Hawai‘i may apply for a permit to harvest a canoe log, which will be reviewed by a group of experts consisting of cultural practitioners; voyaging and racing members; kālaiwa‘a (canoe builders); forestry experts; conservationists; and community members, who will advise DOFAW/DLNR on the final allocation of canoe log permits.

Multiple protection measures will be implemented to ensure that the resources in the area are not degraded due to threats such as non-native animals, invasive weeds, human impacts, climate change, and/ or erosion. There are currently no known populations of cattle or mouflon sheep in the area, and there will continue to be zero tolerance for these animals as they severely impact koa trees and native forest ecosystems. Pigs are known in the area, a mixture of public hunting

and staff control will be used to decrease pig populations and the damage the cause to koa and other resources in the area.. Invasive weeds are not widespread and are mostly contained to roadways in KKCMA. Weed presence has the possibility to increase with increased traffic, and monitoring and control measures will be implemented to ensure new species and populations do not become established. Erosion is another concern, and roadways within the area will be maintained with recontouring of steep, commonly degraded roadways as a high priority objective.

In order to minimize impacts on threatened and endangered (T&E) species and archeological and historical sites, mitigation measures will be implemented. Botanical surveys and archeological surveys will be implemented in all areas prior to any silviculture actions taking place in that unit. No T&E plant species are currently known within the area. Surveys for forest birds will also be implemented, and areas of higher value native forest and bird habitat will be lower priority harvest areas.

Staff have created the following categories for management priorities within KKCMA and ranked them for the area as follows:

1. Watershed Values – protect watershed values of the area.
2. Cultural Practices & Uses – implement small-scale koa timber harvest for canoe construction.
3. Resource Protection – reduce damages from threats such as invasive plants and animals, wildfire, or insects and diseases on resources.
4. Native Ecosystems – protect and enhance native ecosystems in the area.
5. Threatened and Endangered (T&E) Species Management – protect and enhance T&E species in the area.
6. Access, Trails, Hunting & Other Public Uses– provide public use opportunities such as hiking, hunting, and bird watching.
7. Commercial Activity – implement small-scale sales of non-canoe quality trees.

A history of the area and Hawaiian canoe construction is found in Section 2. A full description of the site and the resources within it can be found in Section 3. Threats to the area are detailed in Section 4. Details of the above-mentioned management actions can be found in Section 5. A full list of management priority actions can be found in Table 14.

Table of Contents

EXECUTIVE SUMMARY	1
MANAGEMENT PLAN SIGNATURE PAGE	5
DEVELOPMENT PROCESS TIMELINE.....	6
1. INTRODUCTION & METHODS.....	7
2. HISTORY	8
2.1 Site History	8
2.2 History of Kālaiwa‘a, Hawaiian Canoe Construction.....	12
3. SITE DESCRIPTION	16
3.1 Location	16
3.2 Soils.....	17
3.3 Climate.....	17
3.4 Vegetation.....	19
3.4.1 Rare, Threatened and Endangered Plants:	23
3.5 Koa Timber Resources.....	23
3.5.1 Koa research plot:	27
3.6 Wildlife	27
3.7 Archaeological & Historical Sites	33
3.8 Infrastructure.....	33
3.9 Public Use Opportunities	36
4. THREATS	38
4.1 Invasive Plants	38
4.2 Invasive Animals	40
4.3 Insects & Disease.....	41
4.4 Fire	47
4.5 Flooding & Erosion.....	47
4.6 Climate Change.....	47
4.7 Volcanism	48
4.8 Vandalism & Human Activities.....	49
5. MANAGEMENT.....	50
5.1 Summary of Past Management Activities.....	50
5.1.1 Past & Related Plans	51
5.2 Management Guidelines	51

5.3 Timber Harvest	54
5.3.1 Harvest Plan Overview	54
5.3.2 Pre-Harvest Actions and Mitigation Measures	64
5.3.3 Harvest Volume Restrictions & Harvest Rotations	66
5.3.4 Canoe Tree Application Process	67
5.3.5 Canoe Tree Extraction Operations	68
5.3.6 Thinning & Stand Improvement Operations.....	69
5.4 Non-Harvest Management Objectives	70
5.4.1 Ungulate control.....	70
5.4.2 Increased koa regeneration	70
5.4.3 Invasive plant control.....	71
5.4.4 Wildfire Management	72
5.4.5 Access and Public Use	72
5.4.6 Forest Monitoring and Research.....	72
5.5 Management Actions & Costs	74
5.6 Measures of Success	86
5.7 Future Recommendations	86
6. REFERENCES	87
7. APPENDICES	89
Appendix A: Cultural Impact Assessment (CIA) for the Kapāpala Koa Canoe Management Area.....	90
Appendix B: Kapāpala Koa Canoe Management Area Forest Inventory 2020....	91
Appendix C: Kapāpala Koa Canoe Management Area Working Plant List.....	92
Appendix D: Kapāpala Koa Canoe Management Area Forest Bird Surveys 2021	95
Appendix E: DOFAW Management Guidelines Classification	108
Appendix F: Best Management Practices for Maintaining Water Quality in Hawai‘i.....	114

KAPĀPALA KOA CANOE MANAGEMENT AREA MANAGEMENT PLAN SIGNATURE PAGE

Hawai‘i District certification: This plan was prepared by a team of Division of Forestry and Wildlife (DOFAW) staff to provide a management framework for Kapāpala Koa Canoe Management Area.

Steven T. Bergfeld – DOFAW Hawai‘i District Manager

Date

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

David G. Smith – DOFAW Administrator

Date

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

Dawn N.S. Chang – BLNR Chairperson

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

DEVELOPMENT PROCESS TIMELINE

Kapāpala Koa Canoe Management Area, Hawai‘i

Stage of Development	Date Achieved	Comments
District review	11/30/2022	Comments incorporated
DOFAW review	01/31/2023	Comments incorporated
Partner agency consultation	04/21/2023	1 comment, incorporated
Public consultation	05/31/2023	3 comments incorporated
DOFAW approval	07/31/2023	
BLNR approval		

1. INTRODUCTION & METHODS

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

Management plans will be developed for each individual forest reserve, which will in part reflect the Division's management guidelines specific to that area. This document represents the management plan for Kapāpala Koa Canoe Management Area (KKCMA), a section of the Ka'ū Forest Reserve, and addresses concerns and strategies only related to this section of the forest reserve.

This management plan for KKCMA was developed using a variety of methods. Initial development consisted of reviewing the 2016 draft Forest Management Plan for the area, and reviewing and analyzing DOFAW historic and current files (found at the Administrative and Hawai'i District office). Documents were also obtained from other state agencies including the Department of Land and Natural Resources Land Division and Bureau of Conveyances, and the Department of Accounting and General Services (DAGS) Survey Division. Hawai'i Statewide Geographic Information System (GIS) data relating to biological, historical, and environmental resources were referenced extensively to develop this plan.

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

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

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

2. HISTORY

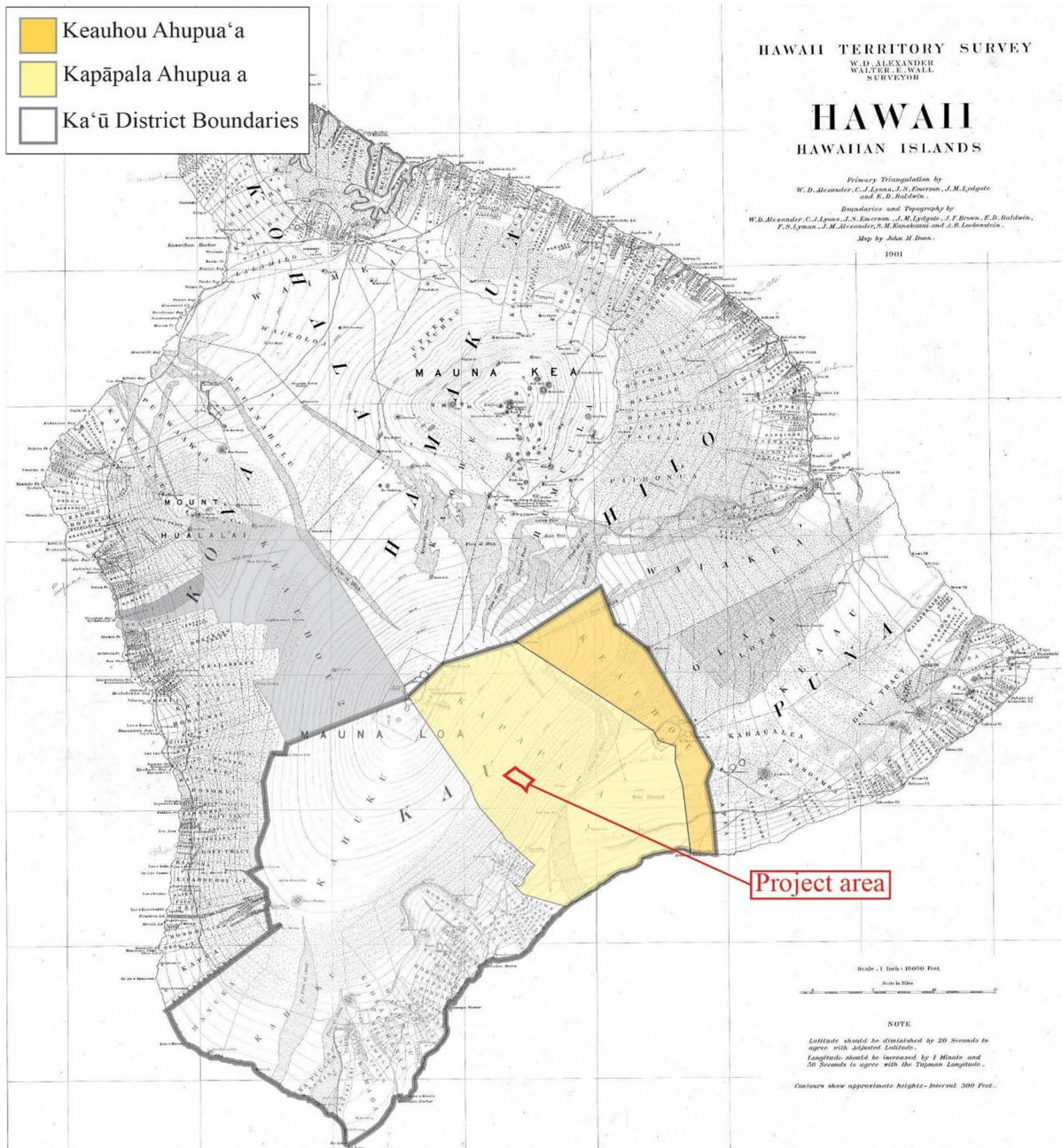


Figure 1 Hawai'i Registered Map 2060 from J.M. Donn (1901) showing KKCMA project area in Kapāpala, Ka'ū. Taken from KKCMA Cultural Impact Assessment (Appendix A)

2.1 Site History

The Kapāpala Koa Canoe Management Area (KKCMA) lies within the ahupua'a of Kapāpala in the moku of Ka'ū (Figure 1). Prior to European contact, the mauka regions of the ahupua'a of Kapāpala, where KKCMA is located, were likely not very heavily populated. Handy et. al (1991 p. 613) describe Hawaiian communities in the moku of Ka'ū, and known evidence of cultivation and inhabitation. They state that “there was never any cultivation, as far as we could learn . . . in

the forests above the pali from Kapāpala to Ohaikea the bird snarers or feather hunters had their huts, but no taro was grown.” They further mention that the closest community was Hilea, a small grouping of homesteads southwest of Kapāpala.

Early European arrivals, including Captain James Cook, observed the moku of Ka‘ū from the sea and accessed some of the coastal areas, but few ventured far into the inland areas where KKCMA is located. A handful of accounts from foreign travelers of the upland areas in Ka‘ū include William Ellis in 1823, and Chester H. Lyman in 1846. Lyman, when describing the ahupua‘a of Kapāpala, notes that he encountered some dwellings and canoe making sheds, and was impressed by the green hills and moist soil (Lyman 1846, p.9-10). Lyman’s documentation of “canoe making sheds” is one account of Hawaiians utilizing trees from the Kapāpala area for the construction of wa‘a, or canoes.

Following the Great Mahele in 1848, the entire ahupua‘a of Kapāpala was designated as crown lands under the control of King Kamehameha III. Around 1860, Frederick Lyman established a small ranch at ‘Ainapō, and in 1860 Charles Richardson and William H. Reed acquired Lyman’s ranch and greatly increased its size by leasing the entire ahupua‘a of Kapāpala from King Kamehameha IV. This expansion started their joint venture of Kapāpala Ranch.

Kapāpala Ranch became the largest working cattle ranch in Ka‘ū, producing meat, dairy, hides, and other commodities. Other uses such as hunting and traditional maile gathering also occurred in the area. Throughout its history the ranch has hosted many famous guests, such as travel writer Isabella Bird, naturalist Archibald Menzies, and it was also a favorite spot of Queen Lili‘uokalani.

Over time the ranch switched owners and its boundaries changed, but it remained on public land either under a lease or permit. The lands managed by the ranch has decreased from the original 1860 lease of the entire ahupua‘a, but the area that would become KKCMA was continuously under ranch management from 1860 until 1989. Evidence that KKCMA was used for grazing still remains on the property including the old barbed wire cattle fence just mauka of the crossroad. There were also likely timber harvests that occurred in KKCMA prior to 1989, but documentation of such events has not been found. The current forest structure of the lower elevations of KKCMA are indicative of its past exposure to cattle grazing and/or timber harvesting (see section 3.4).

Starting in the late 1980s, DLNR began searching for native forests on state land for the purpose of designating areas for koa management, in efforts to expand silviculture operations in the state. The ample koa resources on KKCMA made it an ideal location, and on October 27, 1989, the Board of Land and Natural Resources approved the set-aside of approximately 1,257 acres “for commercial koa timber production, with consideration for recreation, forest bird habitat, and watershed values.” In the 1990s, following struggles by organizations to find koa trees suitable for the construction of voyaging canoes, the purpose of the area was further refined from broad koa management to focus on the management and cultivation of koa canoe logs.

In 2004, the 1,257 acre koa management area was officially sub-divided by the County of Hawai‘i, removing it from the rest of the parcel that is still under lease by Kapāpala Ranch.

Subsequently, in 2004 the Board of Land and Natural Resources approved redesignating the area as the Kapāpala Koa Canoe Management Area, and on June 27, 2005 Executive Order 4109 was issued, officially setting the area aside for the growth and production of koa trees for use in the making of traditional Hawaiian canoes. Seven additional management goals that were defined for the area include:

- 1) Preserve Hawai‘i’s unique natural and cultural inheritance for future generations, by fostering knowledge and respect for Hawai‘i’s native forests, in a way that inspires better care of its natural environment.
- 2) Protect threatened tropical forest habitat and promote environmental policies and practices, that address biological sustainability and human well-being, by identifying and integrating relevant traditional Hawaiian natural resource stewardship models with current Western management strategies.
- 3) Develop natural resource stewardship models that involve a wide range of constituent groups.
- 4) Involve youth through cooperative programs with the Department of Education, University of Hawaii, and other school and education institutions.
- 5) Provide wood workers with portions of harvested trees that are not processed as canoe logs.
- 6) Involve other constituency groups (e.g. canoe clubs, forest management entities, and cultural organizations).
- 7) Provide compatible opportunities for public uses such as hunting and recreation.

The set-aside as a “Koa Canoe Management Area” designation had the potential to jeopardize effective management due to the lack of applicable statutes and rules to enact and enforce for the area. Therefore in 2004, the BLNR approved the cancellation of EO4109, and the issuance of a new EO incorporating the area as the Kapāpala section of the Ka‘ū State Forest Reserve, therefore rules governing forest reserves could be applied to KKCMA. These actions were formalized by the issuance of EO4427 which cancelled EO4109, and EO4428 which formalized KKCMA’s inclusion into Ka‘ū FR on February 27, 2013.

Table 1. Summary of Executive Orders Relating to KKCMA

Action	Date	A/W	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key
Executive Order 4109	May 23, 2005	A	Land Set Aside for the Establishment of Kapāpala Koa Mgmt Area	1257.73	23859	(3) 9-8-001:014
Executive Order 4427	February 27, 2013	-	Cancellation of EO 4109, preparation for addition to FRS	1257.73	23859	(3) 9-8-001:014
Executive Order 4428	February 28, 2013	-	Addition of parcel to FRS as Kapāpala section, K‘aū FR	1257.73	25,042	(3) 9-8-001:014

Table 2. Historical Land Use Agreements in Kapāpala Koa Canoe Management Area.

Type of Action	Action Number	Duration	Description	Acres	Copy of Survey Furnished (CSF)	Tax Map Key parcels included (current TMKs)
Lease		March 1, 1860-1887	Lease to W.H. Reed & C. Richardson	Ahupua'a of Kapāpala excepting Kuleanas		
Lease	106	07/01/1887-06/30/1907	Pasture Lease to Hawaiian Agricultural Co.	172,780		
Lease	603	07/01/1908 - 06/30/1929	Pasture Lease to Hawaiian Agricultural Co.	72,850	1853	
Lease	1920	04/16/1928-07/01/1950	Pasture Lease to Hawaiian Agricultural Co.	50,535	4980	(3) 9-8-001:003
Lease	3376	02/14/1951-12/31/1973	Pasture Lease to Hawaiian Agricultural Co.	37,466	11033	(3) 9-8-001:003, 010, 013, 014
Revocable Permit	5254	November 21, 1975 (BLNR approval) – 10/31/1977	Permit to Ka'ū Sugar Co and Richard Smart dba. Parker Ranch for sugar cane cultivation and pasture purposes	37,266		(3) 9-5-19:1, 2, 12, 16, 17, por 27, 28 ; 9-6-2:5, 10, 11, 13 ; 9-6-12:4; 9-6-13:2; 9-8-1:3, por 2
Revocable Permit	S – 5491	October 28, 1977 (blnr approval) – September 9, 1988 (blnr approved cancellation)	Permit to Ka'ū Sugar, Richard Smart dba: Parker Ranch and Gordon Cran dba: Kapāpala Ranch	38,689		(3) 9-5-19:1, 2, 12, 16, 17, por 27, 28 ; 9-6-2:5, 10, 11, 13 ; 9-6-12:4; 9-6-13:2; 9-8-1:3, por 2
Revocable Permit	S – 6582	September 9, 1988 (blnr approval) – 10/31/1989	Permit to Gordon Cran for pasture and residential purposes.	24,573		(3) 9-8-001: por 003
Revocable Permit	S – 6695	10/27/1989 (blnr approval) -	Permit to Kapāpala Ranch	23,473		(3) 9-8-001: por 003
Lease	S - 5374	12/1/1994-present	Lease for pasture w. Amendment for ecotourism. Lease S-5374 is still active, however <i>KKCMA was officially withdrawn from the lease in 2005.</i>	23,408	22110, HSS Plat 127-A	(3) 9-8-001:014
Right of Entry		10/27/1989	Right of Entry to DOFAW to begin management actions	1257.33	NA	(3) 9-8-001:014

2.2 History of Kālaiwa‘a, Hawaiian Canoe Construction

The significance of the wa‘a, or canoe, in Polynesian and Hawaiian culture is deeply rooted and cannot be overstated. Wa‘a were the main transporter of people from one island to the next across Polynesia, and were utilized in many other aspects of life such as fishing, warfare, and sport (Chun and Burningham 1995; Fornander 1878). When early Polynesian voyagers first landed on Hawai‘i, they continued to construct and utilize canoes and adapted their craft to the new environment of Hawai‘i. Koa (*Acacia koa*), the second most common tree in the islands and a fast growing hardwood species, became the preferred tree used in canoe construction (Holmes 1981).

Canoe construction in Hawai‘i has traditionally been guided by the kahuna kālaiwa‘a, or master canoe carver. The role of kahuna kālaiwa‘a was considered the foremost of all traditional occupational trades, as they had to possess a wide range of technical skills from building to forestry to guiding ceremonies and protocols (Holmes 1981). The kālaiwa‘a was responsible for the entire process of building the wa‘a, from deciding when and how to undertake the process until the completed wa‘a was launched into the ocean.

According to the account of David Malo, an early native Hawaiian historian, “the building of the canoe was an affair of religion” (Malo 1903). Due to the danger, high degree of difficulty, and cultural importance of canoe construction, many rituals and traditions guided the process. The exact process likely varied by location and across the islands, however the CIA drafted for this project (Appendix A) identified the accounts recorded by multiple individuals, including David Malo, Abraham Fornander, Tommy Holmes, Edgar Henriques, and Kalakuokamaile, that outlined the process likely common in the south Kona and Ka‘ū areas, and the steps during canoe construction are listed below. Detailed information can be found in the CIA which has been include as Appendix A of this plan.

- 1) Beginning rituals of the kahuna kālaiwa‘a
- 2) The ascent to the forest
- 3) Selecting the tree
- 4) Cutting and felling rituals
- 5) Rough hewing the canoe on site
- 6) Hauling the rough canoe to the coast
- 7) Final hewing and initial voyage rituals

Canoe Log Selection and Terminology The process of finding the right tree to create a canoe varies among historians. Many different terminologies and methods have been used to describe and qualify the growth form and suitability of koa trees for use in canoe construction. Table 3 lists a variety of Hawaiian terms gathered by Holmes (1981) describing koa trees, many of which relate to the suitability for canoe construction:

Table 3 Hawaiian Koa Terminology (Holmes 1981)

Hawaiian Term	Definition
koa ‘awapuhi	Low density, similar to koa lā‘au mai‘a, but considered female.
koa hi‘u wa‘a	growing straight up before branching; also koa hi‘u awa.
koa huhui	growing straight up, with a cluster of branches at the top.
koa huli pū	having wood of such good quality throughout that it was thought best to avoid cracking the log by exposing and drying out the roots, letting the tree fall over, rather than cutting it down.
koa iho ‘ole	crooked but nicely bent in an arc; could be easily shaped to give the hull a “banana” curve; considered the most desirable type.
koa ‘i‘o ‘ōhi‘a	‘ōhi‘a grain koa, high density (60-80 lbs/ft ³)
koa kamahele	having one branch larger and more serviceable than the trunk itself; also koa lālā kamahele.
koa kolo	leaning or sprawling, but still fit for use.
koa kolopū	growing straight up with no significant branching; of uniform diameter nearly the whole length of the trunk; waves will wash into a canoe made from this type.
koa kū ke‘ele wa‘a	straight but somewhat flattened on both sides.
koa kūpalaha	having a broad, straight trunk, but rather flat on one side.
koa kūpalina	generally usable but imperfect; bent, flattened, short, not well-proportioned.
koa kupulā‘iki	same as koa kūpalaha.
koa lālā kamahele	same as koa kamahele.
koa lā‘au mai‘a	banana colored koa, low density (30-40 lbs/ft ³)
koa lau kane	(no data)
koa lau kani	strong; considered male; possibly same as koa lau kane.
koa lau nui	a large-leafed variety.
koa no‘u	straight, thick, unblemished, not very tall; suitable for a wide, short canoe such as an ‘ōpelu (heavy duty fishing canoe).
koa poepoe	of good size but short and thick.

Outside of growth form, the color, density, and grain of the wood is also of importance to the kahuna kālaiwa‘a. Holmes (1981) presented different densities of wood. Low-density koa (roughly 30-40 lbs/ft³), which was most suitable for paddles but sometimes used for canoes, was known as koa lā‘au mai‘a (banana-colored koa) and was characterized by its soft, lightweight, and yellow color. This type of koa was also known as koa ‘awapuhi (ginger koa) but was considered female. The favored wood grain for canoes was the mid-range density koa (40-60 lbs/ft³), which was valued for both its durability and strength. High-density koa (60-80 lbs/ft³) known as koa ‘i‘o ‘ōhi‘a (‘ōhi‘a grain koa) was less ideal for canoe building as the wood was exceptionally dense which made carving very difficult.

Another important factor often documented is the consultation of the ‘elepaio (*Chasiempis* sp.). ‘Elepaio are native birds that eat small insects, and are considered bold and curious and often follow humans in the forest. Kahuna kālaiwa‘a formed a close connection with ‘elepaio, and

would notice the behavior of these birds and use it to determine if trees were suitable for canoe construction. Holmes (1981) mentions that on islands where ‘elepaio were not present, kahuna kālaiwa‘a may have consulted other birds. Below is one description from Fornander of the process (Fornander 1919-1920):

“If the bird darted down and perched on the trunk of the tree and then ran along the trunk to the other end, the canoe-hewing priest would remark: "The canoe is perfect." The conduct of the bird in running direct from the base to the end was the sign which enabled the priest to pronounce it perfect. Where the bird traversed was the top opening of the canoe. Supposing that the opening of the canoe which the bird apparently intended was underneath, the bird would fly to a certain height, then circle over the tree, the priest would understand that it was urging the turning of the tree. But if the opening that the elepaio intended to be was on the side, it would fly in that direction. On the other hand, if the bird came and stood on the trunk of the tree intended for a canoe, if it continued to remain there for some time, the canoe-hewing priest knew that a defect was at that point. If the bird again ran from the trunk and stood in another place, then another defect was at that locality, and thus the bird would indicate all the defects in the canoe, whether it be rottenness, hollow-cored, or knotted. In this way the canoe-hewing priest was made aware of the defects of the [tree for a] canoe.” (Fornander 1919-1920)

Canoe Size Requirements: Different size trees are typically needed for the construction of different canoes. The dimensions for three major canoe types are shown in Table 4. These dimensions are not restrictive, as different carvers may make larger or smaller versions intended for different uses.

When making a canoe, builders often prefer to utilize a single ideal tree, however some will piece together 2-3 shorter lengths that can come from multiple trees. For the latter style, the most important requirement is tree diameter. Trees can be used even if upper sections of those trees split or do not have the most ideal growth form. Further, some builders may build canoes by combining planks instead of hollowing out entire logs, which allows for more flexibility in tree size and growth requirements. Koa trees that are too small and/or have less optimal growth form (lots of forking, a twisting main stem etc.), are not ideal for being carved into koa canoes.

Table 4 Different Types of Koa Canoes

Canoe Type*	Minimum Width**	General Length**
<u>Fishing</u> (‘ōpelu)- Present-day term for a short, thick hulled, wide bodied and heavy fishing canoe.	24”	10-20’
<u>Racing</u> - The Hawaiian Canoe Racing Association (HCRA) has strict regulations regarding racing canoes. There are separate races for koa canoes, non-koa canoes, and others.	36”	30-45’
<u>Voyaging</u> - The largest type of koa canoes, first designed by the Polynesian people that arrived at the islands of Hawai’i.	40”	40-60’

*Descriptions from Holmes 1981.

**Size requirements are based on discussions with a variety of traditional koa canoe builders. There are no established sizing standards, and these numbers are subject to change depending on the builder.

At this point DOFAW has done timber surveys indicating the size and general growth from of many trees in the area, details of which can be seen in section 3.5 and Appendix B. Surveys have not determined the density or grain types of trees found in KKCMA, but opportunities in monitoring and collaboration with organizations during harvest may shed light on these details in the future.

Ongoing Cultural Practices.

The practice of *kālaiwa‘a* has historical roots but is an evolving art still practiced by many today. The techniques and methods for canoe building are constantly growing, as methods for felling, extraction, and carving are changing as new technologies emerge. One early example can be seen in Figure 2. During the precontact and early historic periods, hauling the koa out from the forest was done entirely by hand. However, as new technologies emerged including carts and wagons, *kālaiwa‘a* adapted their traditions to utilize these new tools to ease the workload.



Figure 2 Men preparing to haul an unfinished canoe to Hōnaunau, South Kona. Photo courtesy of K. P. Emory, Bishop Museum Archives.

Today, modern tools include heavy machinery such as bulldozers and logging trucks for felling and transporting logs, as well as hand tools such as chainsaws to assist in felling and carving are often used in canoe construction. While canoes were traditionally hewn from hollowing out a single log entirely with adzes and hand tools, some builders today utilize chainsaws to rough hew the shape before finishing with adzes. Other builders utilize planks instead of hollowing out a single tree, connecting planks together to create the hull of the canoe. This has the advantage of utilizing more wood from a tree and being able to use smaller sections of a tree in canoe construction.

Given the wide array of traditional and modern ways for selecting, felling and building a koa canoe, DOFAW understands that different organizations will want to implement different techniques. DOFAW supports organizations implementing their own traditional and cultural practices related to canoe tree selection, harvesting and construction at KKCMA, as long as the methods are safe and follow DOFAW's guidelines for timber harvest, as outlined in Section 5.3.

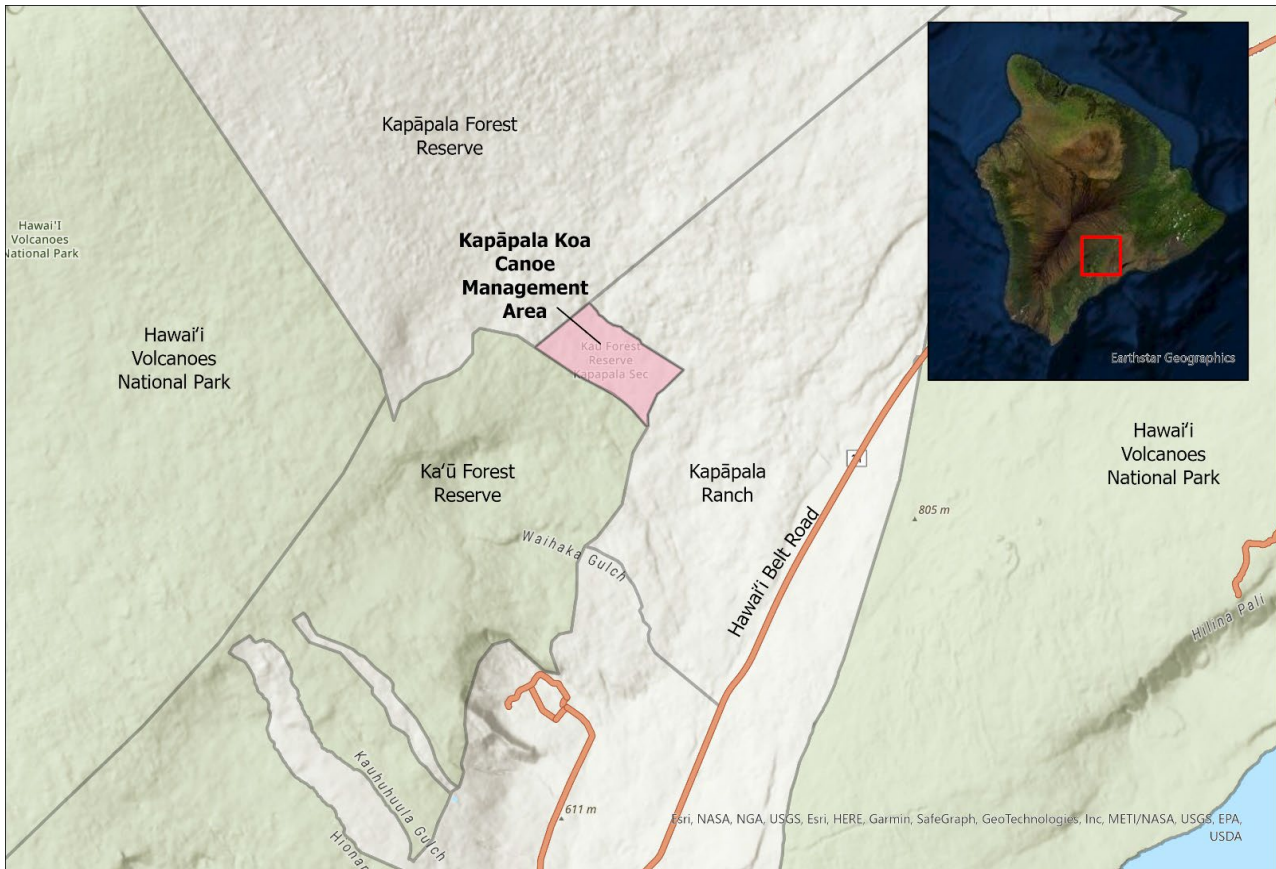
3. SITE DESCRIPTION

3.1 Location

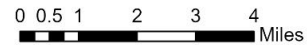
The Kapāpala Koa Canoe Management Area (KKCMA) is comprised of 1,257 acres of public land in the moku of Ka‘ū on the island of Hawai‘i. It is in the ahupua‘a of Kapāpala on the southeastern slopes of Mauna Loa between 3,640ft-5,100ft in elevation, with an average slope between 6-20%. The land cover is completely forested, dominated by mesic montane native koa-‘ōhi‘a forest.

KKCMA is part of the Ka‘ū Forest Reserve and is surrounded by other state lands, including other sections of the Ka‘ū Forest Reserve to the southwest, the Kapāpala Forest Reserve to the northwest, and public lands under general lease and revocable permits to Kapāpala Ranch to the northeast and southeast (Figure 3). Portions of Kapāpala Ranch are also a cooperative game management area (GMA). The small town of Pahala is about 10 miles south of KKCMA, and the town of Volcano is approximately 15 miles to the northeast. Kīlauea caldera is about 12 miles to the northeast as well. KKCMA is composed of Tax Map Key (TMK) (3) 9-8-001:014 and is zoned by the county of Hawai‘i as A-20 agricultural land.

Figure 3 KKCMA Location



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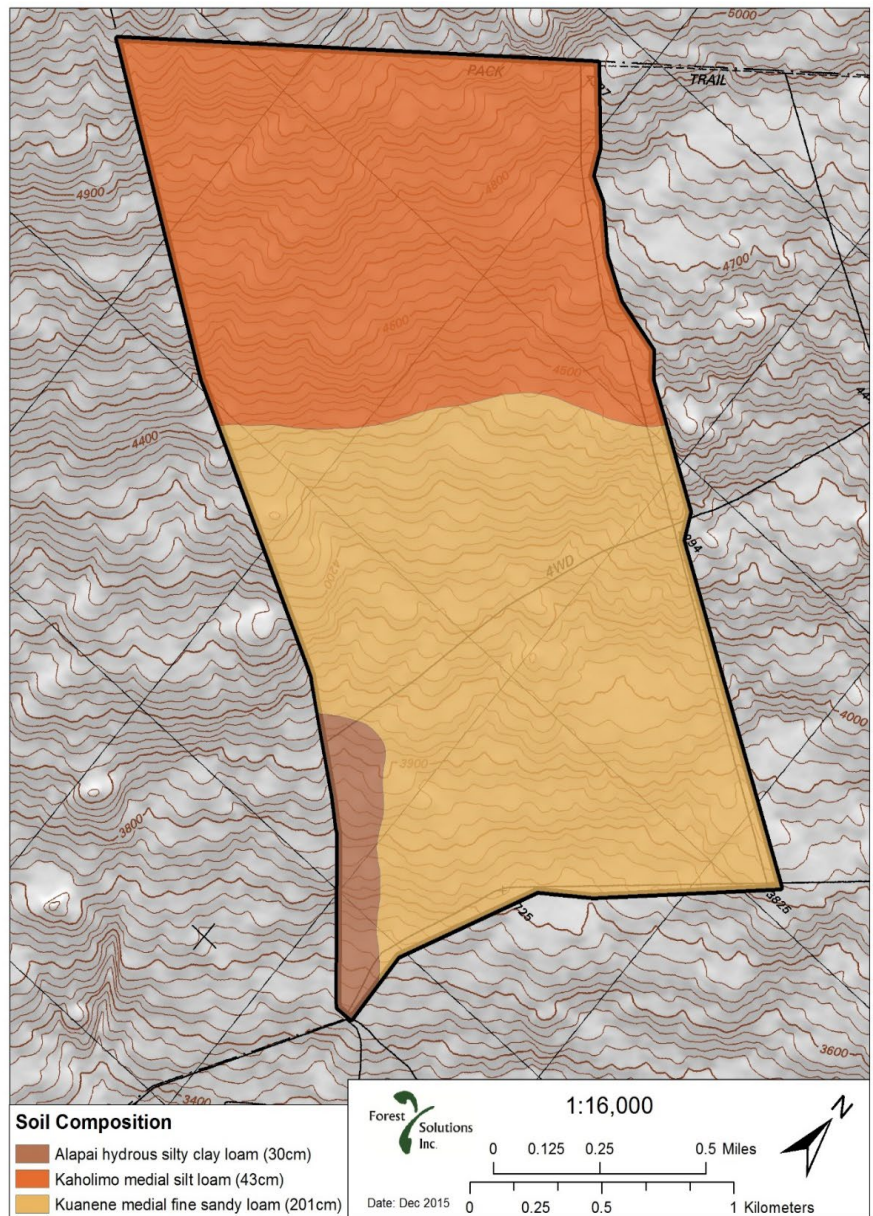


3.2 Soils

The underlying geology in the area is comprised of basic igneous rocks (basalt) beneath weathered volcanic ash and cinders. There are three soil series within KKCMA: Kaholimo, Kuanene, and Alapai (Figure 4). Kaholimo soil developed over basalt bedrock and is prevalent at higher elevations, comprising approximately 45% of KKCMA. The Kaholimo soils in the reserve generally has a rooting depth ranging from 13-17” which is shallow for a forest soil. Kuanene soil developed over pāhoehoe lava flows and comprises approximately 50% of the area, dominating lower elevations. These are the deepest soils within the parcel. Alapai soils cover a small section of the southeast corner of the reserve, and are the most shallow in the parcel.

All of these soils are andisols, meaning they were derived from volcanic ash, and are thus relatively fertile and acidic, with 0-60% organic material at the surface. These soils are highly erodible, which must be considered during forestry operations, especially harvesting. Because of the thin soils and high infiltration rates in the parent material, there is limited water holding capacity in the soil profile. This means the area is susceptible to drought, which is a common occurrence in Ka’ū.

Figure 4 Soils in KKCMA



3.3 Climate

KKCMA has an average annual temperature of 60°F (49-72 °F) and an average annual rainfall of 80 inches. Rainfall is consistent throughout the year with wetter months during the winter, similar to the rest of Hawai’i (Figure 5). Winter is also when temperatures are slightly cooler as daylight

hours are shorter and sun angles lower. The area commonly has dense cloud and fog, further impairing the incident sunlight and providing additional moisture via fog drip. Fog is also quite common given its proximity to Kilauea caldera, however native forests in Ka‘ū do not appear to suffer from fog exposure.

A climatological study of KKCMA was conducted by James Juvik and Paul Fishbein from 1993-1994. They summarized that there was a “distinctive diurnal wind regime (daytime upslope, nighttime downslope)” complementing the prevailing trade wind (cross slope) flow. Also discussed was the heavy rainfall recorded during a few winter storms. Rain totals were larger during these winter storms than all other rain events during the year combined. Winter storms can cause mass erosion and should be considered when planning timber activities.

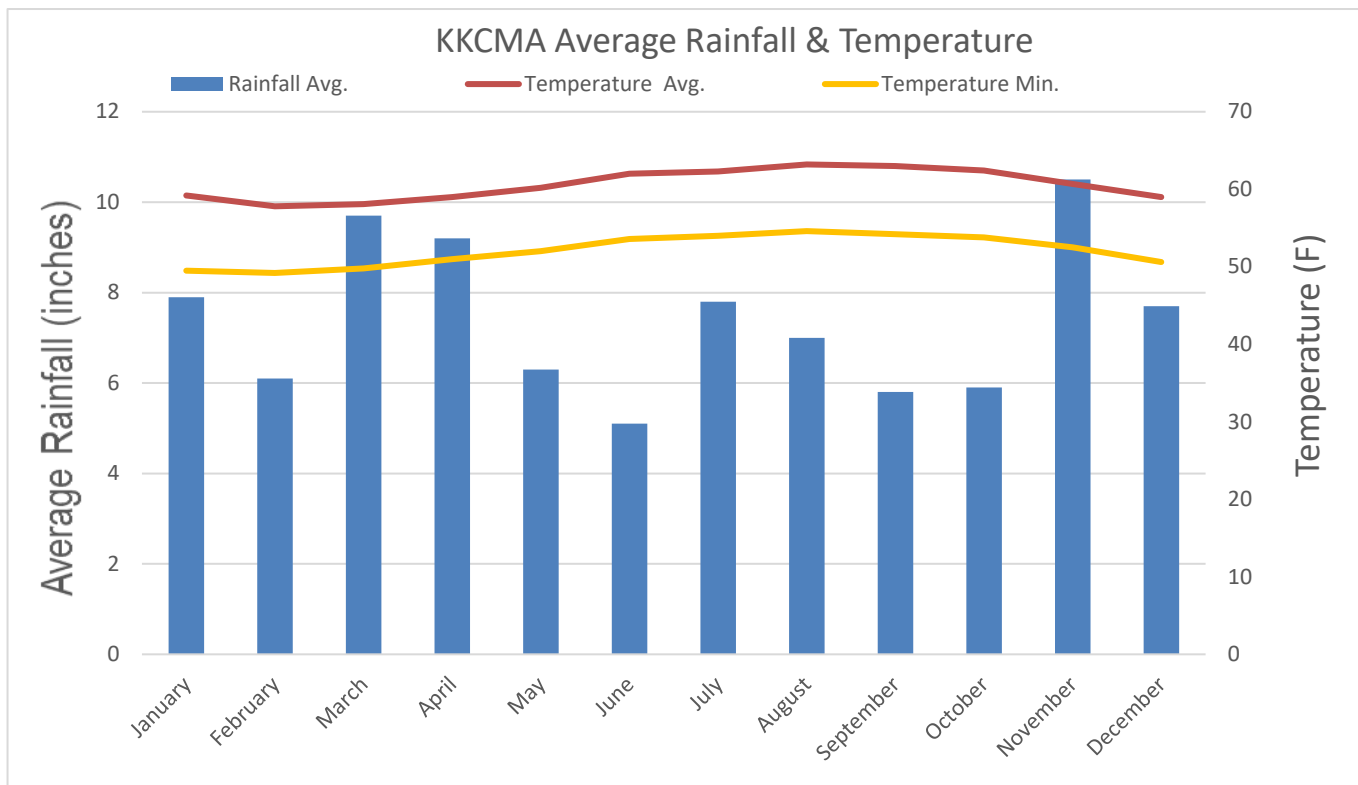


Figure 5 Average monthly rainfall and temperature in KKCMA (Giambelluca et al 2013).

Note: this graph obscures powerful winter rainstorms

3.4 Vegetation

The vegetation at KKCMA is classified as Montane Wet Forest (Wagner 1999). Based on field observations and data collected during forest inventories, the parcel was further split into four strata, largely based on vegetation cover:

- KO1: Open ‘Ōhi‘a Forest (324 acres)
- KO2: Open Koa-‘Ōhi‘a Forest (386 acres)
- KO3: Closed Koa-‘Ōhi‘a Forest (323 acres)
- KO4: Mature Koa Forest (207 acres)

The forest canopy in K01 is characterized as an even-aged stand of ‘ōhi‘a (*Metrosideros polymorpha*). Koa are present but generally as a subcanopy species. The forest canopy of KO2, KO3 & KO4 is mixed with both koa and ‘ōhi‘a. Trees are generally larger and the canopy is more closed the higher you go in elevation. KO4 has the largest, most mature koa trees and is overall the most intact native forest in KKCMA. Common subcanopy species in all strata include pilo (*Coprosma rhynchocarpa*), kōlea (*Myrsine lessertiana*), kawa‘u (*Ilex anomala*), kōpiko (*Psychotria hawaiiensis*), naio (*Myoporum sandwicense*), and ōlapa (*Cheiropodendron trigynum*).

The ground cover in the lower elevation strata, including all of KO1 and the lower parts of KO2, is less intact. It is dominated by non-native grass species such as kikuyu (*Cenchrus clandestinus*), meadow-rice grass (*Ehrharta stipoides*), and various fern species. This extends into KO2, a few hundred yards mauka of the crossroad. Above this, in upper KO2, KO3, and KO4 the percent cover of non-native grass in the understory decreases, and species like Hawai‘i sedge (*Carex alligata*), i‘o nui (*Dryopteris wallichiana*), ma‘ohi‘ohi (*Stenogyne microphylla*), hairgrass (*Deschampsia nubigena*) and ‘ala‘ala wai nui (*Peperomia* sp.) can be found. Common shrubs and ground cover in all strata include ‘ōhelo (*Vaccinium* sp.), uluhe (*Dicranopteris linearis*), and abundant maile (*Alyxia stellata*). Native shrub and fern species that are found primarily in KO3 and KO4, include kanawao (*Hydrangea arguta*), pāpala (*Charpentiera obovata*), ‘ākala (*Rubus hawaiiensis*), and hapu‘u (*Cibotium* sp.). For a current, working plant list of KKCMA, see Appendix C.

The thick sward of alien grasses, lack of native understory and remains of old cattle fencelines in KO1 and lower KO2 all suggest that the lower forests have been heavily impacted in the past, either by grazing, logging, fire, or a combination of the three. Further, in the 2020 inventory surveys KO2, KO3, and KO4 had around double the species richness of KO1. Overall, the parcel is considered to contain relatively intact native ecosystems with minimal pressure from invasive plant species, with the exception of non-native grasses present at lower elevations.



Figure 7 Higher elevations areas have more intact native understories, especially native fern species



Figure 6 Lower elevations areas, especially below the cross-road, are more likely to have non-native grass in the understory

Figure 8 Forest Strata in Kapāpala Koa Canoe Management Area (KKCMA)



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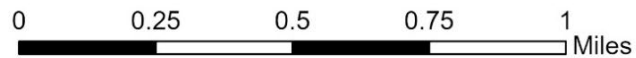


Table 5 Basal Area (ft²/acre) of Native Tree Species by Strata

Strata	koa (<i>Acacia koa</i>)	‘ōhi‘a (<i>Metrosideros polymorpha</i>)	ōlapa (<i>Cheirodendron trigynum</i>)	kōlea (<i>Myrsine lessertiana</i>)	kawa‘u (<i>Ilex anomala</i>)	pilo (<i>Coprosma rhynchoarpa</i>)	naio (<i>Myoporum sandwicensis</i>)	kōpiko (<i>Psychotria hawaiiensis</i>)	Total
K01	22.9	127.4	0.0	0.0	11.4	1.6	0.0	0.0	162
K02	20.8	121.1	1.2	0.00	12.7	2.3	0.0	0.0	156
K03	46.8	74.6	2.5	1.3	6.3	15.2	2.5	1.3	132
K04	25.4	115.3	6.9	4.6	0.00	2.3	4.6	0.0	152
Overall	28.9	109.6	2.7	1.5	7.6	5.4	1.8	0.3	150.3

Table 6 Native Tree Seedlings and Shrubs in KKCMA (Stems Per Acre by Strata)

Tree Seedlings							
Strata	koa (<i>Acacia koa</i>)	‘ōhi‘a (<i>Metrosideros polymorpha</i>)	ōlapa (<i>Cheirodendron trigynum</i>)	kōlea (<i>Myrsine lessertiana</i>)	kawa‘u (<i>Ilex anomala</i>)	pilo (<i>Coprosma rhynchoarpa</i>)	kōpiko (<i>Psychotria hawaiiensis</i>)
K01	0	13	134	0	13	13	0
K02	0	123	38	0	19	85	57
K03	0	197	94	10	31	62	0
K04	265	379	701	19	0	303	0
Shrubs							
Strata	‘ākala (<i>Rubus hawaiiensis</i>)	hapu‘u (<i>Cibotium sp.</i>)	kanawao (<i>Brussaisia arguta</i>)	‘ōhelo (<i>Vaccinium sp.</i>)	pāpala (<i>Charpentaria obovata</i>)		
K01	0	161	0	0	13		
K02	0	208	0	0	0		
K03	10	239	31	83	0		
K04	19	133	0	114	0		

3.4.1 Rare, Threatened and Endangered Plants: Threatened and endangered (T&E) plant species in Hawai‘i are listed under and protected by the Federal Endangered Species Act (ESA) and the State Endangered Species Law, Chapter 195D, HRS. Other species not listed as T&E by either the state or federal listings can still be considered rare or species of concern by land managers.

Currently no rare or T&E plant species are known to occur within KKCMA. A comprehensive vegetation roadside survey of the parcel was completed in 2020 and found no T&E plant species. One individual of *Rubus macraei*, which is not a protected species but is considered rare, was found growing in an old rare plant enclosure just outside of KKCMA in Ka‘ū FR. *R. macraei* is known from approximately 3000-5000 individuals and is relatively common in the supalpine slopes of Mauna Loa. A wild population of *Phyllostegia velutina*, an endangered native hawaiian mint with roughly 30 individuals left in the wild, is known to exist about 3.5 km away from KKCMA. Surveys for rare and T&E plant species should be done in any areas where timber harvest or other management activities are planned that may cause a disturbance to avoid any potential impacts.

3.5 Koa Timber Resources

In line with the specific designation of this area, the primary timber resources of concern are koa trees capable of being carved into canoes. There is a rich history and language around the various types of koa canoes traditionally built by native Hawaiians, and on the type and size of koa trees required (see Section 2.2.).

2020 Timber inventory: In 2020 a timber inventory was done of KKCMA. The inventory consisted of two parts: 1) plot data collected throughout the entire parcel to get an overall estimate of the quantity, volume, and spatial distribution of timber 2) a more in-depth 100% tree count of roadside areas to use for planning and implementing harvest operations in the near future (see Appendix B for the entire timber inventory).

Results of the plot data show that there is approximately 5.5 million board feet (bf) of koa in KKCMA. Of this, an estimated 1 million bf, or around 18% of the koa volume, is in “canoe log trees”, or trees ideal for use canoe log construction. Another 1.5 million bf, or 27% of the koa volume, is in younger trees that will likely be capable of canoe log construction in 10-20 years. The remaining ~3.5 million bf of koa is either too small, or in trees that have the wrong growth form. Spatially, it appears



Figure 9 Big, unbranched trees are ideal for canoe construction

that strata K02 and K03 have higher numbers of canoe log trees. The trees in K01 are smaller and a more often a subcanopy species to ‘ōhi‘a (see section 3.4), and many of the trees in strata K04 are large, but over mature and far from the desired tree form. However, canoe trees can be found in both K01 and K04, just in smaller quantities. Another important finding from the plot data is that koa regeneration is alarmingly low throughout most of KKCMA. Although seedling recruitment for ‘ōhi‘a, kawa‘u, and ōlapa seems to be occurring in all strata, koa seedlings were only present in K04 plots (see Table 6). This could be due to a lack of disturbance, or due to grazing pressures from ungulates. The low levels of koa regeneration is concerning in regards to maintaining a sustainable supply of koa trees for canoe logs.

The 100% tree count measured and evaluated all koa trees within 200 feet of all roads. Based on their form, trees were put into 4 classes as seen in Figure 10, with class 1 being the most ideal growth form for a canoe log and class 4 being the least ideal. For the purposes of this plan trees in class 1 and class 2 were considered useable for canoe logs; class 3 and class 4 were considered unsuitable or less suitable for constructing canoes. Taking both tree form (Figure 10) and diameter requirements (Table 4) into consideration, criteria for what trees could be used in canoe construction were developed and they are shown in Table 7. Results of the 100% roadside tree count show that most of the desirable trees are along the middle cross road (K02) and along the upper northern boundary (K03, K04) (Figure 11).

Table 7 Canoe Log Classification of Koa Trees in KKCMA

Canoe Class	Koa Tree Diameter	Form Classification*	Description**
Ideal canoe log	≥30"	1	Koa tree likely capable of making an entire canoe
Potential/partial canoe log	≥30"	2	Koa tree with potential to make an entire canoe, or parts can be used in canoe construction
Young ideal canoe log	20-30"	1	In about 10-20+ years could become a koa tree capable of making an entire canoe
Young potential/partial canoe log	20-30"	2	In about 10-20 years could become a koa tree capable of making an entire canoe, or parts of a canoe
N/A	<20"	Any	Not capable of being used in canoe construction in near future (10-20 years)
N/A	>20"	3, 4	Not ideal for use in canoe construction

*See Figure 10 for form classification description

**These rough broad categories help provide an idea of ideal canoe trees. Canoe builders may have other methods for quantifying tree shape, such as those in Table 3

Figure 10. Koa Tree Form Classifications Used During 2020 KKCMA Forest Inventory.



Tree Form Class 1: Straight and tall trunk, does not split until canopy (~40 ft), canoe log



Tree Form Class 2: Straight and tall, but splits or forks lower on trunk, potential canoe log

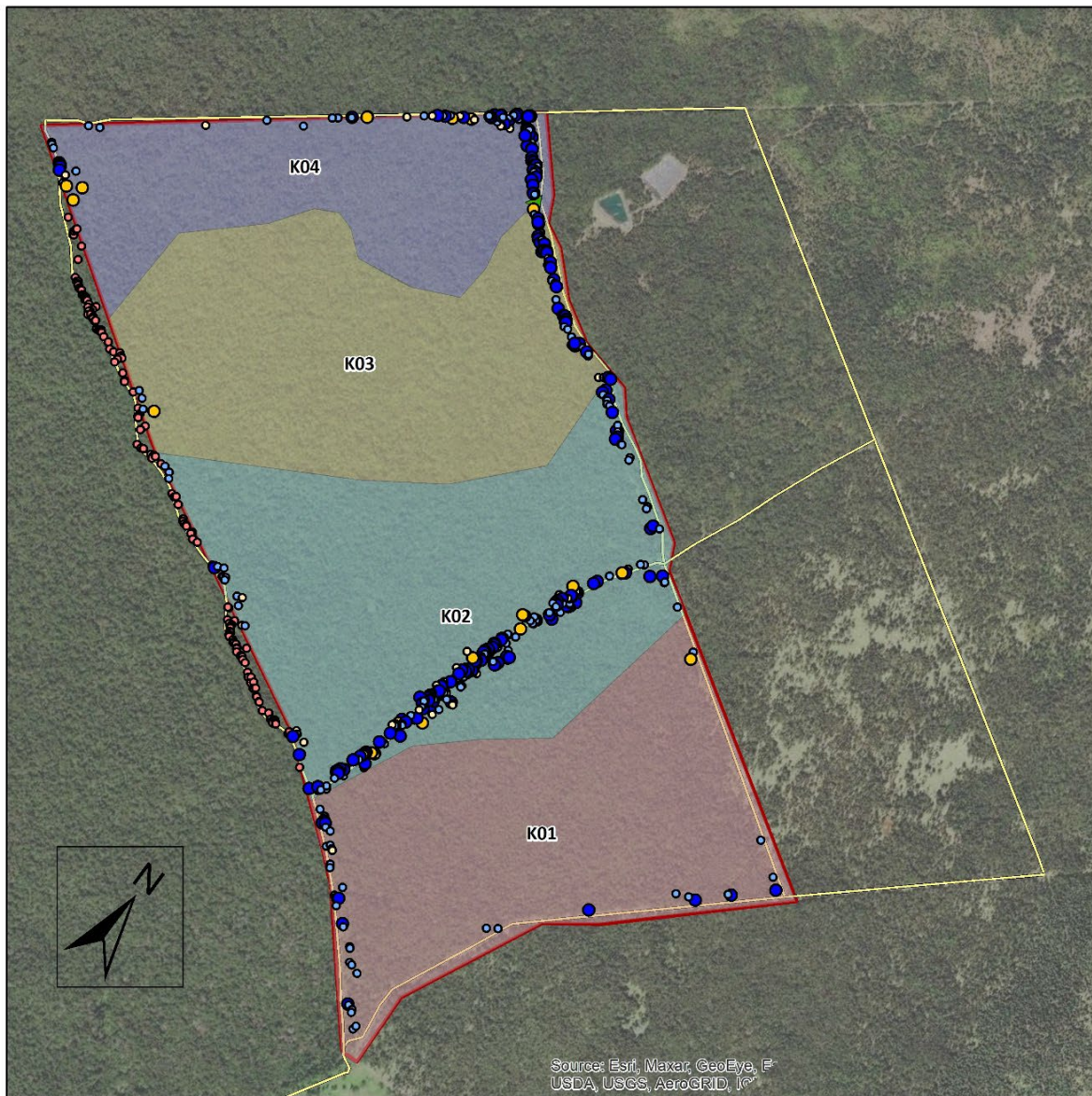


Tree Form Class 3: Big branches fork off from a lower part of the tree, sprawling form



Tree Form Class 4: Many forks, curved trunk, no canoe logs possible

Figure 11 Results of KKCMA Roadside 100% Tree Survey



Roadside Strip Cruise	KKCMA Strata
100% Tally Results	K01: Open Ohia Forest, 324 ac
● Canoe	K02: Open Koa- Ohia Forest, 386 ac
○ Potential Canoe	K03: Closed Koa- Ohia Forest, 323 ac
● Young Canoe	K04: Mature Koa Forest, 207 ac
● Potential Young Canoe	— 4 x4 Roads
● Trees Outside KKCMA Boundary	— KKCMA Boundary
▲ Camp Platform	



Date: 1/6/2021
 Author: Aviva Gottesman



3.5.1 Koa research plot: Within KKCMA there is a small, fenced area managed by the Hawai‘i Agricultural Research Center (HARC) in collaboration with DOFAW and other partners. This originally was a koa seed orchard and part of a project to develop a tree improvement program that will provide koa seeds that have been screened to be resistant to koa wilt disease. Koa wilt is a vascular wilt disease caused by the fungal pathogen *Fusarium oxysporum* f. sp. *koa* that causes high rates of mortality in many koa trees across the state, especially at lower elevations and in field plantings (Dudley et. al 2017). See section 4.3 for more information on koa wilt. Koa wilt disease is not widespread in KKCMA.



Figure 12 Koa trees within the research plot in KKCMA testing resistance to koa wilt

3.6 Wildlife

Native Birds: The native tree canopy and fruit bearing understory plant species in KKCMA provides excellent habitat for native birds. Bird surveys have been done annually since 2018 by the Three Mountain Alliance (TMA) and DOFAW. Fifteen bird species have been detected, the majority of which are native (Table 8). Apapane, followed by Hawai‘i amakihi and ‘ōma‘o, were the most abundant native birds in KKCMA. Native birds are present throughout the entire area, with decreasing abundance at lower elevations. The Japanese white eye was the most abundant non-native bird. (Table 8).

In total, eight species of native birds have been detected, including one threatened species, i‘iwi (*Drepanis coccinea*), and three endangered species, ‘akiapola‘au (*Hemiganthus wilsoni*), Hawai‘i creeper/‘alawī (*Loxops mana*), and the ‘io/hawaiian hawk (*Drepanis coccinea*) (Table 8). Threatened and endangered species in Hawai‘i are listed under and protected by the Federal Endangered Species Act (ESA) and the State Endangered Species Law, Chapter 195D, HRS. Note that the ‘io is no longer a federally listed species but is still considered an endangered species by the State of Hawai‘i.

I'iwi were consistently detected and heavily correlated with higher elevation areas (Figure 16). This is not surprising given that they are highly sensitive to avian malaria, a disease spread by mosquitoes at lower elevations.

The three endangered bird species were all detected in very low numbers (Figure 17). The 'akiapola'au was only detected once, in the highest elevational transect of the parcel. The 'alawī was detected four total times, all in northwest section in strata K03 & K04. 'Io were observed most frequently in K02, potentially because of the opening in the canopy created by the road. 'Io are known to use a variety of habitats and the mix of forested areas and small gaps in KKCMA are ideal for feeding and roosting.

Hawaiian Hoary Bat: The endangered 'ope'ape'a (*Lasiurus cinereus cernotus*, Hawaiian hoary bat) has not been detected in KKCMA but it is highly probable that they are present in or around the area. With thick 'ōhi'a canopy interspersed with open grassy areas and nearby pasture, the forest structure of Kapāpala is ideal habitat for this species.

More research is needed on bat populations across the Hawaiian Islands. Monitoring prey items and availability through invertebrate studies can provide indicators for the health and success of bat populations. Additionally, vegetation cover should be regularly monitored to supplement the other Hawaiian hoary bat monitoring efforts.

The Hawaiian hoary bat can use a variety of land cover types; therefore, promoting a mosaic of diverse habitat types across the landscape may contribute positively to bat populations. Management activities should not seek to create a uniform, homogenous cover of native forest. Hoary bats have been found to utilize corridors and edges of corridors, such as along hiking trails and roads, for hunting and flying through dense forest (Bonaccorso et al. 2015). Since the Hawaiian hoary bat is a solitary, foliage roosting bat that roosts in both native and non-native tree species with a broad height range, care should be taken if any trees are removed from KKCMA (Gorresen et al. 2013). This is especially true if multiple trees are harvested at once, as this increases the likelihood of removing one that potentially has a day roosting bat.

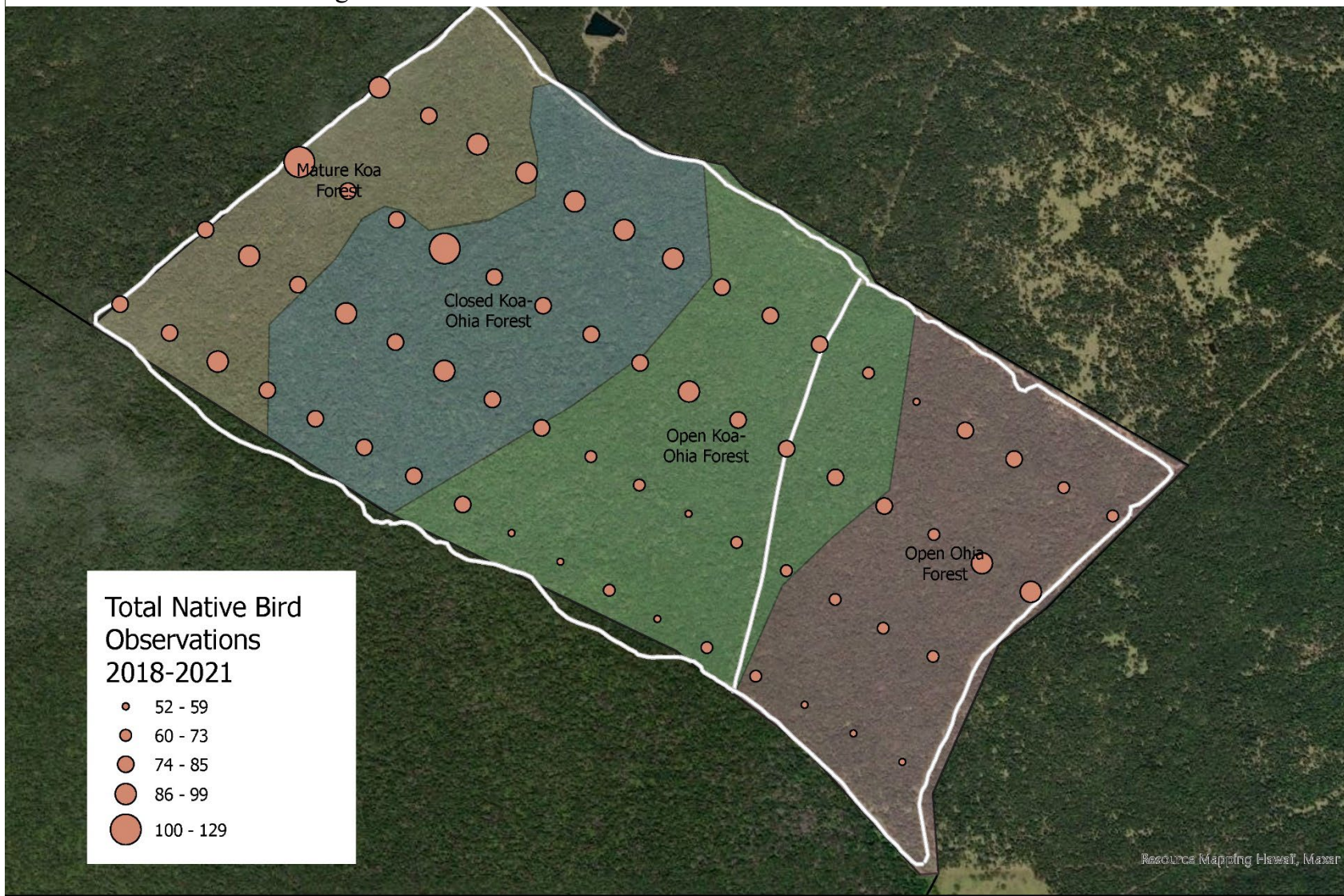


Figure 13. 'Akiapola'au (*Drepanis coccinea*), an endangered forest bird detected in very small quantities in the highest elevations of KKCMA



Figure 14. Hawai'i creeper (*Loxops mana*), another endangered forest bird found in very small quantities in the highest elevations of KKCMA

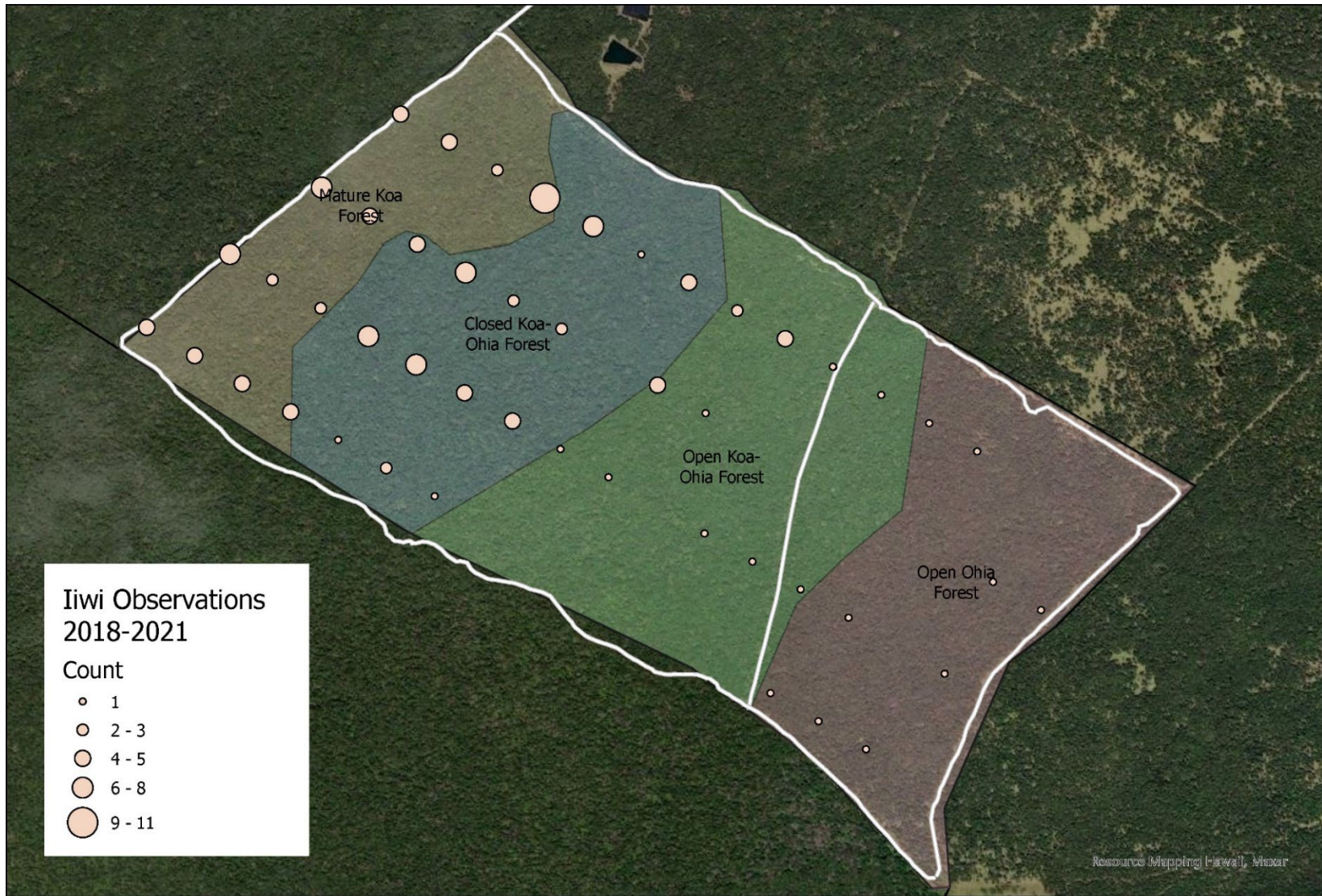
Figure 15 Total Native Bird Observations in KKCMA 2018-2021



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Figure 16 'I'iwi (Threatened) Observations in KKCMA 2018-2021

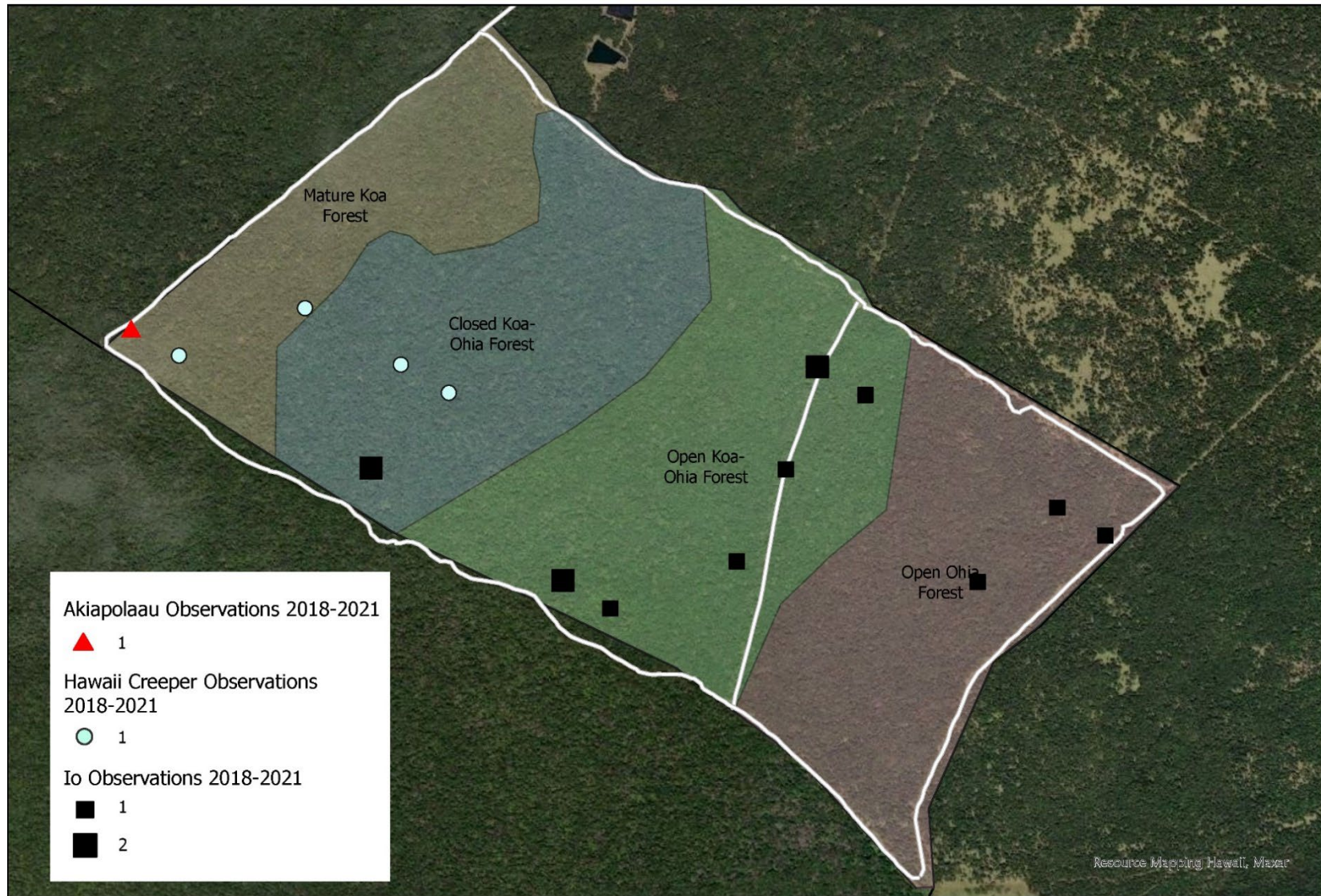


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0 0.25 0.5 0.75 1 Miles



Figure 17 Endangered Bird Species Observations in KKCMA 2018-2021



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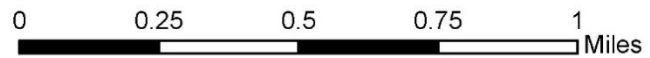


Table 8 Species Detections during 2021 KKCMA Bird Surveys (with comparison of birds per station for 2018-2020)

Alpha Code	Common Name	Scientific Name	Origin [†]	Status* Fed/State	2021 # Stations Occupied	2021 # Detected	2021 Percent Occurrence	2021 Birds per Station	2020 Birds per Station	2019 Birds per Station	2018 Birds per Station
AKIP	‘Akiapola‘au	<i>Hemiganthus wilsoni</i>	End	E/E	0	0	-	-	-	0.02	-
APAP	‘Apapane	<i>Himatione sanguinea</i>	End		65	827	100%	12.72	13.49	10.05	11.66
HAAM	Hawai‘i ‘Amakihi	<i>Chlorodepanis virens</i>	End		64	295	95.4%	4.54	4.60	4.20	3.91
HAEL	Hawai‘i ‘Elepaio	<i>Chasiempis sandwichensis</i>	End		17	23	26.15%	0.35	0.38	0.85	0.48
HCRE	Hawai‘i Creeper/‘Alawī	<i>Loxops mana</i>	End	E/E	0	0	-	-	-	0.02	0.05
HOFI	House Finch	<i>Carpodacus mexicanus</i>	Int		1	1	1.54%	0.02	-	-	-
HWAH	‘Io, Hawaiian Hawk	<i>Buteo solitarius</i>	End	-/E	1	1	1.54%	0.02	0.08	0.08	0.03
IIWI	‘I‘iwi	<i>Drepanis coccinea</i>	End	T/^	16	19	24.62%	0.29	0.65	0.93	0.58
JABW	Japanese Bush- Warbler	<i>Cettia diphone</i>	Int		9	10	13.85%	0.15	0.23	0.41	0.35
JAWE	Japanese White-eye	<i>Zosterops japonicus</i>	Int		60	131	92.31%	2.02	1.78	2.34	2.18
KAPH	Kalij Pheasant	<i>Lophura leucomelanos</i>	Int		2	2	3.08%	0.03	0.02	-	0.03
NOCA	Northern Cardinal	<i>Cardinalis cardinalis</i>	Int		5	8	7.69%	0.12	0.08	0.10	0.09
OMAO	‘Ōma‘o	<i>Myadestes obscurus</i>	End		61	180	93.85%	2.77	1.34	2.08	2.65
RBLE	Red-billed Leiothrix	<i>Leiothrix lutea</i>	Int		25	40	38.46%	0.62	0.09	0.41	0.40
YFCA	Yellow-fronted Canary	<i>Serinus mozambicus</i>	Int		5	6	7.69%	0.09	0.06	0.07	0.06

[†]End = endemic, Int = introduced, Ind = Indigenous; * E = endangered; T = threatened; ^State status here refers to Hawai‘i Island only

Native Insects: DOFAW entomologists implemented insect surveys in KKCMA in April 2023. Preliminary information shows that there aren't likely to be any T&E species present. There is some possibility that the rare picture wing species, *Drosophila silvestris* and *D. silvarentis* may be present, given their host plant species 'olapa (*Cheirodendron trigynum*) and naio (*Myoporum sandwicense*),)) are present but none were found in surveys. Full details on the findings of the 2023 entomological surveys will be completed later in 2023.

3.7 Archaeological & Historical Sites

Based on research done by DOFAW staff and through the Cultural Impact Assessment (Appendix A), the area within KKCMA was likely not heavily inhabited during pre-European contact. Trails, small forest shrines, burial caves and lava tube shelters are the types of historical features that may be present, as the greater area was used historically by Hawaiians for activities such as bird hunting, harvesting timber for canoe-making, and gathering forest plants for medicinal uses. Post-European contact the lower sections of the project area were likely used for grazing, ranching, and/or timber harvest. The remnants of an old ranching era structure, now collapsed, may still be present near the east end of the cross road. DOFAW plan to implement archeological surveys in all areas that may be impacted by silviculture actions prior to any potentially disturbing actions occur, such as timber harvest, skid road construction, or stand improvement actions. Archeological features are protected by state law in Hawai'i. If any evidence of archeological features are found all management activities will stop until appropriate efforts to preserve or mitigate damages to the area can be put in place.

3.8 Infrastructure

Roads: Within KKCMA there are roads that roughly follow the entire perimeter of the parcel, the perimeter roads occasionally dip into the adjacent sections of the Ka'ū FR. There is also one crossroad that cuts across the parcel (Figure 18). Some of these roadways may be impassable or hard to access and may be more suitable to ATV access during or following storms, especially in winter months.

Designated Helicopter Landing Zones: There is one designated landing zone within KKCMA, however it is not actively used and needs maintenance.

Fencelines: The entire boundary of KKCMA is fenced to prevent cattle from entering the parcel. All current fencing was constructed to restrict cattle, and does not control the movement of other ungulates such as pigs or sheep. The northwest and southwest sides of the parcel have been fenced with thicker, bull-wire fencing, constructed between 2019-2021. The northeast and southeast sections of the fence are made of a lighter gauge hog wire, and was constructed within the last 10 years.

Gates & Pedestration Crossovers: There is one the main access gate, known as "domingo corner gate" located on the southwest corner. All other gates are for management use only. There are pedestration crossovers located on the fenceline between Ka'ū FR and Kapāpala FR.

Gathering platform: A platform/gathering place was constructed in the northeast corner of KKCMA. The platform is used by staff, partner organizations, and educational groups for operations.

Koa seed orchard: A koa seed orchard, maintained by the Hawaii Agricultural Research Center (HARC), can be found in the lower section of the reserve. See section 3.5.1 for more information.

Figure 18 Infrastructure at KKCMA



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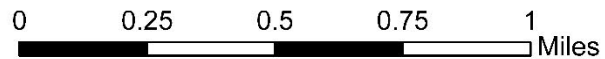




Figure 19. The public can access KKCMA via a rough 4x4 access road, but prior approval must be secured with the adjacent Kapāpala Ranch

3.9 Public Use Opportunities

Vehicle Access & Roadways: While there are multiple access roads to adjacent forest reserve lands in Ka‘ū, there is one road for public access to KKCMA. The entrance is at the Honanui gate, near the 44 mile marker on Mamalahoa Hwy. This access road passes through Kapāpala Ranch, which is under lease, and requires registration and prior approval from ranch staff before the public can pass through this gate. You will not be able to get through the locked gate at the entrance without going through this process. More information about registration and access through Kapāpala Ranch can be found at: <http://kapāpalaranch.weebly.com/public-access.html>

This road is a very rough, 4x4 vehicle only road. During heavy storms, which can be common in the area during winter months, roadways are often not passable. The road first enters Ka‘ū Forest Reserve through Kapāpala Ranch, then provides access to KKCMA at the “domingo gate” in the southwest corner of the parcel (see Figure 18).

Hiking: There are no designated hiking trails within KKCMA, but interior roadways (Figure 18) can be used to hike around the area.

Mountain Biking: mountain biking is allowed unless otherwise posted, but only on established roadways. Due to the remote access and condition of roadways, mountain biking is not a common activity in KKCMA.

Horseback Riding: Horseback riding is not recommended within KKCMA due to the difficult access, lack of trail infrastructure, and generally steep slopes and unstable footing for horses in the area.

Dirt Bikes and All Terrain Vehicles: OHVs are allowed unless otherwise posted, but only on established roadways.

Camping: There are no designated camping areas within KKCMA.

Fishing: No fishing opportunities are available in KKCMA.

Hunting: Hunting in state forest reserves is regulated by the Hawai‘i Administrative Rules (HAR) Chapter 13-121 Hunting General Regulations, Chapter 13-122 Game Bird Hunting, and Chapter 13-123 Game Mammal Hunting. The entirety of KKCMA is within Hunting Unit B. For copies of the administrative rules, additional information on hunter education, hunting licenses and more, visit <https://dlnr.hawaii.gov/recreation/hunting/>.

Forest Product Collection: Koa timber resources from KKCMA will be managed via a separate permit system, see section 5.3.4. Gathering of other non-timber material from plant species that are not on federal or state threatened and endangered species lists is permitted and regulated by DOFAW through standard Forest Reserve System permit procedures as described in Chapter 13-104, Hawaii Administrative Rules (HAR). Gathering of non-listed species or common materials requested in quantities that are determined by DLNR as representing personal use, is regulated through issuance of a Collection Permit free of charge. If quantities are determined to represent commercial use, a Commercial Harvest Permit may be issued at a fee. Consult the Forest Product Price List on the DOFAW website for information on personal versus commercial use quantities, as well as current commercial use pricing:

https://dlnr.hawaii.gov/forestry/files/2013/09/2018-12-11_DLNR_Forest-Products-Price-List.pdf

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

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

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

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

For more information for how to apply for permits for the state Forest Reserve System visit our permitting page:

<https://dlnr.hawaii.gov/dofaw/permits>

Traditional and Customary Rights: Traditional and customary rights of the native Hawaiian people are protected under Hawai‘i law. The Constitution of the State of Hawai‘i, Article XII, Section 7 states: “The State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua‘a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights.”

A Cultural Impact Assessment (CIA) was completed for the KKCMA plan, which can be seen in full in Appendix A. The CIA identified traditional and customary practices and valued cultural resources found within and in the surrounding areas of KKCMA, Kapāpala, and Ka‘ū. Some known cultural practices and resources include, but are not limited to: plant gathering, including koa for canoe building or kālaiwa‘a, and gathering of other plant species such as maile, māmaki, pulu, and ‘iliahi. Further details of known historical and current traditional and cultural practices can be seen starting on p. 85 of Appendix A. For additional inquiries regarding traditional and customary rights, please contact the “Hawai‘i Forestry Manager” at the Hawai‘i Island DOFAW office at the address listed above.

4. THREATS

4.1 Invasive Plants

Invasive plants are non-native species with the ability to invade natural areas, grow and reproduce rapidly, and reduce biodiversity. They are harmful to the environment, economy, and/or human health and can alter ecosystem functions such as freshwater collection, soil erosion, and flood control.

Currently there are limited numbers of invasive plants in KKCMA, but there are large populations of invasive plants below the property. Within KKCMA invasive plants are more common in the lower strata and along roadways. Increased activity or timber harvest can be a vector to introduce new invasive plant species and it creates disturbance where invasive species can flourish. Table 8 lists the invasive plants known to occur in KKCMA or the surrounding Ka‘u area. The Hawai‘i Invasive Species Council has invasive species profiles for many of these species, which can be found online at: <https://dlnr.hawaii.gov/hisc/info/invasive-species-profiles/>. Based on potential impacts, distribution, and available control methods DOFAW has set a management objective for each species:

Invasive plant management objectives:

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

- EDRR (Early detection rapid response) – Species that are not established within KKCMA but are a serious threat to watershed function and/or native ecosystems. Early detection, rapid assessment and response are a critical defense against the establishment of new invasive species.
- Monitor – Monitor spread over time

Table 9 Invasive plant species threatening KKCMA

Species	Common Name	DOFAW Objective (in KKCMA)	Noxious Weed List Status
<i>Abutilon pictum</i>	painted abutilon	EDRR*	None
<i>Andropogon virginicus</i>	broomsedge	Contain	Hawai‘i Noxious Weed List
<i>Bocconia frutescens</i>	plume poppy	EDRR	Hawai‘i Noxious Weed List
<i>Caesalpinia decapetala</i>	cat’s claw	EDRR	None
<i>Cestrum nocturnum</i>	night-blooming jasmine	EDRR	None
<i>Clidemia hirta</i>	koster’s curse	EDRR	Hawai‘i Noxious Weed List
<i>Crotalaria pallida</i>	rattlepod	Contain	None
<i>Desmodium intortum</i>	greenleaf desmodium	Contain	None
<i>Derris elliptica</i>	tuba root	EDRR	None
<i>Ehrharta stipoides</i>	meadow rice grass	Contain	None
<i>Grevillea robusta</i>	silk oak	Contain	None
<i>Fuchsia x hybridus</i>	fuchsia	EDRR	None
<i>Morella faya</i>	firetree	Remove	Hawai‘i Noxious Weed List
<i>Hedychium gardnerianum</i>	Himalayan ginger	EDRR	None
<i>Heterocentron subtriplinervium</i>	pearlflower	EDRR	None
<i>Passiflora laurifolia</i>	orange lilikoi	EDRR	None
<i>Passiflora tarminiana</i>	banana poka	EDRR	Hawai‘i Noxious Weed List
<i>Psidium cattleianum</i>	strawberry guava	Contain	None
<i>Psidium guajava</i>	common guava	Contain	None
<i>Rubus argutus</i>	blackberry	Contain	Hawai‘i Noxious Weed List
<i>Rubus ellipticus</i>	Himalayan raspberry	Contain	Hawai‘i Noxious Weed List
<i>Rubus niveus</i>	mysore raspberry	Contain	Hawai‘i Noxious Weed List
<i>Setaria palmifolia</i>	palm grass	Remove	None
<i>Schinus terebinthifolia</i>	Christmas berry	EDRR	None
<i>Senecio madagascariensis</i>	fireweed	Contain	Hawai‘i Noxious Weed List
<i>Tibouchina</i> spp.	glorybush, cane tibouchina	Contain	Hawai‘i Noxious Weed List

* EDRR – Early Detection, Rapid Response; target species not currently known to occur in KKCMA, but are known in the surrounding areas.

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

4.2 Invasive Animals

Invasive animal species, especially ungulates, are a significant stressor on all native terrestrial ecosystems in Hawai‘i. They have been shown to alter ecosystem processes, contribute to native species mortality, and undermine the integrity and persistence of native ecosystems (Gregg, 2018).

Cattle appear to be the primary animal threat to the native ecosystems in KKCMA. They cause damage by trampling and browsing native vegetation. In KKCMA damage to koa seedlings and inhibition of koa recruitment is especially concerning. Although cattle fencing surrounds the parcel there is still cattle ingress to the area, either from damage to fencing, and gates being left open either intentionally or accidentally. Cattle have been observed in KKCMA and there are signs of activity including excrement and browse damage on vegetation throughout the parcel, especially in the lower strata.

Other ungulates reported from the Kapāpala area include mouflon and pigs. Mouflon cause similar browsing damage as cattle. Pigs root and disturb soil, which disturbs native ecosystems and creates habitat that invasive plant species can then colonize. Other non-native animal species include rats, cats, and mongoose, all of which are widespread in the hawaiian islands and negatively effect native plants and animals.

Invasive animals known to occur in KKCMA and their potential impacts are listed in Table 10. Based on potential impacts, distribution, and available control methods, DOFAW has set a management objective for each non-native animal species.



Figure 20. damage to koa seedlings, likely from grazing from cattle

Invasive animal management objectives:

- **Control** – Reduce populations and/or the vigor of individuals.
- **Contain** – Stop or minimize population growth and geographic spread.
- **Remove** – Full removal of populations within KKCMA.
- **EDRR** (Early detection rapid response) – Species that are not established within KKCMA but are a serious threat to watershed function and/or native ecosystems. Early detection, rapid assessment and response are a critical defense against the establishment of new invasive species.
- **Public hunting** – provide hunting opportunities.

Table 10 Invasive Animals with the Potential to Disrupt Ecosystems in KKCMA

Species	Common Name	Status/Threat	DOFAW Objective
<i>Bos taurus</i>	cattle	Trample plants, strip bark from trees, causing vegetation damage/erosion (currently believed to not be present)	EDRR*
<i>Canis lupus familiaris</i>	dog	Predate on native birds, game mammals and game birds; threat to public safety	Control
<i>Ovis gmelini musimon</i>	mouflon	Eat and trample vegetation; cause erosion (currently believed to not be present).	EDRR
<i>Culex spp.</i>	mosquito	Vectors for diseases that are a threat to public safety and native wildlife (especially <i>Culex quinquefasciatus</i>).	Control
<i>Felis catus</i>	cat	Predate on native and game birds; vectors of toxoplasmosis, a zoonotic disease	Control
<i>Herpestes auropunctatus</i>	mongoose	Predate on native and game birds	Control
<i>Rattus spp.</i>	rat	Predate on native plant fruits/seeds and native and game birds	Control
<i>Sus scrofa</i>	feral pig	Vegetation damage; trail damage & erosion; decrease infiltration/water quality and increase runoff; spread of invasive species and pathogens such as ROD; creating breeding ground for mosquitos carrying avian malaria	Public Hunting, Control

*EDRR – Early Detection, Rapid Response; target species not currently believe to be in KKCMA, but known from surrounding areas

4.3 Insects & Disease

New and sudden increases of insects and diseases can be a serious threat to KKCMA. With globalization and an increased dependence on imports, approximately 20 insect species become established in Hawai‘i every year (State of Hawai‘i 2010). Of particular concern in KKCMA are those that have the potential to cause widespread dieback of predominant forest canopy species such as koa and ‘ōhi‘a. Below are some of the known insects and diseases that threaten KKCMA. Many of these insects or diseases are very hard to control or have limited control options, and a sudden outbreak may drastically alter the forest composition. If an outbreak of one of these diseases does occur, it may drastically alter the management goals for the area.

Based on potential impacts, distribution, and available control methods, DOFAW has set a management objective for each insect or disease.

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

- Early Detection Rapid Response (EDRR) –These species are not established in the area but pose a threat. Actions will be taken to try and control the population early if detected.
- Remove – Elimination of populations within KKCMA
- Monitor – Species is widespread and containment is not feasible. Monitor changes in population over time and evaluate if new control options become available.

Table 11 Insects and Diseases with Potential to Cause Damages in KKCMA

Species	Common Name	Threat	DOFAW Objective (in KKCMA)
<i>Fusarium oxysporum</i> f.sp <i>koae</i>	koa wilt	Dieback and/or decline of koa, especially in low elevations/warmer areas	EDRR
<i>Scotoryhta paludicola</i>	koa moth	Endemic insect that occasionally experiences large population increases that can cause severe defoliation of koa trees.	Monitor
<i>Tetraleurodes acaciae</i>	acacia whitefly	Decreased plant vigor, leaf yellowing/defoliation of varying hosts	EDRR
<i>Accizia uncatoides</i>	acacia psyllid	Decline or poor growth form of koa.	Monitor
<i>Xylosandrus compactus</i>	black twig borer	Stunted growth and death of over 100 tree and shrub species	Monitor
<i>Ceratocystis luku'ōhi'a</i> , <i>C. huli'ōhi'a</i>	rapid 'ōhi'a death	Widespread and rapid death and/or stress of 'ōhi'a lehua	Monitor
<i>Klambothrips myopori</i>	naio thrips	Defoliation and potential death of naio	Monitor
<i>Plasmodium relictum</i>	avian malaria	Deadly to many species of birds, especially native hawaiian species	Monitor

Koa wilt: Koa wilt is a vascular disease that affects the xylem tissue and water transport capabilities of koa trees and can eventually lead to tree mortality. The disease is caused by the soil borne fungal pathogen *Fusarium oxysporum* f. sp. *koae* that invades susceptible plants through the root system (Dudley et. al 2017). The first sign of infection in trees is usually a yellowing or wilting of leaves on a single branch or part of the tree's canopy. If the branch is cut, there are usually dark stains in the sapwood. This disease severely restricts koa reforestation in most low to mid-elevation locations (sea level to approximately 1,000m elevation) with mortality rates commonly exceeding 75% (Dudley et. al 2017).

The virulence of *Fusarium oxysporum* in relationship to soil temperature is well studied in many host species and it has been determined that there is increased virulence at higher temperatures (Scott et al. 2001, Landa et al. 2006). The effects of koa wilt appear minimal at KKCMA and it is hypothesized that the high elevation and cool ambient soil temperatures of the area are not optimal for the survival of *F. oxysporum* f. sp. *koae*. Nonetheless, with climate change and the

potential for increasing soil temperatures, koa in KKCMA should be monitored for signs of koa wilt.

DOFAW has worked in collaboration with the Hawaii Agricultural Research Center (HARC) to create seed orchards of koa trees that have been screened and found resistant to koa wilt and installed across the state. This statewide network of koa orchards are located on state and private lands across the state, providing wilt resistant, localized koa seeds for outplanting and reforestation projects. One of these seed orchards was planted in KKCMA in roughly 2014 and is still functioning today.

Acacia whitefly: The acacia whitefly (*Tetraleurodes acaciae*) is a new pest that was first identified in Hawai‘i in 2021 from populations in Waikiki on O‘ahu. Infestations can lead to decreased plant vigor, including leaf yellowing, wilting, and defoliation. Their preferred hosts are within the Fabaceae plant family but other species can be affected as well. Known hosts include common landscape trees such as shower trees (*Cassia* spp.), orchid trees (*Bauhinia* spp.), and endemic plants such as wiliwili (*Erythrina sandwicensis*) and koa (*Acacia koa*). At this point the acacia whitefly has only been detected on O‘ahu, but more monitoring is likely needed on other islands. For more information see:

<https://hdoa.hawaii.gov/pi/files/2021/12/NPA-21-02-Tetraleurodes-acaciae2.pdf>

Black twig borer: The black twig borer (*Xylosandrus compactus*) is a small ambrosia beetle that is a major forestry, ornamental, and agricultural pest. They damage and stunt the growth of over 100 different shrub and tree species in Hawai‘i (Hara & Beardsley 1979). Female black twig borers tunnel into woody twigs, leaving pin-sized entry holes. Once inside they excavate galleries and lay eggs. This excavation, along with the introduction of pathogens, is the cause of damage to the host. Black twig borers damage koa and field plantings of other host species, hindering restoration and reforestation efforts. It is not known if black twig borer is a problem within KKCMA. Further surveys are needed to determine the extent and damages to trees in the area.

Acacia psyllid: The acacia psyllid (*Accizia uncatoides*) was first detected in Hawai‘i in 1966. This insect feeds on new growth of koa, which usually does not kill trees but can potentially lead to forking or multiple stems. This is a concern for KKCMA since growth form is important for koa canoe logs. Both biocontrol and chemical agents have been used to control acacia psyllids, the latter with success in forest plantings (Baribault 2014). Insect surveys in April 2023 did not find any acacia psyllids present, which is uncommon for forests in Hawai‘i (K. Insect surveys in



Figure 21 A koa trunk infected with koa wilt. Note the staining in the sapwood. Photo by J.B. Friday

April 2023 did not find any acacia psyllids present, which is uncommon for forests in Hawai‘i (K. Magnacca, pers. comm). The presence or extent of acacia psyllids present, which is uncommon for forests in Hawai‘i (K. Magnacca, pers. comm). Forest health monitoring surveys should continue to look for this pest species and potential impacts to koa regeneration should be examined.

Koa moth: The koa moth (*Scotoryhta paludicola*) is an endemic insect on the islands of Hawai‘i, Maui and O‘ahu. The caterpillars feed on koa leaves and are capable of defoliating large swaths of koa forests. The insect is normally present in low levels in the koa forests. In January 2013 DLNR staff reported sever defoliation of koa forests above Hilo, and surveys concluded the cause was likely due to damages from large populations of the *S. paludicola* caterpillars. The outbreak soon spread all over Hawai‘i island causing wide spread defoliation. The outbreak seemed to subside within a few months in most places and trees began to re-leaf. It is not known what caused the large population spike and eventual decline, but this is another insect that should be monitored for in KKCMA.

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

Through various efforts, managers have recognized a few patterns of disease occurrence and spread. Climate does not seem to limit presence of the disease, but ROD appears most aggressive in wet areas and lower elevations, likely from higher temperatures. Storm and wind events that wound ‘ōhi‘a trees can lead to infection by the fungus. Typically, these storm events occur in an “episode” with a spike of tree mortality, followed by a decreased continuing mortality.

Another pattern that has been more recently observed in surveys is the higher incidence of *C. luku'ōhi'a* detections in areas where hoofed animals are present, compared to adjacent areas where animals have been removed. The mechanisms are not fully understood, but it is thought that by wounding trees, animals might cause tree infection if spores are present. It is also possible that animals are moving spores of the fungus contained in soil, and research on animals directly spreading ROD are underway.

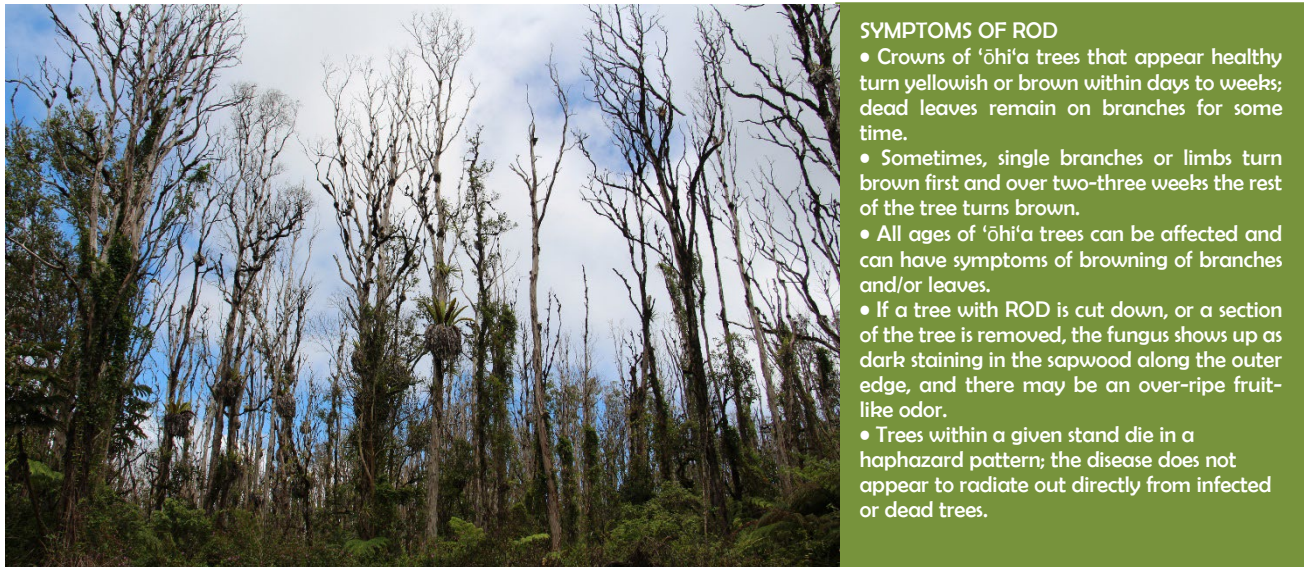


Figure 22. 'Ōhi'a killed by ROD in lower Puna on the island of Hawai'i Photo Credit: J.B. Friday

Ambrosia beetles which bore into 'ōhi'a trees are responsible for releasing frass which contains fungal spores into the environment. Entomologists have conducted controlled studies demonstrating that beetles can actually carry the fungus on their bodies and directly infect living 'ōhi'a seedlings. However, beetles normally attack dead and dying trees, and scientists do not think that beetles serve as the main disease vector. Humans can also spread ROD through moving soil either on their clothing, boots, or vehicles. Anyone entering or exiting KKCMA should brush and sanitize all footwear and vehicles to minimize the risk of spreading ROD pathogens.

ROD is now found throughout Hawai'i Island forests and will need to be managed in the long-term similar to invasive plants or effects of climate change. It is believed that spores of both *Ceratocystis* species are circulating widely on the island, and management actions can only help reduce wounding and entry points for the disease to enter trees. The relationship to feral animals offers potential management tools for preventing wounding and possibly spread of the disease by removing animals from the landscape. It is not currently clear which animals are responsible, but the pattern has been seen in forests with high populations of cattle and pigs, the former which strip bark from 'ōhi'a trees and the latter which damage roots when digging for food.

To protect important 'ōhi'a stands and forests, managers can utilize ungulate management (exclusion fences, hunting, or animal removal) to reduce incidence of ROD. This may be the most effective tool we have for managing ROD, but this only removes one potential vector and cannot prevent ROD outbreaks caused by storm damage. Areas in which ungulates have already

been excluded are still likely to have ROD show up, but the rate of infection over time is likely to be reduced.

ROD has been detected in KKCMA and the surrounding areas. A few 'ōhi'a trees that were sampled confirm the presence within KKCMA, and a large number of positive samples have been documented in the adjacent Ka'ū Forest Reserve to the west. Almost all samples taken in and around KKCMA show the presence of *C. luku'ōhi'a*, the more damaging of the two pathogens.

Myoporum thrips: Myoporum, or naio thrips (*Klambothrips myopori*) feed on and infest native naio trees (*Myoporum sandwicense*). Myoporum thrips are likely native to Australia or New Zealand and were detected in Southern California in 2005. In 2008, it was found on the island of Hawai'i and then found in several locations on O'ahu in 2018. They cause leaf distortion, gall-like symptoms and in severe cases, death. It appears that naio trees located in drier habitats are more vulnerable, and widescale dieback, potentially combined with drought stress, has been seen at Pu'u Wa'awa'a on Hawai'i island. Mortality rates could increase with climate change if rainfall decreases. Thrips and thrips damage have been observed throughout KKCMA, but widespread dieback has not been documented. Insect surveys in April 2023 did not detect any *K. myopori* present, although some plants showed slight damage associated with the insect. It may be that they move into the area seasonally and with warmer, drier weather, but the exact reasoning for their absence in surveys is undetermined.



Figure 23. Close up of curled leaf damage due to naio thrips, *Klambothrips myopori*

Avian malaria: This disease is carried by mosquitos and is deadly to many native birds species. It is considered one of the key factors limiting the distribution and abundance of native forest birds in Hawai'i. Even when avian malaria isn't fatal, it can decrease lifespans, and female birds infected with malaria can pass down a genetic predisposition for shorter life spans (Asghar et al. 2015). The range of suitable habitat for mosquitos is expanding as temperatures rise due to climate change, placing Hawaii's forest birds at higher risk of avian malaria and further decreasing their available habitat. Bird surveys of KKCMA show that threatened and endangered bird species are mostly found at higher elevations which may be partly due to the presence of avian malaria (see section 3.6).

4.4 Fire

Native ecosystems in Hawai‘i are not well adapted to wildfire and the majority of native plant species are not able to regenerate after a fire. Wildfires tend to lead to increased cover of non-native species and can convert forested areas to shrublands or grasslands (Trauernicht 2014). There have been no documented fires within KKCMA and wildfire risk in the parcel is considered low. However, wildfires are still possible, especially with human activity in the area. The principal human caused ignition threats are from vehicles or heavy equipment interactions with vegetation on roadways, arson, or illegal campfires. Fires have been documented in the adjacent Ka‘ū Forest Reserve and at lower elevations nearby. In 2005, a roughly 100 acre burn occurred on state land in the Kapapāla Ranch area about 3 miles directly south of KKCMA. In 2002/2003, the Pahuamimi fire burned 1000+ acres in Kapāpala FR, about 5 miles east of KKCMA.

4.5 Flooding & Erosion

Flood risk is considered low in KKCMA due to the lack of nearby streams. Erosion is a concern, as topsoil in portions of the reserve is shallow and highly erodible (see section 3.2). Erosion is most likely to occur along roadways, especially during heavy winter storms which can be common in the Ka‘ū area. The use of heavy machinery during timber harvest or other management activities could also increase soil erosion and appropriate mitigation strategies should be implemented.

4.6 Climate Change

Forest ecosystems in Hawai‘i will face new environmental conditions and a variety of increased threats associated with climate change. According to the 2012 Pacific Islands Regional Climate Assessment (PIRCA), documented indicators of climate change in the region include increasing air temperature (more significant at higher elevation), decrease in rainfall across much of the region, decrease in ground water discharge to streams, changes to frequency and intensity of climatic extremes, mean sea level rise (Western Pacific), and changes in species distributions. Potential impacts to our communities and natural environments include shifts in rainfall patterns, a decrease in freshwater supplies, increase in extreme weather events, flooding and erosion, increase in non-native biological invasions, increase in frequency and size of wildfires, and an increased risk of species extinction (Keener et al. 2012).

In 2018, the Pacific Island Climate Change Cooperative (PICCC) and EcoAdapt completed the Hawaiian Islands Climate Vulnerability and Adaptation Synthesis. Through literature reviews, expert elicitation, vulnerability mapping, and workshops with resource managers and conservation planners, the synthesis provides information to improve understanding of climate



Figure 24. Roadways in KKCMA can get washed out and hard to pass due to erosion

change impacts, increase capacity to reduce impacts, and facilitate decision-making by land managers (Gregg 2018). The climate synthesis contains summaries of adaptation strategies and actions for habitats types and ecosystem services.

The habitat classification from the 2018 Climate Synthesis that applies to KKCMA is Mesic and Wet Forests, which according to the report are moderately vulnerable to climate change. Some of the recommendations suggested for mitigating damage from climate change in these habitats are to expand fencing and ungulate removal, prioritize the planting of native species that thrive in a wide variety of conditions, and to determine agency roles in biosecurity plans for the area. The full summary of climate change adaptation for mesic & wet forests on Hawai'i island can be found here:

http://www.cakex.org/sites/default/files/documents/EcoAdapt_Hawaii_Mesic%20%26%20Wet%20Forest_Adaptation%20Summary_January2018.pdf

4.7 Volcanism

Although KKCMA is only about 12 miles southwest of Kīlauea crater, the parcel is at low risk of having direct lava flow or an eruption event. Figure 26 shows the lava hazard zones for the island of Hawai'i; Zone 1 is the area of greatest hazard and Zone 9 is the least hazardous. KKCMA falls within lava hazard Zone 6 on the southeast slope of Mauna Loa (Juvik & Juvik 1998).

A secondary effect of volcanic activity, volcanic smog or “vog,” is of concern at KKCMA. Vog refers to the hazy air pollution caused by volcanic emissions. The main particles of concern are sulfur gases, especially sulfur dioxide (SO₂), and small particulate matter (PM). In high quantities vog can cause serious deterioration of metal fencing and other infrastructure. Vog can also damage vegetation, especially non-native crops and agricultural species. Some native plants, such as ‘ōhi‘a lehua, appear to have adapted to periodic exposure to vog (Elias & Sutton 2017). Humans vary in their sensitivity to vog, but symptoms can include respiratory irritation or a general lack of energy.

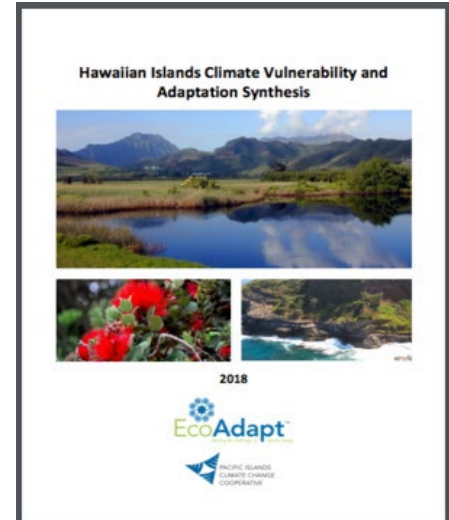


Figure 25 The Hawaiian Islands and Climate Vulnerability and Adaptation Synthesis

4.8 Vandalism & Human Activities

It is believed human activities are one of the main reasons for cattle ingress into KKCMA. Gates to the area have been left open, either purposefully or accidentally, allowing cattle to enter the area. Vandalism of infrastructure in the area, particularly to the fencing surrounding KKCMA is another potential source of cattle ingress. Cattle damage native forest ecosystems and are likely severely limiting koa regeneration. This threatens the continued supply of koa resources for cultural uses for generations to come.

Illegal, unpermitted harvesting of non-timber forest products has also been documented in the area. DOFAW staff have also seen evidence of maile propagation activities, including fertilizer and other cultivation paraphernalia within KKCMA and other parts of Ka'ū FR. Bringing soil, compost, or fertilizer into the forest is unsafe as it can lead to the spread of insects and diseases, such as rapid 'ōhi'a death and little fire ants. The unpermitted collection of forest products leads to the decline of resources for the rest of the public and for those collecting pono, with permits and in non-commercial quantities.

Other human activities of concern that have been noted is evidence of drug use in the area, and unsanctioned camping. Unsanctioned camping and campfires can be a fire threat, and drug use can create an unsafe environment for educational groups or the public.

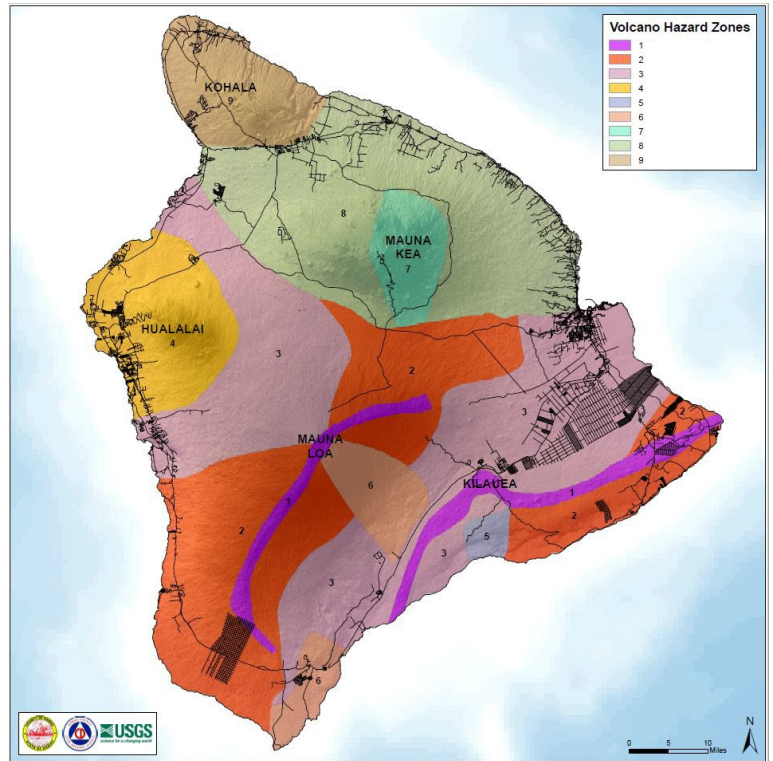


Figure 26 Volcano Hazard Zones on Hawai'i Island. KKCMA lies within Hazard Zone 6.

5. MANAGEMENT

5.1 Summary of Past Management Activities

DOFAW began managing KKCMA in 1989. For information on the area before 1989, see Section 2.1. Between 1990-1994, state funding was secured and a cattle proof fenceline was constructed around the parcel in two phases. During the construction of this fence, some trees were cut and harvested that were either obstructing the fence or threatening the integrity of the fenceline. Cattle from nearby ranchlands still ingressed into the area during and after fence construction, which was mainly managed by notifying the nearby ranches to retrieve and remove cattle. Cattle have been periodically removed over time, but they often encroach back into the area. Fence maintenance has improved, but cattle ingress either through fence failures or gates being left open is an ongoing issue.

A variety of timber, flora and fauna surveys have been completed in KKCMA. Multiple timber surveys have occurred, including a 2000 inventory of koa and ‘ōhi‘a, partial timber surveys in 2006 and 2007, and a full timber inventory in 2020, the 2020 Kapāpala Koa Canoe Forest Inventory (Appendix B). The 2020 inventory focused on koa timber resources, but also describes other vegetation in the area, and has heavily influenced the understanding of forest composition and koa timber resources for this plan. A roadside plant species list of KKCMA was completed in 2021, noting the presence of every plant species found in view from the roadside areas. This has been adapted to the Kapāpala Working Plant List (Appendix C). The Three Mountain Alliance (TMA) and DOFAW have collaborated on annual bird surveys in KKCMA from 2018-2022, of which the 2018-2021 data can be seen summarized (Section 3.6) and in its entirety (Appendix D).

The Three Mountain Alliance spearheaded a Youth Education Plan in the early 2010’s, which included the construction of a gathering platform in the northeast corner of KKCMA (see Figure 18). TMA led educational trips to the area, but a few problems led the organization to determine it was not an ideal site. The parcel is open to the public, and some evidence of drug use and illegal camping had been noted. Also, the remoteness of the location, in combination with the very rough 4x4 access road that was often impassable during winter storms, made it hard to reliably access the area for educational groups.

In the southwest corner of the parcel, the Hawai‘i Agricultural Research Center (HARC) in collaboration with DOFAW, created a koa seed orchard to provide koa seeds from trees screened to be resistant to koa wilt, a disease that often kills or heavily impacts koa trees, mainly at lower elevations (see section 3.5.1 and 4.3). This orchard is still present and active.

KKCMA Working Group: In an effort to advance the sustainable management of KKCMA, TMA and DOFAW partnered in late 2014 to bring together roughly 20 key stakeholders including cultural practitioners; voyaging and racing associations, clubs, and members; wa‘a (canoe) builders; forestry experts; conservationists; land managers; and residents of Ka‘ū. This working group was asked to provide insight and guidance on the long-term stewardship of the forest and appropriate use and perpetuation of wa'a and other forest resources in KKCMA. The first several meetings of the working group began by sharing knowledge that ultimately led to the development of a 2016 Preliminary Forest Management Plan. In 2017 and 2018, the working

group supported DOFAW in drafting an application and allocation protocol for canoe logs from KKCMA. Based on feedback from the working group and the preliminary plan and allocation protocol, it was determined a forest inventory was needed, which was implemented in 2019 and early 2020 (Appendix B). The forest inventory provided DOFAW with the needed information to revise and finalize the forest management plan for KKCMA, which the working group was once again asked to provide guidance on. The KKCMA working group has met approximately one to three times per year since its inception, for a total of ten meetings. Over the last seven years, the working group has been a source of diverse expertise and varied perspectives that are critical to the development of this Management Plan and the overall advancement of KKCMA.

5.1.1 Past & Related Plans

Plans that contain relevant information on the resources and management strategies pertinent to the management of KKCMA are listed below.

- Hawai‘i’s State Wildlife Action Plan
- DOFAW Forest Action Plan
- DOFAW Draft Management Guidelines (Appendix E)
- USFWS Endangered Species Recovery Plans
- KCF Preliminary Draft Management Plan (2016)
- Kapāpala Koa Canoe Forest Youth Education Plan
- Ka‘ū Forest Reserve Management Plan (2012)
- Forest Management Plan for the Waiākea Timber Management Area

5.2 Management Guidelines

DOFAW has developed a set of draft management guidelines and associated maps to assist in evaluating and balancing human activities and resource management goals and objectives. The purpose of the guidelines is to provide administrative policy direction and prioritize resource management activities based on the integrity of existing natural resources and social needs in five principal classifications: Conservation Resources, Forest Products Management, Recreation Management, Vegetation Management, and Hunting Management (Figure 27). Detailed definitions of these classifications and their associated management strategies can be found in Appendix E.

Forest Products Management Guidelines: There are four categories for Forest Products Management: Large Scale Commercial (F-1), Small Scale Commercial (F-2), Personal Use (F-3), and Restricted (F-4). **KKCMA is listed as F-2.** While the main purpose of KKCMA is koa timber harvest for koa construction, this is considered at a small, non-commercial scale and not large scale commercial. Some small scale commercial harvests will occur due to thinning operations in the area.

Conservation Resource Guidelines: There are four categories for Conservation Resources: C-1 (High Conservation Resources), C-2 (Medium Conservation Resources), C-3 (Low Conservation Resources), and C-4 (Little to No Conservations Resources). **KKCMA is listed as C-2.** KKCMA consists of predominantly intact native forest, something that is increasingly rare in

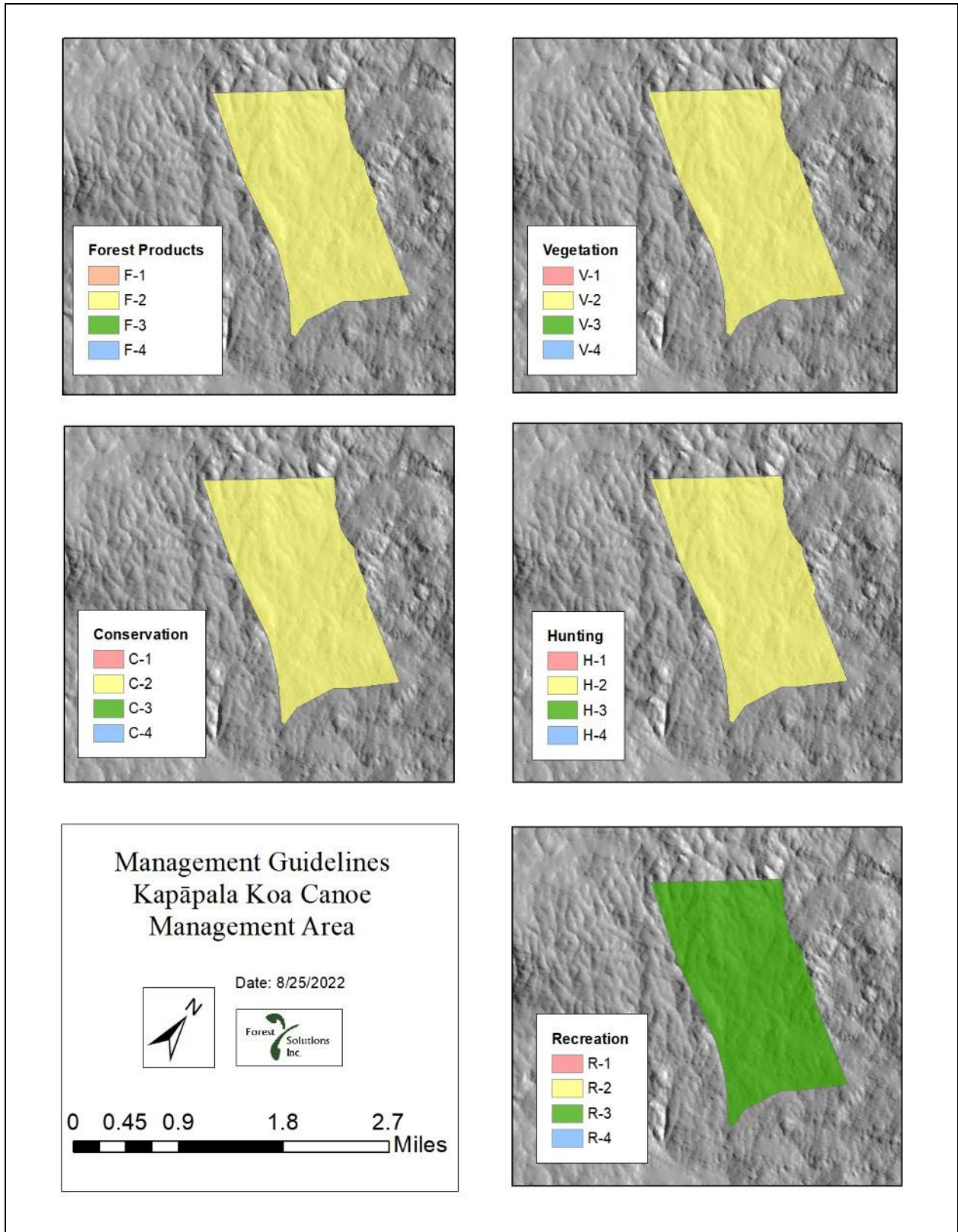
Hawai‘i. However, there are minimal rare or endangered species, and unique resources in the area, which is why it is not considered C-1. However, it is still a very important area of conservation value.

Vegetation Management Guidelines: There are four categories for Vegetation Management: V-1 (Highest Quality Native Vegetation), V-2 (Predominantly Native Areas), V-3 (Considerable Degraded Vegetation Areas) and V-4 (Heavily Degraded Areas). **KKCMA is listed as V-2.** Similar to the conservation guideline, the vegetation in KKCMA is predominantly native, although there are some non-native grasses in lower areas and some invasive species along roadways (see section 4.1).

Hunting Management Guidelines: There are four categories for Hunting Management: Active Hunting Management (H-1), Moderate Hunting Management (H-2), Low Intensity Hunting Management (H-3), and No Hunting Management (H-4). **KKCMA is listed as H-2.** Public hunting is encouraged and common activity in KKCMA. However, the main objective of providing a long term sustainable supply of koa timber is a higher management objective than providing continuous hunting opportunities, which are a secondary management objective.

Recreation Management Guidelines: There are four categories for Recreation Management: R-1 (High Recreation Management), R-2 (Medium Recreation Management), R-3 (Low Recreation Management), and R-4 (Restricted Access). **KKCMA is listed as R-3.** Due to its remote location and difficult accessibility, KKCMA is not a common recreation area for many visitors. However, there is current public access that allows for hiking, bird watching, hunting and forest product gathering, provided you secure access through the nearby ranchlands (see section 3.9).

Figure 27 Management Guidelines for KKCMA



5.3 Timber Harvest

5.3.1 Harvest Plan Overview

The primary goal for this area is to sustainably produce koa logs suitable for building canoes now and for future generations. However, other goals, such as the protection of watershed benefits, native ecosystems, threatened and endangered species, and providing recreational opportunities, are also priorities. Therefore, this timber harvest plan is designed so that KKCMA can fulfill the need for koa canoe logs while also ensuring these other resources will be protected in perpetuity. This will be done by using sustainable silviculture and forestry practices developed for a 100-year horizon, and will be revisited at least every 10-years to integrate adaptive management strategies as needed.

The harvesting and forestry management proposed at KKCMA will follow the practice of disturbance-based or structural retention silviculture. This involves retaining various structures at the time of harvest, longer harvest rotations, and active creation of heterogeneity in the managed stand (Gustafsson et al. 2012). By attempting to emulate natural disturbance processes, management actions can give rise to a complex, structurally diverse forest while still utilizing and cultivating timber resources. In Hawai‘i, the most common disturbances in forests are flooding and landslides caused by extreme rainfall events, wind damage from tropical cyclones, and wildfire (Barton et al. 2021). In general, the spatial extent and intensity of the disturbance are inversely correlated with frequency, meaning small storms occur more frequently than large hurricanes or floods (Barton et al. 2021). At KKCMA, there are often windstorms that cause one or more koa trees to fall, increasing light availability to the forest ground and allowing a new generation of seedlings to grow. Forest management prescriptions can simulate this process through the harvest of single trees and groups of trees across the landscape at varying frequencies.

The main resource targeted during harvest operations will be large koa trees capable of being made into canoes (see Section 3.5). However, harvesting only large trees from the forest will, in the long term, result in a forest composed of smaller trees with poor form. The practice of removing only large trees, with hope that smaller ones will fill in, is referred to as high-grading or diameter-limit harvesting. This is an unsustainable practice with deleterious outcomes well documented in forests world-wide (Power et al. 2019, Oliver & Larson 1996). Through harvesting a variety of sizes and qualities of koa trees, forest



Figure 28 The disturbance-based harvest plan is meant to minimize impacts on the forest and promote regeneration of koa resources

management can positively influence the development of future koa stands, as opposed to selectively harvesting all the large koa trees in an area.

Therefore, harvest activities at KKCMA will be two-fold, and implemented in the same location:

1. Selective harvest of canoe trees
2. Thinning or other stand improvements actions, including selective harvests of non-canoe trees.

Canoe log harvests will be geographically paired with thinning and stand improvement operations to create openings for seedling recruitment and to prevent high grading through the removal of non-canoe quality trees. All timber management prescriptions will be guided by Hawai'i's Best Management Practices (BMP) policies (Appendix F) to mitigate any potential negative impacts from forestry activities. BMPs have a central focus on protection of water quality, and as such they commonly address maintenance of forest roads, timber harvesting, skid trails, reforestation, site preparation, and the protection and management of watersheds (Cristan et al. 2016).

Forest Management Units:

To assist in the organization of management practices, the forest has been divided into ten forest management units (FMU's). These FMU's are large enough to allow for efficient forest management operations yet small enough to be managed in a designated time frame. Each FMU has a unique identification number (UID), so that operations within it can be tracked and planned (Figure 30).

Forest Management Classes:

Each FMU is also assigned a management class as either 1) Restoration 2) Forest Product Management, or 3) Resource Protection (Figure 30). These classes represent the overall management goal for that unit and the potential management activities in that area. However, this does not mean management activity must be applied across the entire area, or that activities will not overlap across classes.

Restoration (271 acres): The lower elevation forests in the restoration management class contain an open 'ōhi'a forest with koa mostly in the sub-canopy (Figure 8). This area has a prior history of grazing and potentially past harvesting (see section 3.4), and is the most in need of restoration of forest structure. Suitable management activities may include pre-commercial thinning, commercial thinning, weed control, and enrichment planting of koa and/or other seedlings as needed.

Forest Product Management (684 acres): The mid-elevation in the forest product management class (Figure 30) contain both open 'ōhi'a-koa forest and closed koa-'ōhi'a forest and has koa trees of all diameter classes. These units include strata K02 and K03 (Figure 8), therefore, containing the transitional zone from the low elevation forest to the thick, diverse, mature koa

forest. This seems to be the best area for promoting the growth of canoe logs, as there is a higher concentration of canoe trees in this area (Figure 32). Management activities may include pre-commercial thinning, commercial thinning, and forest stand improvements.

Resource Protection (285 acres): The upper elevation forest of KKCMA contains remnant native, intact forest with mature koa trees represented by strata K04 (Figure 8). This area is critical to native bird populations, potential T&E species habitat, and overall watershed functions. The majority of koa trees are large, mature, sprawling trees that would not be suitable for canoes, though they contain a large volume of wood. There are three FMU's in this class, totaling 285 acres (Figure 30). This area has high conservation value and management will mostly include forest protection and forest stand improvements, with limited harvesting to target specific resources. However, canoe tree harvest of desired resources will occur as needed in the area.

Harvest Priority Zones:

In addition to FMU's and management classes, the forest has been divided into Priority Zones according to proximity to roadways. The goal of defining Priority Zones is to concentrate the harvest impact to specific areas at different times. Priority 1 is located within 200-feet from the roads and canoe tree resources have already been identified to help facilitate initial harvest activities. Priority 2 is 400-yards from the road and Priority 3 is the interior units that are more than 400-yards from the road (Figure 31). Both canoe tree harvests and stand improvement activities are planned to begin in the Priority 1 Zone in the first 10 years of the plan, then move into Priority 2 management units, followed by Priority 3 management units. However, Priority Zones are not restrictive and harvest activities can occur outside of the given Priority Zone as needed to allow for adaptive management.



Figure 29 Upper areas shown as “resource protection” in Figure 31 have more intact native ecosystems and large koa trees, but many are not ideal for canoe construction. Harvesting may still occur in these areas, but will be a lower priority.

Figure 30 Forest Management Units (FMUs) categorized by Forest Management

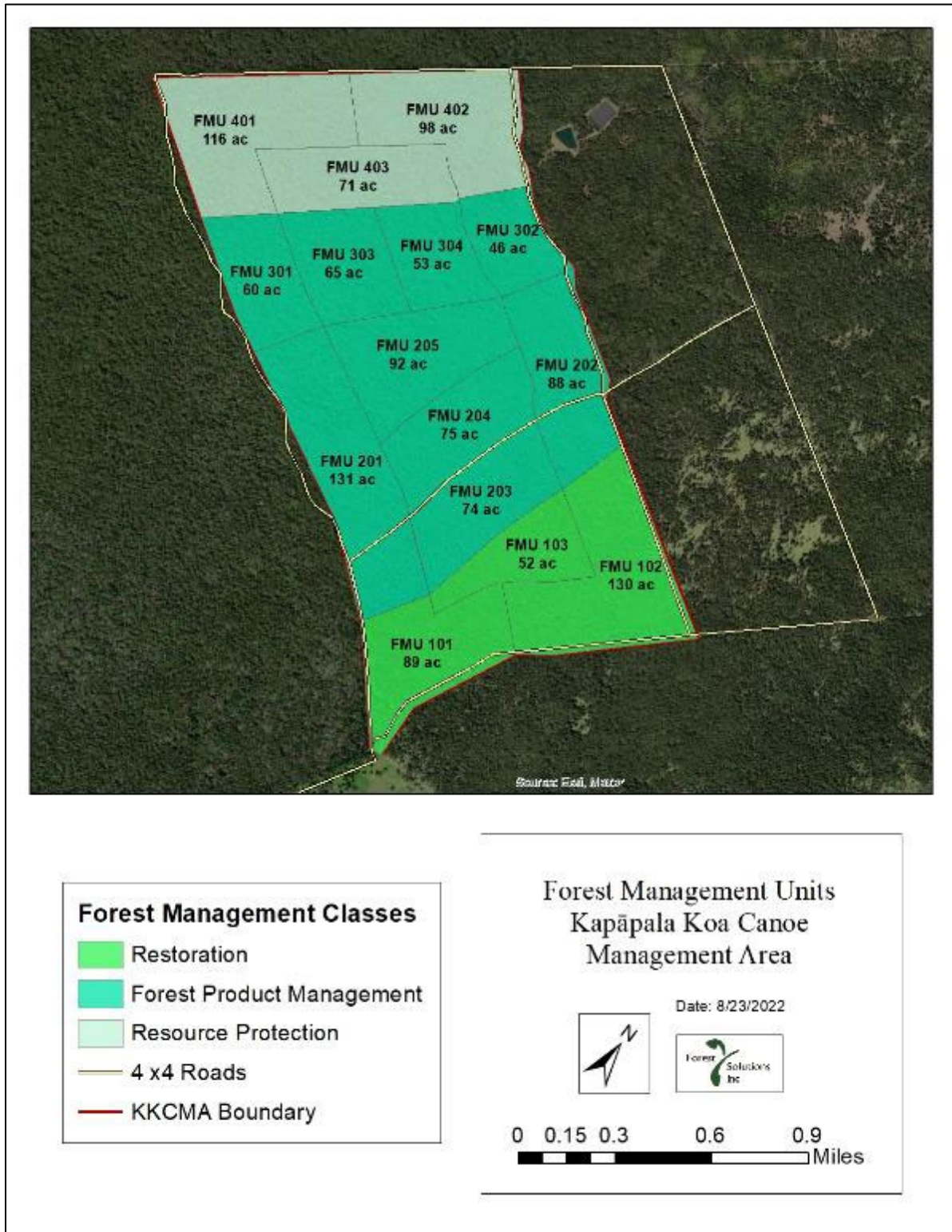


Figure 31 Priority Areas for Silviculture Activities

Note: Priority areas are broad designations showing where timber harvest, thinning operations, and general stand improvement actions are most likely to occur in the next 10-20 years. Actual operations may vary based on adaptive management needs

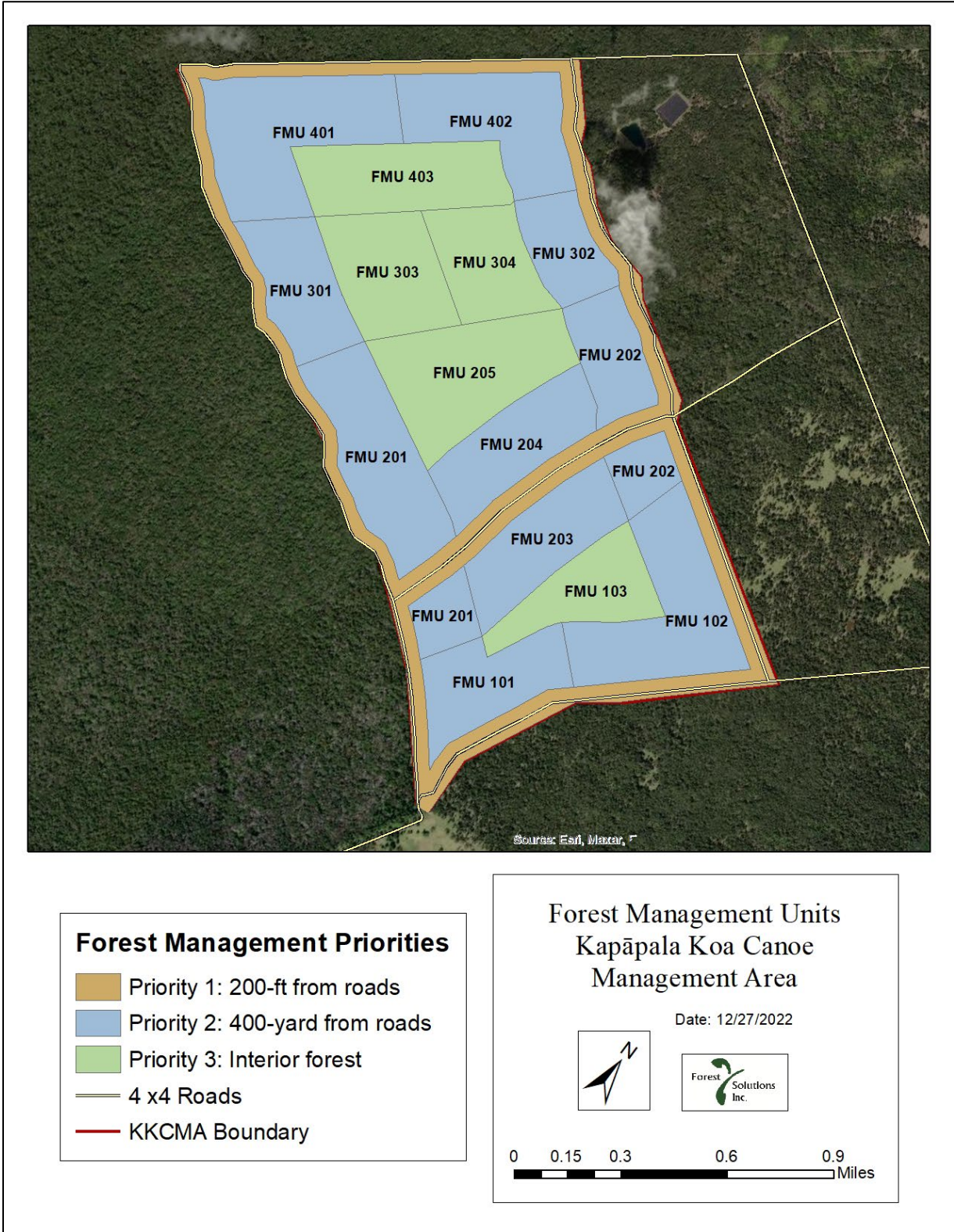


Table 12 Description of Forest Management Units (FMUs)

Management Class	Forest Type*	FMU	Acres	Estimated volume (bf)**	Koa canoe tree frequency***	Location	Potential Silviculture Actions
K01: Restoration	Open 'Ōhi'a Forest	101	89	192,000	Low	400-yard	pre-commercial & commercial thinning, enrichment planting, weed control, harvesting
		102	130	280,800	Low	400-yard	
		103	52	113,000	Low	Interior	
K02: Forest Product Management	Open Koa-'Ōhi'a Forest	201	131	460,500	Medium	400-yard	pre-commercial & commercial thinning, forest stand improvements, weed control, harvesting
		202	88	361,600	Medium	400-yard	
		203	74	248,500	Medium	400-yard	
		204	75	290,300	Medium	400-yard	
		205	92	475,000	Medium	Interior	
K03: Forest Product Management	Closed Koa-'Ōhi'a Forest	301	60	475,300	High	400-yard	
		302	46	393,200	High	400-yard	
		303	65	566,900	High	Interior	
		304	53	463,000	High	Interior	
K04: Resource Protection	Mature Koa Forest	401	116	383,000	Medium	400-yard	forest protection, stand improvements, limited harvesting
		402	98	325,300	Medium	400-yard	
		403	71	476,200	Medium	Interior	

*see section 3.4 for in-depth description of forest composition

**volume is rounded to nearest 100 board feet (bf)

***see section 3.5 for in-depth description of koa resources

Roadside Inventory and Known Canoe Quality Trees:

During the 2020 timber inventory, all living koa trees over 20 inches and within 200-feet of the roadsides were tallied and spatially logged with GPS. The roadsides were targeted as a good starting point for canoe tree selection, as these trees are easier to access, thus they will require fewer initial resources to harvest and leave minimal impact on the forest. A total of 822 koa trees

were tallied (Table 13). There was a total of 64 canoe trees and 123 potential/partial canoe trees. Additionally, 193 young canoe trees and 230 young potential/partial canoe trees will likely reach canoe size in 10- 20 years. There were 212 koa trees over 20 inches that were identified as unsuitable for canoe logs (see section 3.5 for more information on canoe log descriptions). Only living trees were catalogued, although canoe builders have indicated that dead and downed trees can also be utilized.

During the 2020 timber inventory, sample plots were also taken at regular intervals in the interior of KKCMA. While not a full survey, some notes were made of canoe quality trees in the interior of KKCMA. Figure 32 shows the location of known living canoe quality trees in KKCMA. While not complete, this help identify what areas of the forest are most likely to have canoe quality trees. Note Figure 32 only shows living trees.

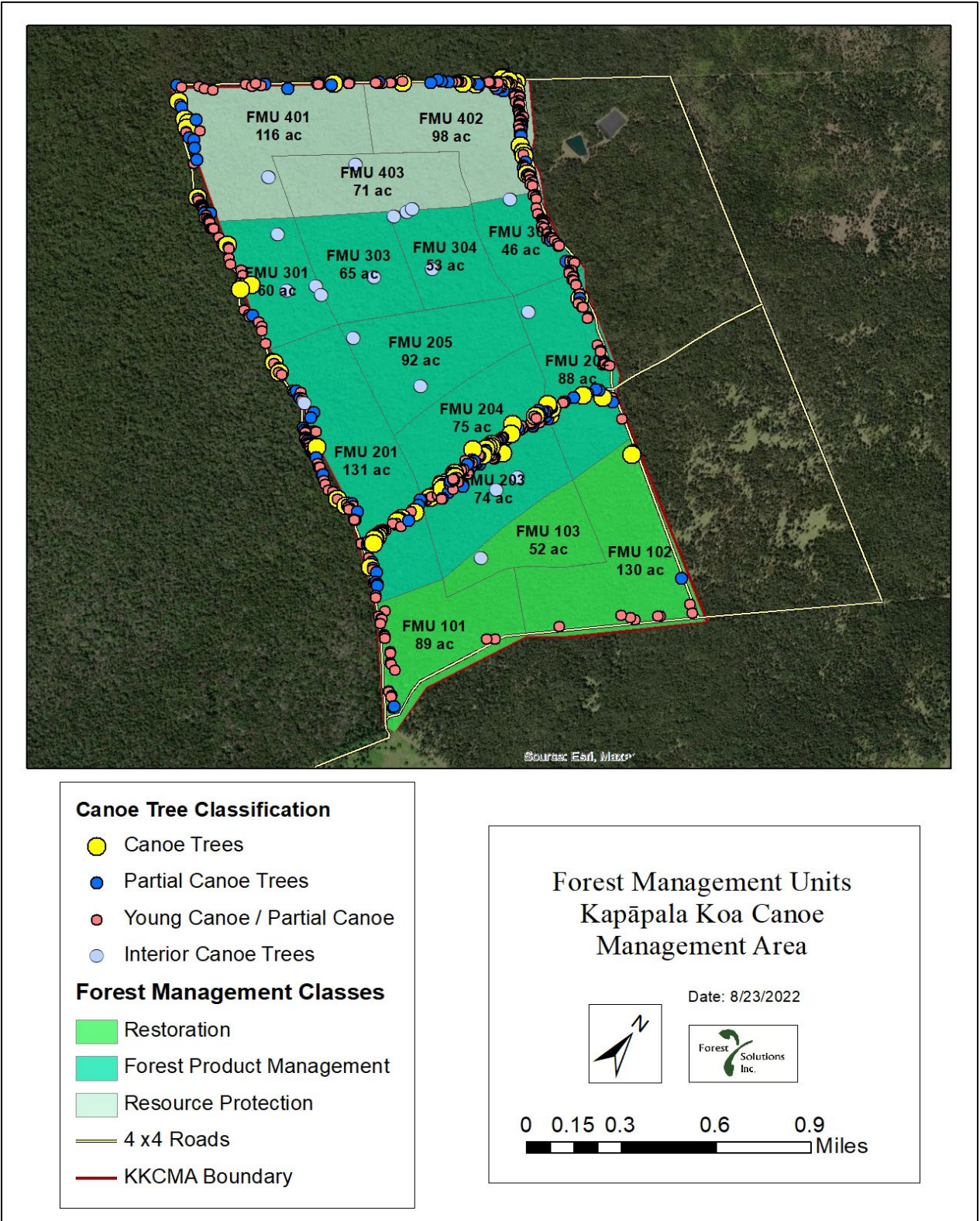
Table 13. Results of Canoe Trees* from 2020 100% Roadside Tally

200-ft boundary by FMU	Canoe	Partial Canoe	Young Canoe	Young Partial Canoe	Additional Koa > 20 in (non-canoe form)
101	0	1	4	17	28
102	1	1	4	5	11
201	14	32	39	45	54
202	6	10	13	17	36
203	6	20	17	30	4
204	13	17	34	16	0
301	3	3	4	18	20
302	0	2	17	15	12
401	6	18	12	25	37
402	15	19	49	42	10
Total**	64	123	193	230	212

* See section 3.5 for more information on canoe tree classification. These totals do no include dead and downed trees, which can be utilized.

Figure 32 Location of Known Koa Canoe Quality Trees in KKCMA

Note: While not complete, this map identifies areas with the highest potential for canoe quality trees (see section 3.5 for details on canoe tree classification). All living trees within 200ft of roadways were assessed in the 2020 timber survey (Appendix E). Interior areas have not been fully surveyed, but some canoe trees were noted during plot sampling. This map only shows living trees, but dead and downed trees may also be utilized in canoe construction.



Skid Trails and Interior Access

Skid trails, also known as skid roads, are roads installed for access to conduct management activities, such as the harvest of forest products. At KKCMA, skid trails will be used to extract logs from the forest and bring them to the main access roads. The objective of these trails is to allow suitable access while minimizing damage to the forest ecosystem, and not creating a large network of permanent public access roads.

Skid trail installation will follow Best Management Practices by planning the design and location with the objective of minimizing the disruption of natural drainage and preventing excessive soil displacement. Skid trails should have a slope of three to five percent and not exceed a slope of ten percent. Skid trails on a steep slope will require occasional water bars or drainage features. The width of the trail should be one meter (3.28 ft) wider than the width of the equipment employed for log extraction (Gumus and Turk 2016). Typically at KKCMA, this results in a trail width between 12 - 16 feet.

It is difficult to predict the scope of land impacted by skid trails without knowing the number of trees and their locations for each harvest entry.

Research on harvest access systems found skid trails impact between 1.6% to 10% of the harvest area in temperate and tropical forests (Sawyers et al. 2012, Medjibe et al. 2013, DeArmond et al. 2021). KKCMA is a small-scale, selective harvest system, therefore the skid trails will not be extensive, and the subsequent impact will be minimal. Additionally, the scarification created by skid trails will likely increase koa germination.

Post-harvest clean-up may include the retirement of skid trails that will no longer be needed. Retired skid trails are covered with slash piles (treetops, small branches) from the harvest to mulch erosion-prone areas and to discourage continued use of the trail. Lightly used skid trails can fully recover within a decade or less (DeArmond et al. 2021). If a skid trail is in an area that will require ongoing management activities (e.g. weed control, enrichment planting, thinning), the trail may be maintained and used again. It is always better to re-use existing skid trails, instead of removing mature trees to clear a new skid trail. Therefore, skid trails will always be GPS marked to maintain a record of their locations.

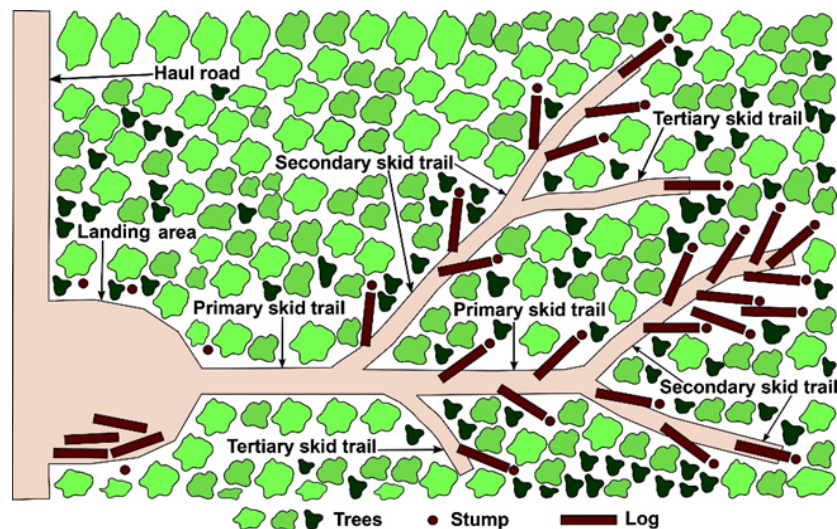


Figure 33 Example of a skid trail and timber hauling road system (DeArmond et al 2021)



Figure 34 Examples of Skid Roads in Hawai‘i.

Top Row l to r: 1) newly constructed skid road 2) skid road about 5-10 years after construction 3) skid road 10+ years after construction.

Bottom row l to r: 1) a newly constructed skid road 2) a similar skid road 4 years after construction

5.3.2 Pre-Harvest Actions and Mitigation Measures

All efforts will be taken so that silviculture activities, such as skid road construction, timber harvest, and stand improvement operations, occur in such a way that the least amount of ecological damage occurs. Mitigation and avoidance of impacts to resources may include spatially and temporally avoiding sensitive and/or listed species, pre-harvest surveys of the areas, and ensuring staff are knowledgeable of sensitive natural and cultural resources. Further descriptions are provided below:

Native Birds: In consideration of the native bird populations, mitigation measures will be taken to minimize impacts to T&E bird species. Recent surveys (see section 3.4) indicate that most of the T&E species have been detected at higher elevations in KKCMA. Harvest activities will be generally be lower in these areas, especially in the northwest corner where ‘akiapola‘au and ‘alawī have been detected. Additionally, extra caution will be taken between March 1 to June 1 during the nesting and fledging season of native bird species, including ‘i‘iwi. Prior to harvest, the immediate area will be checked by DOFAW staff to survey for bird nests in or nearby trees being felled. If ‘io are found nesting, harvesting within 330 feet of that area will not proceed until the juvenile hawk has fully fledged.

Hawaiian Hoary Bat: To reduce the chances of injuring ‘ope‘ope‘a, the Hawaiian hoary bat, no tree harvest will occur between June 1 and September 15. Harvest and related forest disturbance activities will therefore be done in the period from September 16 to June 1, when it is least likely to affect native listed fauna reproduction. Prior to harvest, the immediate area will be checked for visual observations of bats that may be nesting or foraging nearby. Additionally, information on bat identification will be included in the worker training event for field personnel prior to starting harvest operations.

Native Invertebrates: Implement staff surveys for rare or T&E native insects and spiders and seek to avoid habitat and obligate host plants as part of adaptive management.

Rare and Endangered Plants: Prior to harvest, botanical surveys will be performed to check harvest areas and proposed skid road pathways to ensure activities will not harm sensitive or T&E resources. Currently, no T&E plant species are known in the area (see section 3.4).

Should any T&E flora species be found, they will be buffered to at least 50 ft. of their location or larger if warranted to keep the population safe and the area will be flagged. The buffer includes not felling trees into this area or creating skid roads in that area. The proper agencies will be advised of and consulted for further mitigation steps.

Historical Sites & Archeology: DOFAW will implement archeological surveys in all areas of KKCMA prior to the implementation of any timber harvest, skid road construction, or thinning operations. This may either be through one large survey of the entire parcel, or through incremental surveys. Regardless, potentially disruptive management actions such as timber harvest,

skid road construction, and stand improvement actions will not occur in an area prior to archeological surveys of that place.

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 the State Historic Preservation Division (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.

Rapid ‘Ōhi‘a Death (ROD): ROD is known to occur within and near KKCMA, and mitigation measure are meant to decrease the potential spread or increase of ROD in the area. Damages to ‘ōhi‘a trees can increase pathways for ROD to enter uninfected trees (see section 4.3), and silviculture actions may require the impacting some ‘ōhi‘a trees during skid road construction or timber harvest. However, damages can be mitigated by implementing the following actions (CTAHR, accessed June 2022):

- Inspect and clean all vehicles, machinery, equipment, and material (including fill) prior to entering the forest. Vehicles and machinery must be sanitized using hoses to clean wheel wells, bumpers, grill, fenders, and side panels behind wheel. A pressurized hose is recommended, though a hose with spray nozzle attachment can be used.
- Sanitize boots, backpacks and equipment with 70% isopropyl or ethanol. Vehicles should be washed before and after entry into the area.
- Avoid damaging ‘ōhi‘a trees by hand clearing a path for the machinery ahead of time. Place the path where valuable trees are less dense and make the path only as wide as needed to fit the machine.
- When possible, give small ‘ōhi‘a a 10-ft buffer and large ‘ōhi‘a a 20-ft buffer to minimize damage to roots and trunks.
- If damage occurs, fresh injuries to ‘ōhi‘a can be sprayed with a pruning sealant to prevent ROD-causing fungi from landing on the wounds and causing infection. Be aware that the use of pruning sealant will not guarantee that the tree will be safe from infection.

Improved Road Access & Erosion Management: To improve access for harvest operations, road improvements and road contouring along some roadways within KKCMA (see Figure 18) are high management priorities. Also, some sections of the access road will likely need improvements to facilitate the movement of heavy machinery and forest products.

Due to the steep nature of the mauka-makai roads within KKCMA, road re-contouring will be necessary to reduce the constant need for road maintenance and to help facilitate management activities. Road contouring is a grading technique that decreases the slope of the road in areas that are severely impacted by erosion. The road is re-routed along a contour, making a small turn in the road, reducing the slope of the road. Road contouring increases the longevity of the road by mitigating erosion and improves overall water quality in the area. Road contouring will be limited to within the 200-ft road buffer and will not extend into the interior of the forest.

Temporary skid trails will be created as necessary to access interior forest areas during harvest operations. After harvest operations, skid trails can be closed with slash piles to prevent continued use of roads. This will be done to decrease chances for invasive species entry and spread, decrease chances for erosion, and decrease habitat fragmentation, among other concerns.

To reduce erosion and for safety concerns, all operations will be halted during heavy rain and storm events, and may be postponed until staff deem roadways safe. Storms in KKCMA are most common during the winter and early spring.

5.3.3 Harvest Volume Restrictions & Harvest Rotations

In order to ensure sustainable harvest levels, and to maintain other goals such as watershed protection and native ecosystem protections, restrictions on the amount that will be harvested within KKCMA will be put in place. No more than 500,000 board feet, or approximately 10% of the 5.5 million board feet of koa estimated within KKCMA, will be removed from the forest within a 10-year period. The volume restriction includes all harvest and thinning operations, including harvesting of canoe trees and additional silvicultural activities.

Like many tree species, diameter growth for koa varies throughout tree and stand development. Koa growth studies have found an annual growth rate ranging between 0.24 inches/year in low quality shady sites, to 0.59 inches/year in direct sunlight (Baker et al. 2009). This is an average of 0.41 inches of growth per year, indicating that the average diameter in a 100-year-old stand of koa trees would be 41 inches. Therefore, we estimate that a typical racing canoe size log (see section 3.5), with a healthy thinning regime, is attainable at or before a koa tree becomes 100 years of age.

The harvest rotation is the planned number of years between the time a stand regenerates and its final cutting at a specific stage of maturity (Nyland 2007). The harvest rotation for a canoe tree is 100 years, meaning after a canoe tree is removed and an opening is created for a seedling to grow, that seedling will be a canoe quality tree in 100 years. If 1% of the forest area is harvested each year, then the first 1% will be ready to harvest again after 100 years. This concept is scaled up to 10% of the forest area every 10 years, to account for variability in management intensity from year to year.

Although there is variety in koa volume densities across the property, if 10% of the total volume is removed in an area, then that volume will return over the course of the lengthy 100-year rotational period. In fact, it is likely that more than the original volume will come back due to stand improvement activities and forest health management.

Expected demand and available koa timber: The protocol and guidelines required for an organization to be allocated a canoe are extensive. Further, the number of suitable organizations and canoe carvers is finite. Once all the organizations needing a canoe tree are satisfied, they will not need another one for many years. By implementing a harvest limit of 10% of the total volume over a 10-year period, the annual harvest volumes may vary depending on the needs of the organizations. It is likely that koa canoe trees will be in high demand initially, and then decrease significantly with each subsequent year. On average, a canoe tree is estimated to be

between 3,000 bf and 5,000 bf, therefore the harvest limit is more than enough to meet the needs of all the eligible organizations and sustain harvest activities to support the management of the forest.

According to recent inventories and surveys, stand development theory, and anticipated stand improvement actions, a maximum volume of 500,000 board feet every 10 years is predicted to be a sustainable number that will not negatively impact the koa canoe resource and associated forest ecosystems. After each 10-year period, the plan shall be reviewed to ensure the harvest limit restrictions remain sustainable.

5.3.4 Canoe Tree Application Process

Organizations within the state of Hawai‘i may submit an application for the opportunity to harvest a koa tree or tree(s) from KKCMA for the purpose of creating a koa canoe for cultural and traditional uses. This includes for the purpose of creating racing canoes, voyaging canoes, or fishing canoes, among others. Details on the application, scoring and ranking system for applicants and the allocation process will be outlined in a separate submittal that will be brought before the Board of Land and Natural Resources (BLNR) for approval. However, the general application process and award of a canoe log from KKCMA will be as follows:

- 1) Organizations will submit an application for a canoe log from KKCMA.
 - a) Organizations must be able to demonstrate their financial capacity and means of processing the log into a canoe, demonstrate they have an experienced builder available with the capacity to utilize the log, and have a harvest plan approved by DOFAW.
 - b) Organizations must have a Stewardship Plan outlining forest conservation or land stewardship activities.
 - c) This is a separate application than any other requests for timber from DOFAW, such as the salvage timber waiting list.
- 2) Applications will be reviewed by a selected group of experts that will provide recommendations to DLNR/DOFAW to make final decisions and issue a special use collection permit to allow for harvest.
 - a) Applicant reviewers will consist of cultural practitioners; voyaging and racing associations, clubs, and members; wa'a (canoe) builders; forestry experts; conservationists; land managers; and community members of Ka‘ū and Hawai‘i island.
- 3) DOFAW will identify specific trees that are available for harvest according to the plan. The number of trees and volume of koa harvested annually will depend on the number of qualified applicants, in accordance with the 10-year harvest volume restriction of 10% of the total volume of the area.
- 4) The organizations that are selected will be able to select the appropriate tree for harvest, and be provided a timeline of when they are allowed to perform the harvest. The

organizations are encouraged to collaborate with one another or in conjunction with DOFAW's other management activities to decrease costs, or independently to determine a date for the harvest.

- 5) All harvest operations will be conducted according to the State's Best Management Practices (Appendix F).

5.3.5 Canoe Tree Extraction Operations

The harvest operations, and costs associated with extracting canoe trees, will be the responsibility of the organization who is awarded a special use permit for canoe tree harvest. All thinning or stand improvement silviculture actions will be the responsibility of DOFAW. This allows organizations the flexibility of what protocols and methods are appropriate for their traditional and cultural use of harvesting canoe logs, and to allow for different organizations to have different processes for harvest.

Harvesting whole logs destined to become canoes requires different operational activities than harvesting short saw logs for parts or sale. The method recommended for extraction is ground-based, however alternative extraction methods may be feasible (i.e. helicopters). Ground based methods use chainsaws or bulldozers to fell trees and heavy machinery to extract them. Some trees may be felled by a bulldozer pushing over the tree and slowing its descent to the earth to protect the wood. Once a tree is felled, it is extracted to a main access road where it can be loaded onto a highway truck. The extraction can potentially be damaging to the tree and should be supervised by an experienced forest manager to help preserve the condition of the log. Specialized heavy machinery may be needed to safely move these large logs without damaging them. Trees will be extracted from the forest to the road using skid trails, which are temporary routes for the machinery to remove the log. Skid trails will be surveyed and marked ahead of time, to avoid sensitive habitat, such as mature 'ōhi'a trees. Typically, scarification of the soil by machinery on skid trails can activate koa seeds and stimulate regeneration of koa seedlings.

The labor costs associated with harvesting include hiring an experienced cutter, a ground man, and a machine operator, are the responsibility of the applicant for the canoe log. DOFAW is not responsible for harvesting and delivering the logs to the applicant. Machine rentals may include an excavator, a forwarder, and/or a bulldozer. These machines need to be transported to and from the forest, which adds additional costs to the operation. Finally, the log is transported on the highway in an oversized load transportation vehicle and may ultimately be shipped off the island to another location. The budget is estimated between \$6,000 and \$20,000, though it is highly variable and subject to change according to harvest operations and the destination of the log. As many organizations are not experienced foresters and timber harvesters, an existing advisory group, consisting partly of experienced foresters, as well as DOFAW staff, may be able to provide guidance and connections to capable extraction operators and best practices.

If and when possible, it will be cost-efficient and reduce impacts on infrastructure and on the forest if operations between organizations or with DOFAW can be combined or done in quick succession with each other. All harvest and thinning operations must follow Hawaii Timber Best

Management Practices (Appendix F) and any other guidelines included in the special-use permit for canoe log extraction, and will be done to minimize impacts on the forest.

5.3.6 Thinning & Stand Improvement Operations

Thinning is a stand improvement action designed to preserve a balance of tree sizes and genetic diversity in the forest by removing smaller and less well-formed trees. By removing sub-standard quality trees, thinning promotes a superior growing stock for future growth. The result is a balanced stand containing both large and small trees, which prevents the negative impacts of high grading (only harvesting the biggest and best trees). Thinning in KKCMA will target koa trees, as they are the most common and fastest growing native tree in the area. ‘Ōhi‘a and other natives will usually not be targets for thinning operations unless considered hazard trees. Thinning will favor a selection of dominant koa trees to grow into canoe quality trees quicker and at a higher frequency.

As harvesting operations occur at KKCMA, dense stands of young trees are expected to grow in the openings created by tree removal. Young koa growing in this environment experience high rates of mortality and grow very slowly. Research on koa stands ranging from 9 to 25 years found that thinning leads to substantially increased tree growth rates and tree vigor (Baker et al. 2009). Therefore, the two thinning practices that will be implemented at KKCMA are pre-commercial thinning and commercial thinning. Both practices are employed to reduce stand densities, prevent stagnation, improve tree form, and increase the growth of the remaining trees. **The goal of all thinning operations is stand improvement, not resource extraction.**

Pre-commercial thinning. This thinning method is performed prior to trees reaching merchantable size. During pre-commercial thinning, small trees are cut and typically left in the forest, allowing the remaining trees to grow quicker due to less competition (NRCS 2012). This type of thinning can be done in-house by DOFAW with mechanical or chemical methods, depending on the size of the trees being thinned. The smaller the trees, the less costly it is to perform the thinning operation. Wood from precommercial thinning may be collected and made available to woodworkers and community members through collection permits.

Commercial thinning. This involves removing damaged or poor form trees that are of merchantable size. Commercial thinning operations will target koa trees that are damaged or have abundant rot, to provide growing space for future koa canoe trees. Staff will also remove trees that are less dominant or of poor form. Commercially thinned trees may be sold for revenue to be used in the continued management of the forest, i.e.:

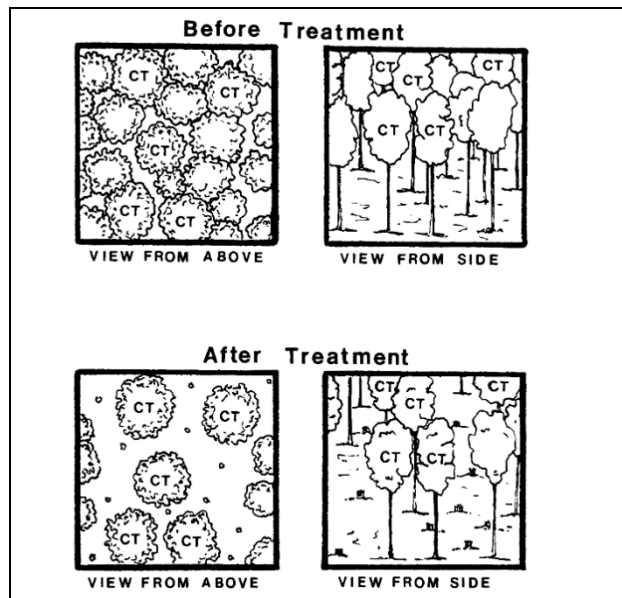


Figure 35 Aerial and side views of stand before and after releasing crop trees by crown tree release/thinning operations. (Lamson et al. 1990)

ecosystem protection, weed management, thinning operations, inventory, and data collection. Additionally, both types of thinning could potentially provide material for canoe parts or other woodworking opportunities.

In forest management, land managers utilize species-specific stocking guides to develop a sound precommercial and commercial thinning regime. Unfortunately, a koa growth model does not exist and conclusive stocking data is not available. However, studies have examined the response of koa to thinning and found that stands thinned to lower densities of trees (80-120 trees per acre) result in much faster growth of the remaining trees, compared to stands thinned more lightly (Baker et al. 2009). Managers at KKCMA will continue to draw on the latest koa forestry research, combined with on the ground stand assessments, to develop and adapt a suitable thinning regime.

5.4 Non-Harvest Management Objectives

5.4.1 Ungulate control

The control of ungulate populations is a high priority for KKCMA. The primary threat to the recovery of forests within KKCMA is from grazing cattle (see section 4.2). The entirety of KKCMA is fenced, and currently staff believe the area is cattle free. Recently there has been evidence of a small feral herd (<5 cattle) present in the reserve, and that ingress from nearby ranching land has occurred either when gates are left open, or potentially through openings in the fence due to vandalism. Scheduled fence checks and monitoring of the area through checking game cameras are currently ongoing to ensure cattle do not return, and if any cattle are found they will quickly be removed. Another goal is to secure funding to be able to install cattle guards at access gates to prevent intrusion. For this project to succeed, the threat of cattle must be removed and actively monitored to ensure they do not come back in.

Sheep, mouflon sheep, and goats are not currently found in KKCMA, but monitoring will be done to ensure they do not enter the area. These ungulates detrimentally browse native vegetation, including koa, therefore there will be zero tolerance for sheep, mouflon, goats and cattle in the area. Damage to koa seedlings and regeneration is too costly economically, biologically, and culturally.

Pig populations are present at KKCMA, and they have the potential to grow and severely damage natural and cultural resources, especially koa trees in the area (see section 4.2). Currently, KKCMA is open to public hunting as part of hunting unit B (see section 3.9). DOFAW plans to include additional staff control of pigs to reduce populations levels within KKCMA. This may include trapping, staff hunting, and adding skirting to fence lines to protect forest resources, with the possibility of making the area 100% ungulate free depending on forest health needs and the needs to protect koa resources for canoe construction.

5.4.2 Increased koa regeneration

The 2020 timber inventory showed that natural recruitment of koa seedlings is low or non-existent throughout much of the area (see section 3.5 and Appendix B). This is likely due to recent browsing by cattle, and more intensive cattle control will likely increase seedling

recruitment. However, other management actions that can be done to increase koa recruitment include:

Scarification: Koa seeds have a hard, protective seed coat that protect it for a few decades or more in the soil. Most of KKCMA contains mature, fruiting koa trees and therefore likely has a healthy seedbank of koa seeds in the soil. Scarification of the seed coat is needed to break dormancy for germination. Ground disturbance due to silviculture operations (see section 5.3) will scarify seeds and stimulate germination. This operation is inexpensive, effective and will be an important component of stand replacement, provided that cattle are excluded.

Enrichment planting: Insufficient koa regeneration can occur due to a limited seed bank, uneven diameter class distribution, disease or invasive species, and inadvertent cattle predation. Should regeneration fail, planting of seedlings from good seed stock will be needed. The seed source should come from within KKCMA and should be propagated using well-developed nursery techniques.

If large areas are found without regeneration, then proper forestry techniques including site preparation and competition control should be considered to ensure survival of planted seedlings. This is an unlikely outcome, such as in the recovery of a severe fire or when reforesting open grass patches.

5.4.3 Invasive plant control

At this time, invasive weed populations are minimal throughout the forest (see section 4.1). Current weed management actions, including the eradication of palm grass (*Setaria palmifolia*) and monitoring for the presence of Early Detection and Rapid Response (EDRR) target species will continue (see section 4.1 for a list of target weed species and goals). However, with increased management activities and traffic in the forest, it is likely that there may be an increase in weed populations. To mitigate the spread and introduction of invasive plants due to increased public access, informational signage and boot brushes will be installed at the forest entrance to encourage public cleaning of gear. Additionally, the ROD prevention protocol (section 5.3.2), including pressure washing vehicles, will also provide protection against weed seedlings and propagules from entering the area.

Monitoring of areas post harvest or after stand improvement actions is necessary to detect and quickly control new weed populations. A diverse monitoring regime (outlined in section 5.4.6) promotes early detection of incipient weeds, as well as long-term information on changes in understory species composition.

When needed, additional invasive weed management will be conducted to achieve the desired control of the target weed species. Manual and chemical control of habitat-modifying weed species will target incipient weeds that may be altering the native forest composition. Biological control will also be used to manage invasive species when they are available.

5.4.4 Wildfire Management

Management for the prevention of wildfire requires that both the perimeter road and the interior crossroad are maintained as fuelbreaks. Maintenance includes clearing the road of vegetation or fallen trees. Fire activity in surrounding areas should be monitored to determine the level of risk at KKCMA. If fire risk is high, the area will be closed to the public. The existing helicopter LZ (Figure 18) will also be improved and maintained to prepare for wildfire response. Finally, water access must be identified and secured to prepare for the control of a wildfire.

5.4.5 Access and Public Use

Ongoing road maintenance and road improvements (see section 5.3.2) will facilitate safe public access of the forest. Road contouring for harvest operations will help improve access and prevent erosion in the area. Road re-grading is another common maintenance that will be implemented to remove ruts and washouts created by erosion.

Roadways can be utilized for hiking and bird watching opportunities, as well as access for hunting and forest collection. Hunting will be monitored and managed according to HAR Chapter 122 & 123. Signs and a boot cleaning station will be installed and maintained at the entrance to increase public awareness on pests and disease (i.e. ROD, invasive plants, invasive animals). DOFAW requests all hunter takes be reported to contribute to monitoring efforts. Various non-timber products can be collected in the forest with the proper collection permit (see section 3.9), and when possible non-commercial timber resources from silvicultural activities in the area will be made available to the public for wood working, focused on traditional and cultural uses. Further, DOFAW will look to collaborate with cultural and educational groups, as well as organizations harvesting canoe logs, to integrate traditional and cultural practices and collaborate on management of KKCMA when possible.

5.4.6 Forest Monitoring and Research

Forest monitoring is critical to determine the success of management activities and to facilitate adaptive management at KKCMA. DOFAW staff will conduct regular fence checks and informal monitoring during site visits to observe ungulate transgress, as well as invasive weed species. In addition to informal forest checks, regeneration plots and/or photo points near or in harvest areas, and permanent sample plots will track the long-term growth and recovery of trees in the area. Further, a full forest inventory, similar to what was conducted in 2020 (Appendix B), will be conducted roughly every 10-20 years. All monitoring activities will include forest health assessments of priority insects and diseases (Table 11).

Regeneration plots and photo points

Prior to each harvest, between one and three regeneration plots should be installed to measure baseline forest conditions. The plots will measure the abundance (count) of koa seedlings and saplings, as well as other regenerating tree species. Observations of ungulate browse within the plot will be recorded. Each plot will have a photo point associated with it, to provide photo documentation of the forest conditions. Plot re-measurements and photo point documentation should occur approximately 6 months post-harvest and then every 2-3 years after that. The regeneration plots and photo points will provide both quantitative and qualitative data tracking forest development over time.

Permanant Sample Plots and other research opportunities

DOFAW, either internally or through collaborations with outside groups, will establish monitoring to track growth and health of timber resources, likely through permanent sample plots. Permanent Sample Plots (PSPs) are fixed plots designed to measure koa growth and yield. All trees in the plots are marked and measured repeatedly to track growth. Data generated from this type of monitoring can help contribute to the general understanding of koa stand dynamics, aiding in management decisions regarding diameter class thinning or other silviculture prescriptions. This forest provides an excellent opportunity for the research community to collect continuous data to create various predictive biometric equations for use in koa forest management.

Additionally, DOFAW will continue to collaborate with Hawai'i Agriculture Research Center (HARC) on koa research by maintaining the existing seed orchard and research plot within KKCMA (see section 3.5).

Inventory of koa resources

A complete inventory of the forest, documenting all trees that meet the criteria for a canoe log currently and trees that will meet the criteria in the near future, is vital to determine how many canoe logs are in the forest. This inventory will focus on koa resources, to understand how management activities have impacted the forest. Data gathered from this management inventory will provide information on stocking, basal area, diameter, heights, form, and health. This inventory is the most infrequent of all monitoring work, estimated to be conducted every 10-20 years, and will be similar to the inventory conducted in 2020 (Appendix B).

Biodiversity and forest health monitoring

Regular monitoring supports the early detection of pests and disease. DOFAW will collaborate with partners to secure essential technical information and understanding of new threats. Forest health monitoring will include checking for evidence of ROD within KKCMA to determine if the distribution is increasing over time. For the protection of T&E bird species, DOFAW will continue to collaborate with the Three Mountain Alliance in annual forest bird monitoring.

Bird Surveys

DOFAW will continue to collaborate with TMA to implement annual bird surveys at KKCMA. This data has been crucial to develop spatial representation of native birds and T&E species in the reserve and track the impacts of climate change on increasing distribution of avian malaria.

Insect Surveys

DOFAW plans to implement invertebrate surveys at KKCMA in the near future. These surveys will be done by DOFAW staff, mainly focusing on insects and spiders and not cover all invertebrates. Surveys will focus on T&E and rare insect species such as the endangered picture wing fly *Drosophila heteroneura* and other rare species like endemic species of pinapiao (*Megalagrion* sp.).

5.5 Management Actions & Costs

Table 14 Management Goals for KKCMA

Priority #1: Watershed Values

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Reduce impacts of ungulates on watershed resources	Cattle control & removal	Maintain fences surrounding KKCMA through regular fence checks and repairs	\$15k/year, staff & mgmt. costs
		Replace fence with bull wire as needed (10+ years)	\$1M
		Continued monitoring of cattle populations & removal as needed	Staff & mgmt. costs only
		Implement Cattle guards at 3 gates entering property (\$20K per cattle guard)	\$60K
		Check game cameras to ensure cattle remain absent from the area	Staff & mgmt. costs only
	Mouflon sheep monitoring	Continue to monitor (game cameras, staff observations) for presence of mouflon within the area (currently none are believed to be present)	Staff & mgmt. costs only
	Monitor & manage pig populations	Promote & track public hunting of pigs within the area	Staff & mgmt. costs only
		Increase staff control of pigs in the area through trapping and/or staff hunts	Staff & mgmt. costs only
		Install fence skirting along existing fencelines	~\$800K

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Minimize Erosion	Monitor and manage access road conditions	Implement road contouring in steep areas of mauka/makai roads prone to erosion	\$20K
		Conduct road maintenance (gravel fill potholes) as needed	\$TBD/year + staff costs
	Minimize erosional impacts from harvest operations	Ensure all harvest operations follow harvest best management practices (Appendix F)	Staff & mgmt. costs only
		Suspend all harvest operations during storms or heavy rain events	Staff & mgmt. costs only
Collaboration	Maintain DOFAW's partner role in the Three Mountain Alliance (TMA) Watershed Partnership	Establish regular communications, schedules, and protocols with WP	Staff & mgmt. costs only
		Participate in WP meetings.	Staff & mgmt. costs only
Climate change adaptation	Monitor latest information on climate change, vulnerability, modelling, and adaptation.	Participate in climate change seminars, meetings, and workshops	Staff & mgmt. costs only
	Track changes to forest composition over time	Utilize monitoring to determine if forest plant composition changes over time. Adapt management actions as needed to account for new environment as needed	Staff & mgmt. costs only

Priority #2: Cultural Practices & Uses

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Increase DOFAW capacity to manage KKCMA	Increase funding and resources for KKCMA	Request funding for a dedicated forester position to guide the management, community collaboration, planning, and implementation of projects at KKCMA	~\$74-90K/year
		Pursue state and federal funding sources to implement short and near term management goals	Staff & mgmt costs
Oversee & guide koa canoe tree harvest	Facilitate canoe tree distribution	DLNR will manage and award koa canoe tree allocation, in collaboration with recommendations from community, cultural, user group, and natural resource experts	Staff & mgmt. costs only
		Provide oversight prior to and during the applicant koa tree harvest	Staff & mgmt. costs only
		Work with canoe log recipients to ensure they implement work plans aimed at conserving and/or giving back to KKCMA or other forest areas within the state	Staff & mgmt costs only
		Encourage and collaborate with applicants on culturally appropriate harvest operations and protocols	Staff & mgmt costs only
		Ensure all permits require compliance with DOT regulations of transporting oversize or overweight vehicles.	Staff & mgmt costs only

General Management Actions	Tactical Goals	Action Items	Estimated Cost
		Ensure transportation crews coordinate with DOT through oversize load permit process to determine scheduling	Staff & mgmt costs only
Manage koa resources for sustainable long term supply of canoe logs	Ensure sustainable harvest levels for long term use	Track harvest levels annually and evaluate harvest goals and operations every 10 years	TBD, Staff & mgmt costs
		Implement forest monitoring as described in Resource Protection below	TBD
	Promote koa regeneration	Conduct mechanical scarification in select areas to increase koa seedling recruitment	Staff & mgmt. costs only
		Implement enrichment planting as needed	TBD, based on acreage
	Conduct silvicultural activities to improve koa canoe log availability	Develop thinning plan with desired stocking densities prior to implementation	Staff & mgmt. costs only
		Conduct thinning in specified management units according to a designated timeline	TBD Staff & mgmt. costs only
	Integrate traditional Hawaiian knowledge in silviculture operations	Implement traditional Hawaiian practices in the monitoring, selection of canoe trees, and management of KKCMA	Staff & mgmt. costs only

Priority #3: Resource Protection

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Manage incipient and established invasive species	Invasive species monitoring and control	Prevent the establishment of new invasive weed species within KKCMA, especially those outlined in Table 8 of this plan	TBD
		Use photo point monitoring (as well as regeneration and timber inventory data) to track invasive species levels over time	Staff & mgmt. costs only
		Implement manual, chemical, mechanical, and/or biological control as needed	Manual - \$625/ac, chemical- \$350/ac, and mechanical- \$180/ac
		Require cleaning of harvest machinery per Best Management Practices (Appendix F)	Staff & mgmt. Costs only
		Encourage public cleaning of gear via informational signage and boot brushes at forest entrance	Staff & mgmt. costs only
Manage ungulate populations	Control all ungulate populations at levels consistent with forest protection needs	Regular checks for animal ingress	Staff & mgmt. costs only
		Install motion sensor game cameras at known locations of cattle ingress	\$2,000
		Staff control of ungulates according to observations by staff, hunting data, and regeneration data	Staff & mgmt. costs only

General Management Actions	Tactical Goals	Action Items	Estimated Cost	
		Install cattle guards at gates	\$60K	
Forest health protection from insects and diseases	Protection of koa trees from insects and diseases	Include monitoring for koa insects and diseases, especially those outlined in Table 10 of this plan, in all monitoring activities, including timber inventory	Staff & mgmt. costs only	
	Early detection of pests and disease	Assist and collaborate with partners to secure essential technical information and understanding of new threats	Staff & mgmt. costs only	
	Rapid 'Ōhi'a Death		Include ROD sanitation and prevention procedures for all collection permits issued for KKCMA	Staff & mgmt. costs only
			Minimize impacts and wounds to 'ōhi'a trees during harvest operations	Staff & mgmt. costs only
			Look for signs of increased ROD distribution within KKCMA	Staff & mgmt. costs only
	Monitor avian malaria	Utilize forest bird surveys to monitor distribution of avian malaria in the area	Staff & mgmt. costs only	
	Increase public information and awareness on pests and disease	Sign installation and replacement as needed	\$2K/year + staff costs	
Wildfire management and prevention	Wildfire prevention	Maintain roadways to act as fuelbreaks	Staff & mgmt. costs only	

General Management Actions	Tactical Goals	Action Items	Estimated Cost
	Wildfire response	Monitor fire activity in surrounding areas to determine activity increases in elevation or in surrounding areas	Staff & mgmt. costs only
		Improve and maintain helicopter lz for access to the area	Staff & mgmt. costs only
		Ensure access to water in case of fire response in the area	Staff & mgmt. costs only
Forest monitoring and research	Forest monitoring	Conduct regular fences checks, and informal staff monitoring of presence of invasive species through regular operations	Staff & mgmt. costs only
		Conduct photo point plots to measure regeneration and identify evidence of ungulates	Staff & mgmt. costs only
		Implement growth monitoring, likely through permanent sample plots (PSPs)	TBD
		Conduct full timber inventory (roughly every 10-20 years)	\$30K
	Collaborate with Hawaii Agriculture Research Center (HARC) on koa research	Utilize seed orchard/research plot for timber or growth experiments	TBD
		Management and maintenance of fenceline around research plot	TBD
		Collect wilt resistant seeds from current orchard trees	TBD
		Collaborate with HARC on establishing alternative koa orchard seedlings on Hawai'i island	Staff & mgmt costs only

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Cultural resource protection	Protect Historic Sites found within KKCMA	At a minimum, an archaeological survey will be undertaken once a potential harvest area is defined and before any harvesting activities are carried out.	TBD
	Include native Hawaiian knowledge within management plans and actions	Seek as a part of management to utilize names of traditional places, Hawaiian environmental zones (wao) and associated individuals such as former konohiki	Staff & mgmt costs only
	Formalize and utilize existing working group	Continue to utilize the existing working group to guide appropriate cultural protocols and advise on planned activities.	Staff & mgmt costs only
		Utilize working group to advise on the canoe log allocation process	Staff & mgmt costs only
		Continue to maintain the working group consisting of kālaiwa‘a, kūpuna and kama‘āina of Kapāpala and Ka‘ū, canoe clubs, forestry experts, and other stakeholders	Staff & mgmt costs only
	Develop culturally integrated educational and stewardship opportunities	Require hālau (organizations) requesting a canoe log to implement stewardship, educational, and/or outreach efforts as a form of reciprocation as part of receiving permits to harvest a canoe log	Staff & mgmt costs only
		Collaborate with Ka‘ū and Hawai‘i island community groups and organizations on educational and stewardship opportunities at KKCMA	Staff & mgmt costs only

Priority #4: Native Ecosystems

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Maintain intact native forest habitats	Protection of upper elevation and interior forests	Interior and upper elevation areas prioritized as resource protection areas where silviculture operations will not occur	Staff & mgmt costs only
	Ensure regeneration of koa and other native trees post harvest operations	Based on monitoring data, utilize scarification or enrichment planting to ensure native seedlings regenerate in harvest areas	TBD
	Utilize monitoring to track native ecosystems over time	Photo point data, regeneration, and timber inventories will use to track status of native ecosystems overtime, and guide protection measures or adjustments to harvest operations	Staff & mgmt costs only
Climate change adaptation	Anticipate and facilitate habitat migration	Monitor abundance of native and invasive species as temperature rises and precipitation changes	Staff & mgmt costs only
	Prepare for increased possibility of insects and diseases	Integrate monitoring for insects and diseases (esp. those in Table 10) in monitoring and surveys	Staff & mgmt costs only
Minimize invasive species impacts on native ecosystems	Ungulate control	see Resource Protection goals for invasive plants, cattle, mouflon, and pigs	Staff & mgmt. costs only
	Invasive weed control		

Priority #5: Threatened & Endangered Species

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Protection and recovery of listed rare plants and animals	Protection of T&E bird species	DOFAW to implement pre-harvest surveys for T&E birds in any areas prior to harvest	Staff & mgmt. costs only
		Prioritize mid-elevation areas for majority of harvest operations	Staff & mgmt. costs only
		Continue annual forest bird monitoring in collaboration with Three Mountain Alliance	TBD
		If hawks are found nesting, no harvest operations will occur within 330 feet until the juvenile hawk has fully fledged	Staff & mgmt costs only
	Protection of the Hawaiian hoary bat	Maintain diversity in forest cover to protect bat habitat and food sources	Staff & mgmt. costs only
		Temporal avoidance of harvest operations to avoid bat pupping season (June 1-Sept 15)	Staff & mgmt. costs only
	Protection of rare plant species (none currently known within parcel)	Implement DOFAW staff monitoring for T&E plant species in all areas planned for timber harvest prior to any timber operations	Staff & mgmt. costs only
	Protection of T&E insect species	Implement DOFAW staff surveys of insects in the area. Utilize surveys to avoid damages to listed T&E species	Staff & mgmt. Costs only

Priority #6: Access, Trails, Hunting, & Other Public Uses

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Promote public hunting through Chapter 122 & 123	Regulate hunting as per HAR Chapter 122 & 123	Monitor and manage hunting activities	Staff & mgmt. costs only
		Ask hunters to report their daily take to contribute to monitoring efforts	Staff & mgmt. costs only
Maintain a variety of public uses	Encourage sustainable collecting of plants by the public	Require the use of collection permits for maile collection	Staff & mgmt. costs only
		Issue collection permits for other non-timber forest products	Staff & mgmt. costs only
		Collaborate with DOCARE to enforce over-harvesting or illegal collections within KKCMA	Staff & mgmt. costs only
	Facilitate public use of the forest for cultural, educational, and stewardship activities	Collaborate with organizations harvesting canoe logs to implement conservation and restoration efforts	Staff & mgmt. costs only
		Collaborate with cultural and educational groups	Staff & mgmt. costs only
	Utilize non-commercial timber resources from stand improving silviculture activities	Supply pre-commercial thinning timber to small wood workers and cultural practitioners through collection or harvest permits	Staff & mgmt. costs only
	Maintain hiking and bird watching opportunities	Utilize roadways as hiking and bird watching opportunities	Staff & mgmt. costs only
Maintain public access	Maintain roadways within parcel	Road maintenance and improvements as needed	Staff & mgmt. costs only

General Management Actions	Tactical Goals	Action Items	Estimated Cost
	Secure access agreement to the reserve	Solidify public access agreement through Honanui road	Staff & mgmt. costs only

Priority #7: Commercial Activity

General Management Actions	Tactical Goals	Action Items	Estimated Cost
Commercial thinning operations	Utilize commercially viable timber from thinning operations	Generate revenue from small scale commercial thinning operations through the sale of harvested koa. Revenue would be used to fund management at KKCMA	TBD

5.6 Measures of Success

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

- Number of koa canoe tree permits allocated
- Number of non-timber forest product collection permits allocated
- Percent increase of koa population rates
- Percent reduction of ungulates present in the forest
- Number of invasive animals removed
- Acres of invasive plants controlled
- Miles of fence maintained
- Number of T&E plants/animals protected
- Acres of forests without new invasive species established
- Acres of native ecosystem that remain intact
- Number of stewardship projects implemented
- Number of cultural and educational group visits/ events
- Number of regeneration plots and photo points installed and remeasured
- Number of biological surveys and/or research studies conducted

5.7 Future Recommendations

Additional suggestions for management activities include:

- Conduct further surveys of other biological resources
- Continue to monitor harvest levels to ensure they remain sustainable for long term use
- Utilize regeneration plot results to help inform adaptive silvicultural management
- Collect seeds for establishing seed orchards
- Continued collaboration with Working Group
- Plan for harvests of more interior areas where appropriate.
- Collaborate with educational, cultural, and conservation groups at KKCMA when possible.

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7. APPENDICES

Appendix A: Cultural Impact Assessment for the Kapāpala Koa Canoe Management Area

Appendix B: 2020 Kapāpala Koa Canoe Forest Inventory

Appendix C: Kapāpala Koa Canoe Management Area Working Plant List

Appendix D: Kapāpala Koa Canoe Management Area Forest Bird Surveys 2021

Appendix E: DOFAW Management Guideline Classification Definitions

Appendix F: Best Management Practices for Maintaining Water Quality in Hawaii

Appendix A: Cultural Impact Assessment (CIA) for the Kapāpala Koa Canoe Management Area

Due to the length of the Cultural Impact Assessment, the entire document has been made available online at the address below:

https://dlnr.hawaii.gov/forestry/files/2023/03/CIA_Kapapala-Canoe-Forest-3.14.2023_final.pdf

Appendix B: Kapāpala Koa Canoe Management Area Forest Inventory 2020

Due to the length of this appendix, the entire document has been made available online at the address below:

<https://dlnr.hawaii.gov/forestry/files/2023/01/Kapapala-Koa-Canoe-Management-Area-Inventory-2020.pdf>

Appendix C: Kapāpala Koa Canoe Management Area Working Plant List

Kapapala Koa Canoe Area Roadside Survey

March 10, 2021

Conducted by L. Perry and J. VanDeMark

This was a roadside survey to compile a plant species list. All roads (approximately seven miles) in the Kapapala Koa Canoe Area were traversed and plant species recorded within 200 feet of the roadways. No endangered species were observed along these roadways but there was a rare species (*Rubus macraei*) observed adjacent to the western boundary of the Koa Canoe Area within an old Vicia enclosure. It will be important to look for this species during future surveys when any koa felling is to occur. DOFAW recommends that prior to any tree felling a comprehensive floristic and entomological survey be conducted in the immediate vicinity of each tree that is extracted from this area and along any pathways that are utilized to extract such trees to minimize damage to native species. Another recommendation is to prioritize the lowest areas in terms of elevation for tree extraction first as these areas are more degraded by introduced species and less damage will be done to native species and the habitat by concentrating extraction activities in the lower half of the Koa Canoe Area. The forest steadily improves in terms of quality the higher in elevation one travels.

Native species observed:

Tree and Shrub species:

Acacia koa (koa)

Metrosideros polymorpha (ohi'a)

Cheirodendron trigynum ('olapa)

Ilex anomala (kawa'u)

Melicope volcanica (alani)

Myoporum sandwicense (naio)

Myrsine lessertiana (kolea)

Psychotria hawaiiensis (kopiko)

Broussaissia arguta (kanawao)

Coprosma ernodeiodes (kukaenene)

Coprosma rhynchocarpa (pilo)

Vaccinium reticulatum (ohelo)

Vaccinium calycinum (ohelo)

Dodonaea viscosa (a'ali'i)

Lythrum maritimum (pukamole)

Pipturus albidus (mamaki)

Rubus hawaiiensis ('akala)

Rubus macraei (rare species of *Rubus* that was observed in old Vicia enclosure just outside of Koa Canoe area)

Styphelia tamieamiae (pukiawe)

Vines, Herbaceous and Grass Species:

Astelia menziesiana (pa'iniu)

Alyxia stellata (maile)
Carex alligata
Deschampsia nubigena
Stenogyne calaminthoides
Smilax melastomifolia (hoi kuahiwi)
 Fern Species:
Amauropelta globulifera (palapalai a Kamapua`a)
Asplenium lobulatum (pi`ipi`I lau manamana)
Asplenium contiguum
Athyrium microphyllum (`akolea)
Cibotium glaucum (hapu`u pulu)
Cibotium menziesii (hapu`u `I`i)
Cyclosorus interruptus (neke)
Dicranopteris linearis (uluhe)
Diplazium sandwichianum (ho`i`o)
Dryopteris hawaiiensis
Dryopteris wallichiana (`i`o nui)
Marattia douglasii (pala)
Microlepia strigosa (palapalai)
Nephrolepis cordifolia (sword fern)
Pneumatopteris sandwicensis (ho`i`o kula)
Pseudophegopteris keraudriana (waimakanui)
Pteris cretica (`oali)
Pteris excelsa (`iwa)
Sadleria souleytiana (`ama`u)
Sadleria cyatheoides (`ama`u)
Sphenomeris chinensis (pala`a)

Non-native species observed:

Grass Species:
Andropogon virginicus (broomsedge)
Anthoxanthum odoratum (sweet vernalgrass)
Ehrharta stipoides (meadow rice grass)
Holcus lanatus (Yorkshire fog, velvet grass)
Paspalum vaginatum (seashore paspalum)
Pennisetum clandestinum (kikuyu grass)
Schizachryium condensatum (bushy beard grass)
 Tree, Shrub and Herb Species:
Anemone huphensis (Japanese anemone)
Arundina grandifolia (bamboo orchid)
Crocsmia x crocosmiiflora
Desmodium intortum
Erechtites valerianifolia
Fragaria vesca (European strawberry)
Grevillea robusta (silk oak)
Ipomoea sp.

Juncus effusus (Japanese mat rush)
Morella faya (faya tree)
Musa sp. (banana)
Physalis peruviana (poha)
Plantago major (plantain)
Pluchea symphitifolia (sourbush)
Psidium cattleianum (waiwi)
Pyracantha angustifolia (firethorn)
Rubus argutus (blackberry)
Senna pendula
Tibouchina herbacea (glorybush)

Appendix D: Kapāpala Koa Canoe Management Area Forest Bird Surveys 2021

Three Mountain Alliance Forest Bird Surveys
at the Kapāpala Koa Canoe Forest
Summary of Detections in 2021

March 2021



The TMA forest bird surveys at Kapāpala Koa Canoe Forest took place February 8 & 20, 2021. Survey efforts were led by Colleen Cole, TMA Coordinator; assistance was provided DOFAW staff.

Table 1. Participants, 2021 Kapāpala Koa Canoe Forest Bird Surveys

Name	Affiliation	Counter type
Colleen Cole	TMA	Primary
Ian Cole	DOFAW East Hawai‘i Wildlife	Primary
Bret Mossman	DOFAW NARS	Primary
Alex Wang	DOFAW NARS	Primary
Naomi Himley	KUPU/DOFAW NARS	Secondary

Observers used the variable circular plot method (VCP). At each station species, distance and detection method (audible and/or visual) were recorded for each individual bird detected during an 8-minute interval. For rare birds, detection before or after the count period and detections between stations were also recorded. Data were entered into a MS Access database using the Avian Monitoring Entry Form. Entered and proofed data were passed on to USGS for inclusion in Hawai‘i Forest Bird Database and possible future analysis of population trends. This report provides a short summary of the detections.

A total of 65 stations along four transects were surveyed in the Kapāpala Koa Canoe Forest (Figure1). The counters detected seven introduced species, and six endemic species including one threatened species (‘I‘iwi). All species detections are presented in Table 2 and illustrated in Figures 2-10.

Table 2. Species detected during the 2021 Kapāpala Koa Canoe Forest bird surveys, with comparison of bps values for three prior years.

Alpha Code	Common Name	Scientific Name	Origin [†]	Status* Fed/State	2021 # Stations Occupied**	2021 # Detected	2021 Percent Occurrence	2021 Birds per Station	2020 Birds per Station	2019 Birds per Station	2018 Birds per Station
AKIP	‘Akiapola‘au	<i>Hemiganthus wilsoni</i>	End	E/E	0	0	-	-	-	0.02	-
APAP	‘Apapane	<i>Himatione sanguinea</i>	End		65	827	100%	12.72	13.49	10.05	11.66
HAA M	Hawai‘i ‘Amakihi	<i>Chlorodepanis virens</i>	End		64	295	95.4%	4.54	4.60	4.20	3.91
HAEL	Hawai‘i ‘Elepaio	<i>Chasiempis sandwichensis</i>	End		17	23	26.15%	0.35	0.38	0.85	0.48
HCRE	Hawai‘i Creeper/‘Alawī	<i>Loxops mana</i>	End	E/E	0	0	-	-	-	0.02	0.05
HOFI	House Finch	<i>Carpodacus mexicanus</i>	Int		1	1	1.54%	0.02	-	-	-
HWA H	‘Io, Hawaiian Hawk	<i>Buteo solitarius</i>	End	-/E	1	1	1.54%	0.02	0.08	0.08	0.03
IIWI	‘I‘iwi	<i>Drepanis coccinea</i>	End	T/-^	16	19	24.62%	0.29	0.65	0.93	0.58
JABW	Japanese Bush-Warbler	<i>Cettia diphone</i>	Int		9	10	13.85%	0.15	0.23	0.41	0.35
Jawe	Japanese White-eye	<i>Zosterops japonicus</i>	Int		60	131	92.31%	2.02	1.78	2.34	2.18
KAPH	Kalij Pheasant	<i>Lophura leucomelanos</i>	Int		2	2	3.08%	0.03	0.02	-	0.03
NOCA	Northern Cardinal	<i>Cardinalis cardinalis</i>	Int		5	8	7.69%	0.12	0.08	0.10	0.09
OMA O	‘Ōma‘o	<i>Myadestes obscurus</i>	End		61	180	93.85%	2.77	1.34	2.08	2.65
RBLE	Red-billed Leiothrix	<i>Leiothrix lutea</i>	Int		25	40	38.46%	0.62	0.09	0.41	0.40
YFCA	Yellow-fronted Canary	<i>Serinus mozambicus</i>	Int		5	6	7.69%	0.09	0.06	0.07	0.06

[†]End = endemic, Int = introduced, Ind = Indigenous; * E = endangered; T = threatened; ^State status here refers to Hawai‘i Island only.

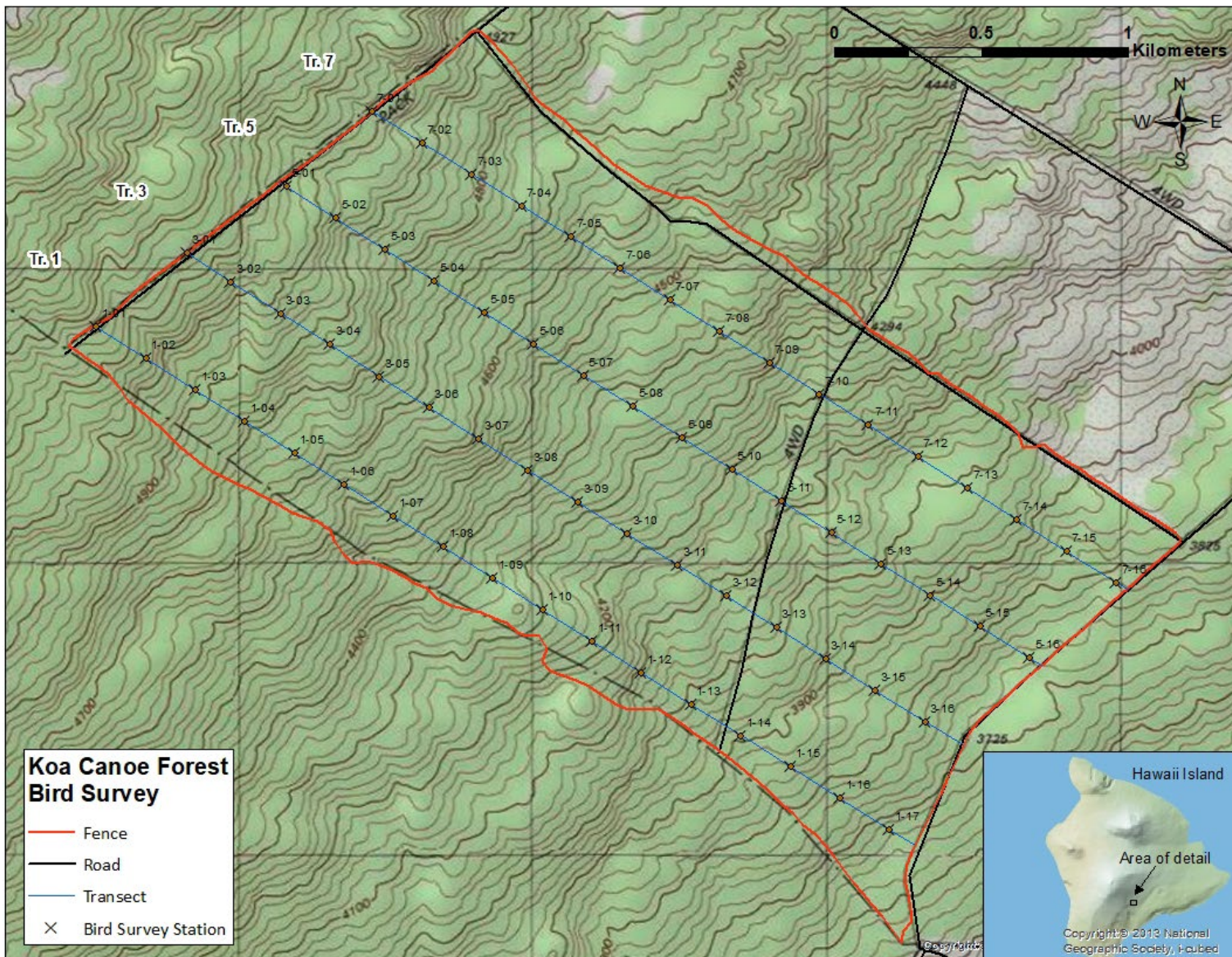


Figure 1. Transects and stations surveyed during the 2021 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

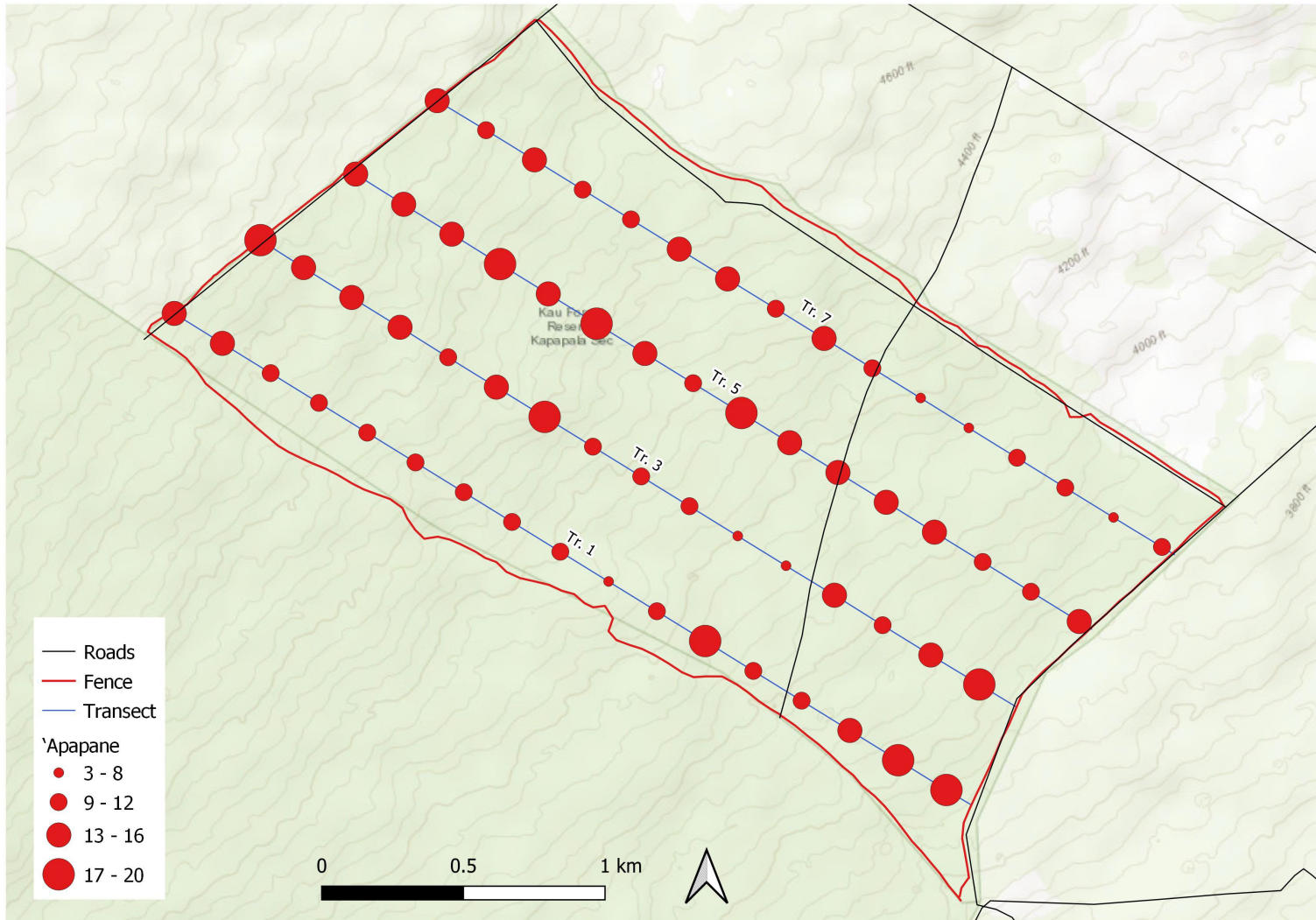


Figure 2. Detections of 'Apapane (*Himatione sanguinea*) during the 2021 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

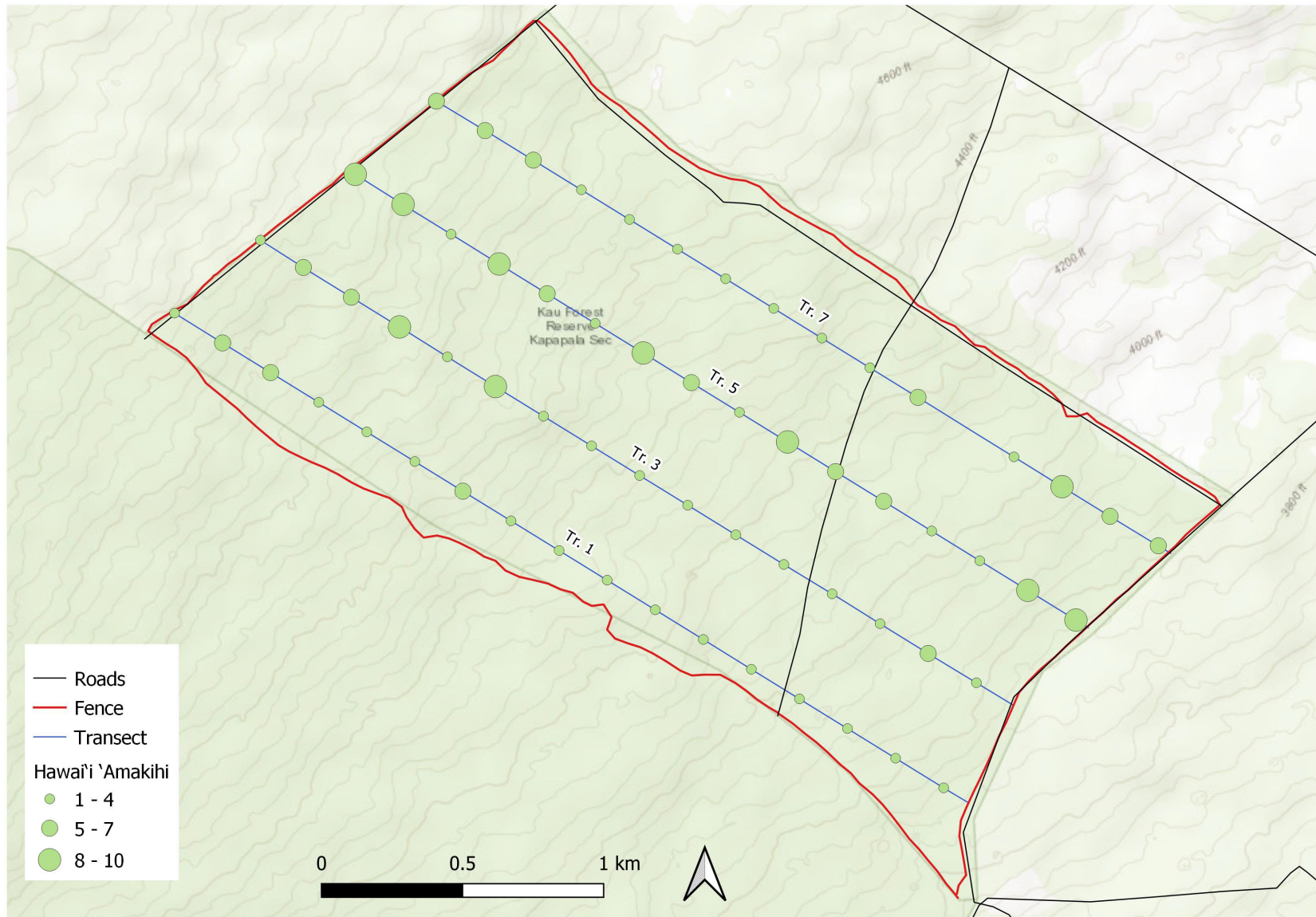


Figure 3. Detections of Hawai'i 'Amakihi (*Chlorodepanis virens*) during the 2021 TMA forest bird surveys

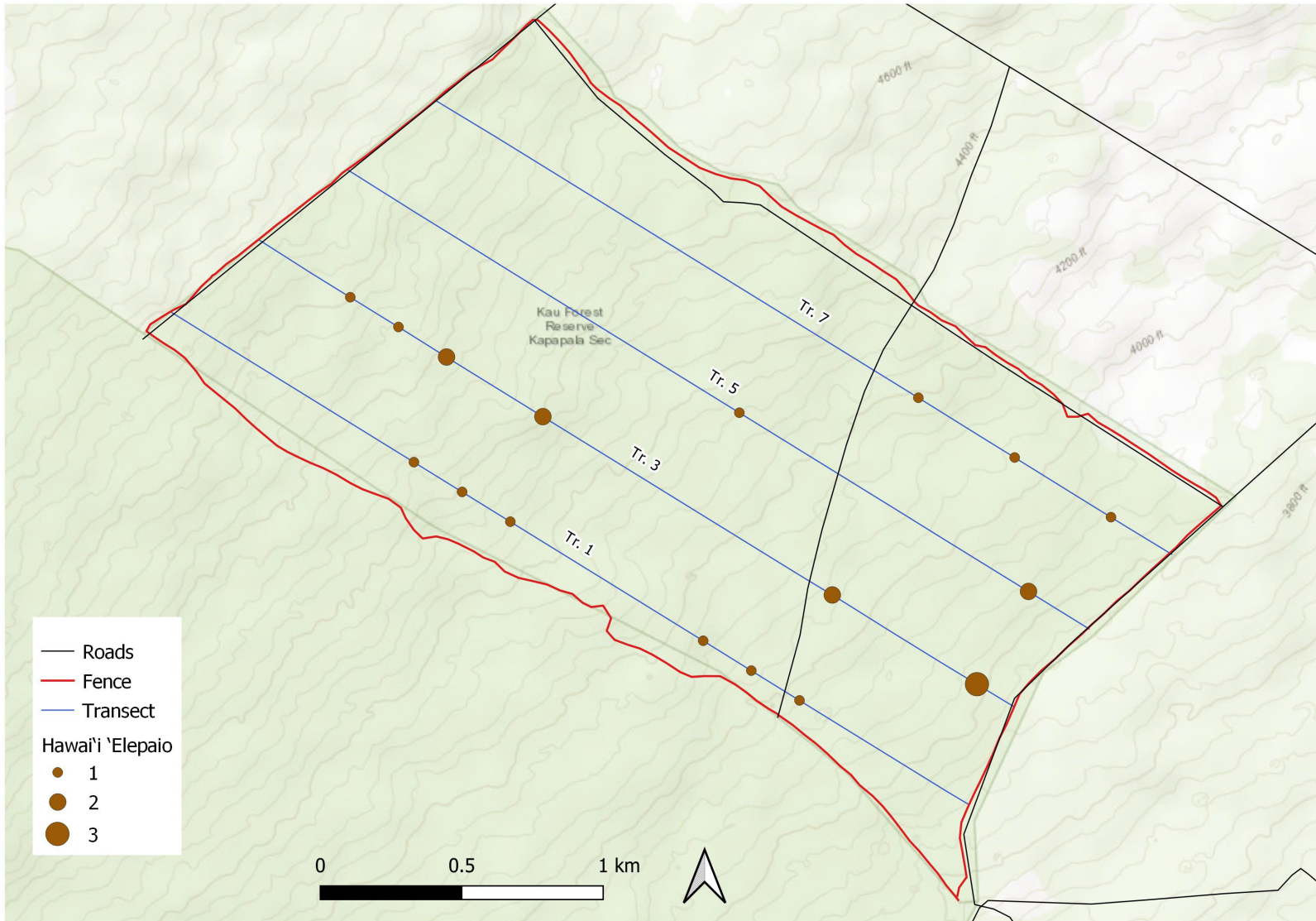


Figure 4. Detections of Hawai'i 'Elepaio (*Chasiempis sandwichensis*) during the 2021 TMA forest bird surveys

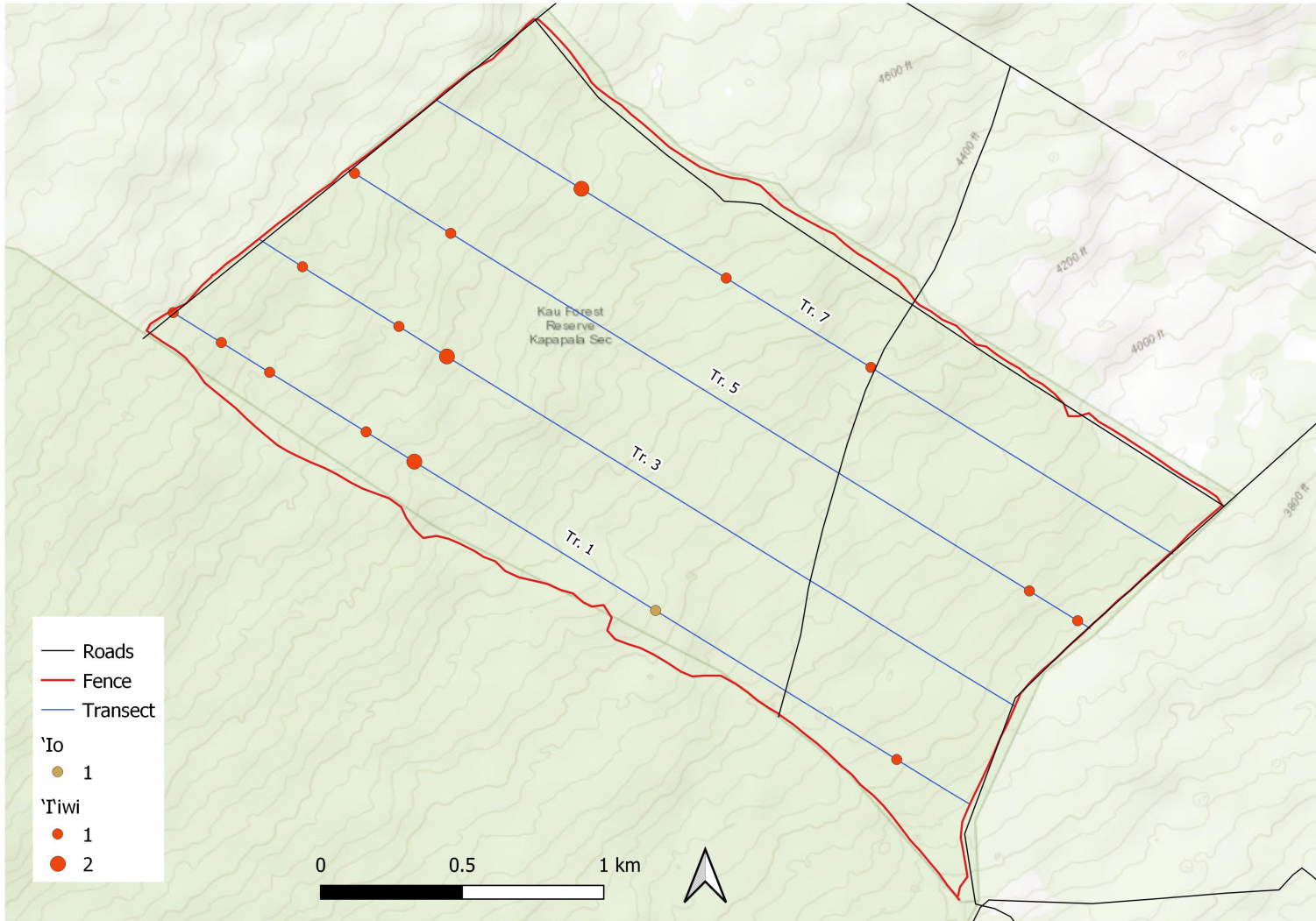


Figure 5. Detections of 'Iwi (*Drepanis coccinea*) and 'Io/Hawaiian Hawk (*Buteo solitarius*) during the 2021 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

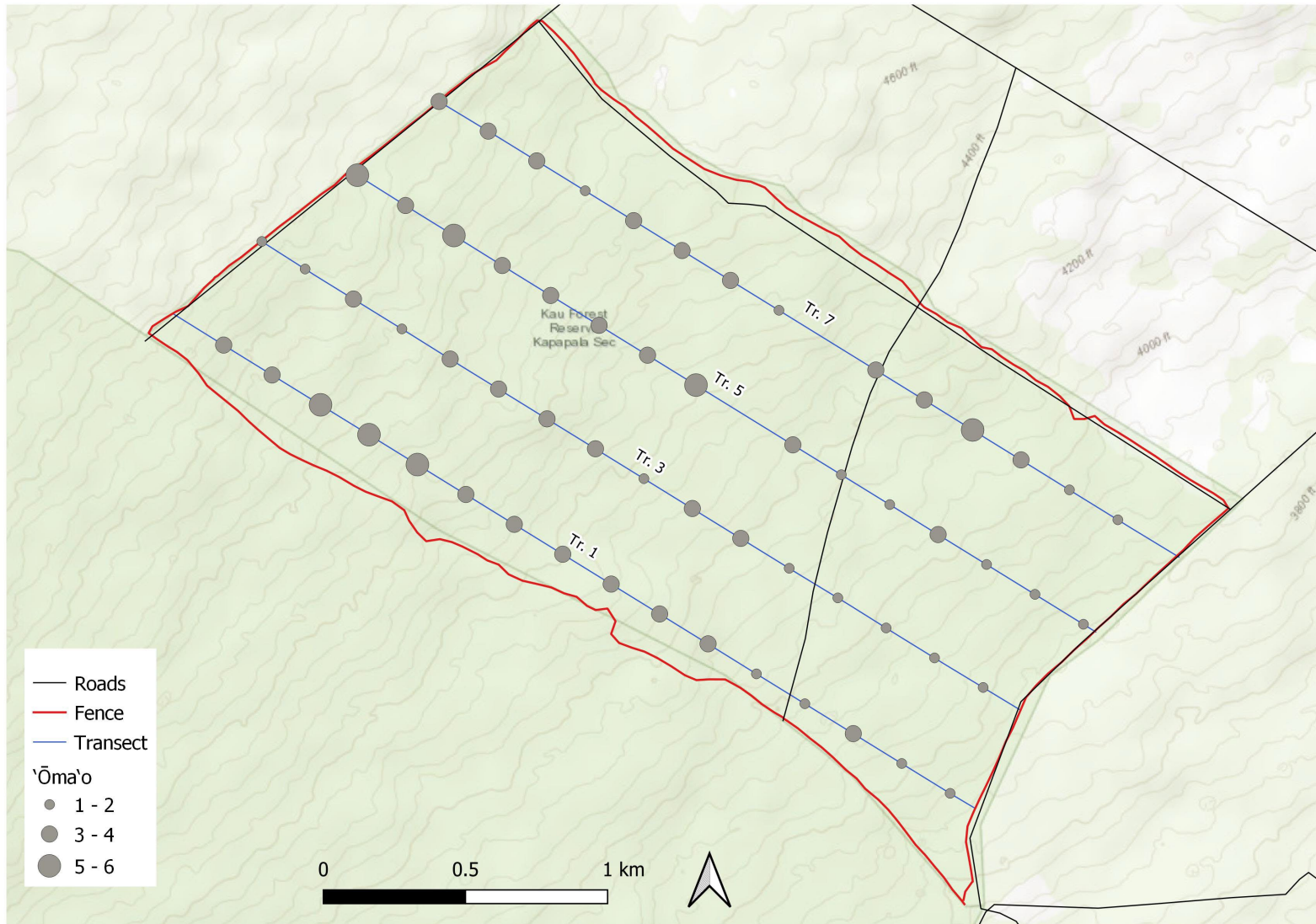


Figure 6. Detections of 'Ōma'o (*Myadestes obscurus*) during the 2021 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

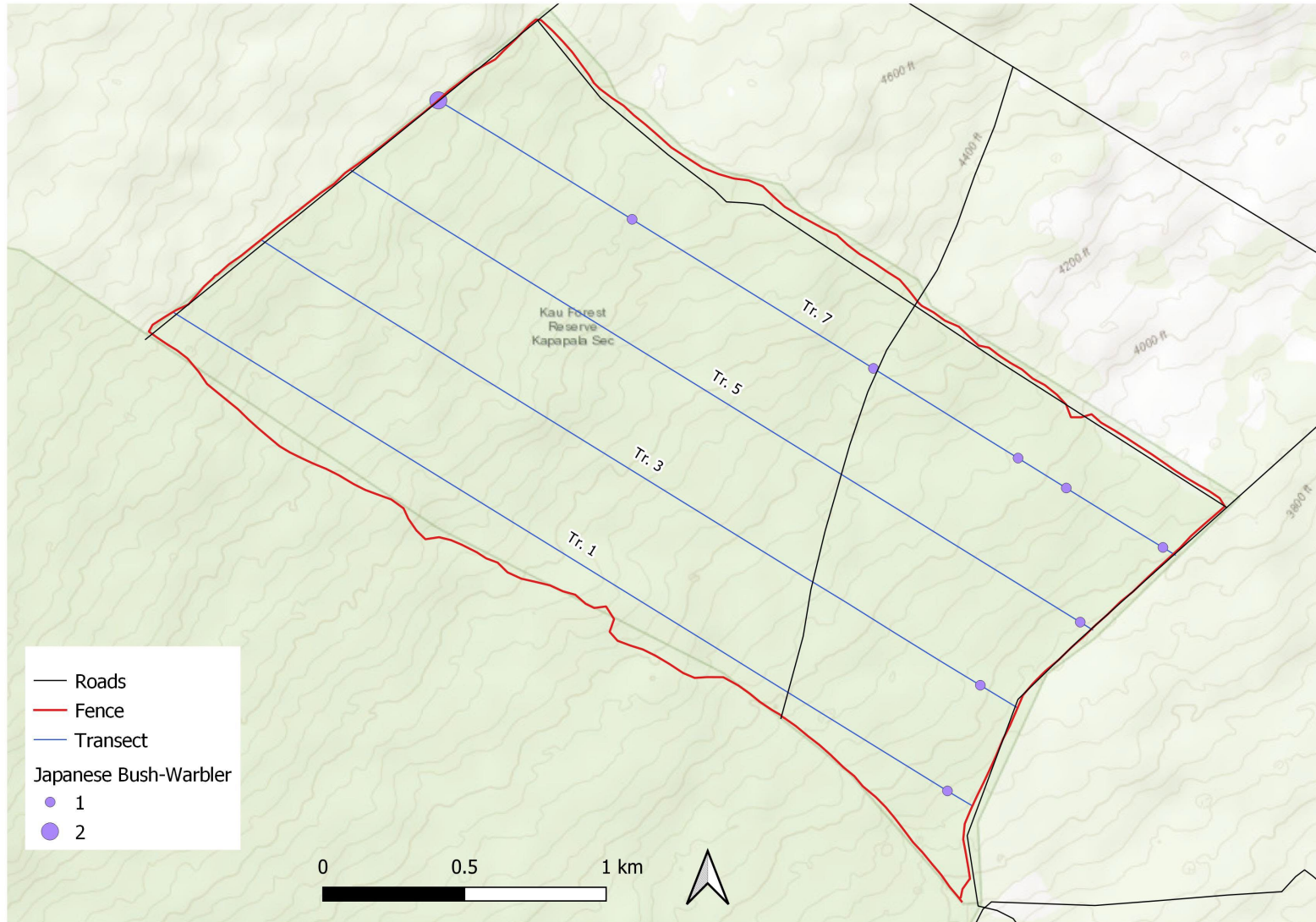


Figure 7. Detections of Japanese Bush-Warbler (*Cettia diphone*) during the 2021 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

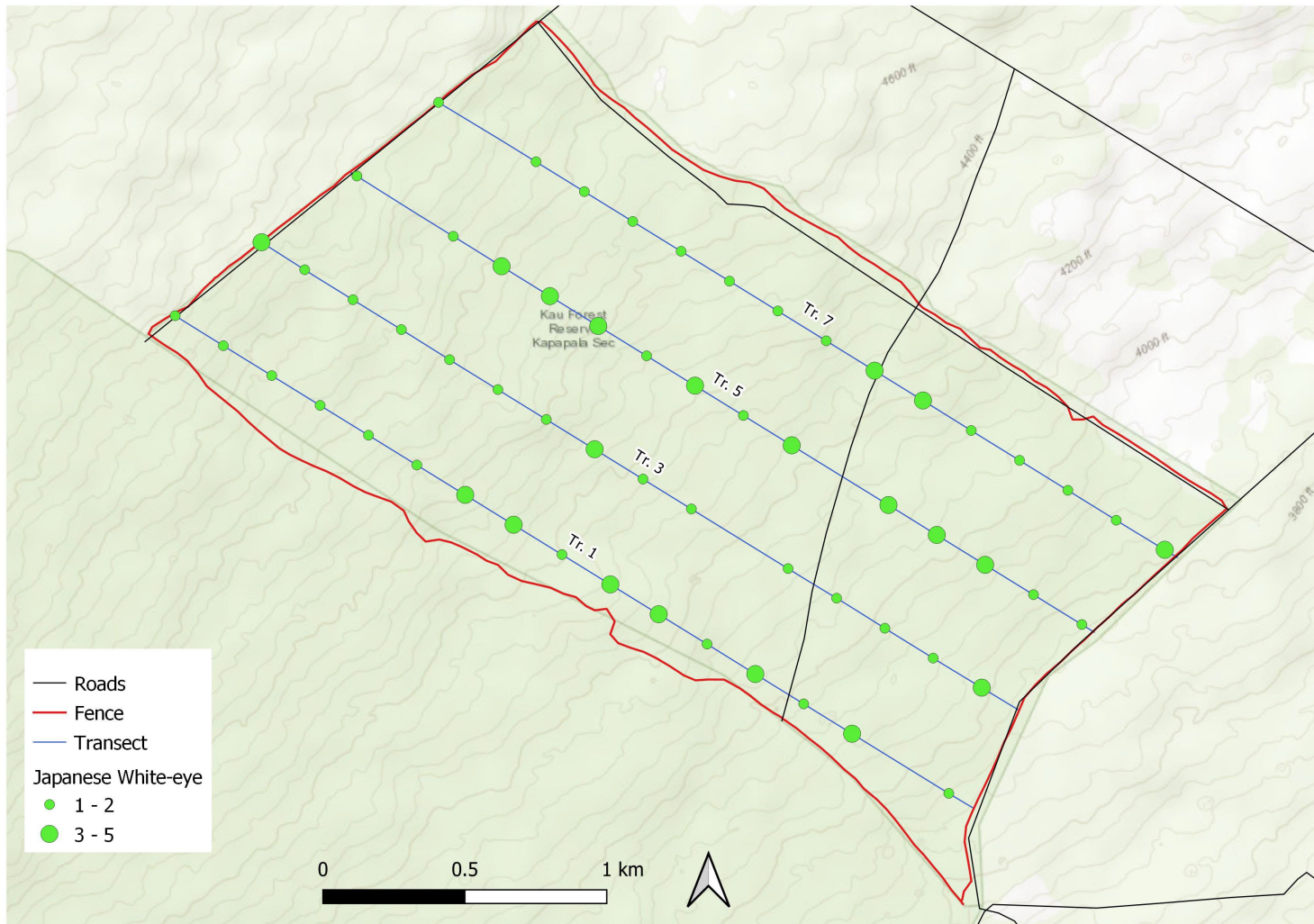


Figure 8. Detections of Japanese White-eye (*Zosterops japonicus*) during the 2021 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

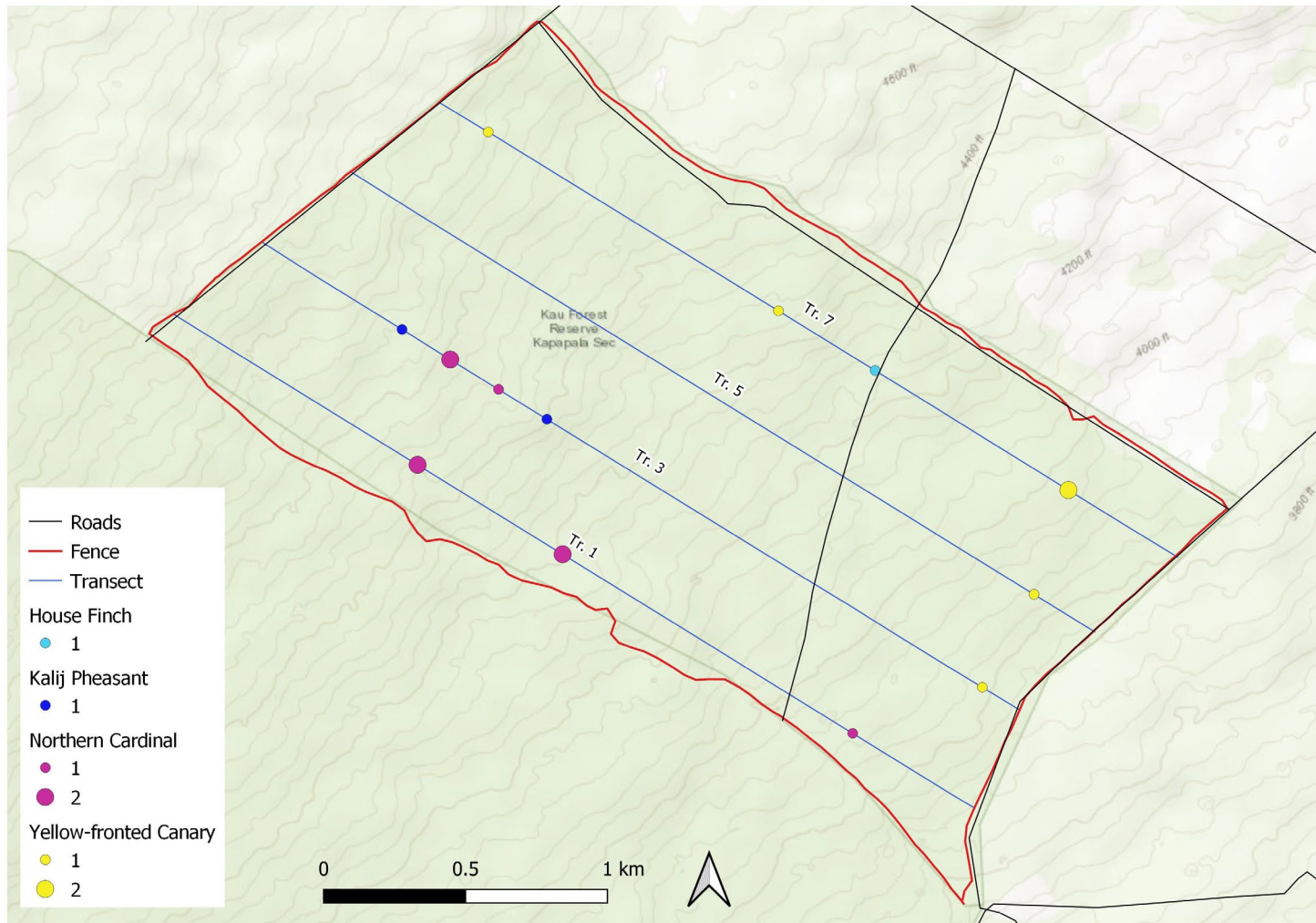


Figure 9. Detections of House Finch (*Carpodacus mexicanus*), Kalij Pheasant (*Lophura leucomelanos*), Northern Cardinal (*Cardinalis cardinalis*), Red-billed Leiothrix (*Leiothrix lutea*) and Yellow-fronted Canary (*Serinus mozambicus*) during the 2020 TMA forest bird surveys at the Kapāpala Koa Canoe Forest.

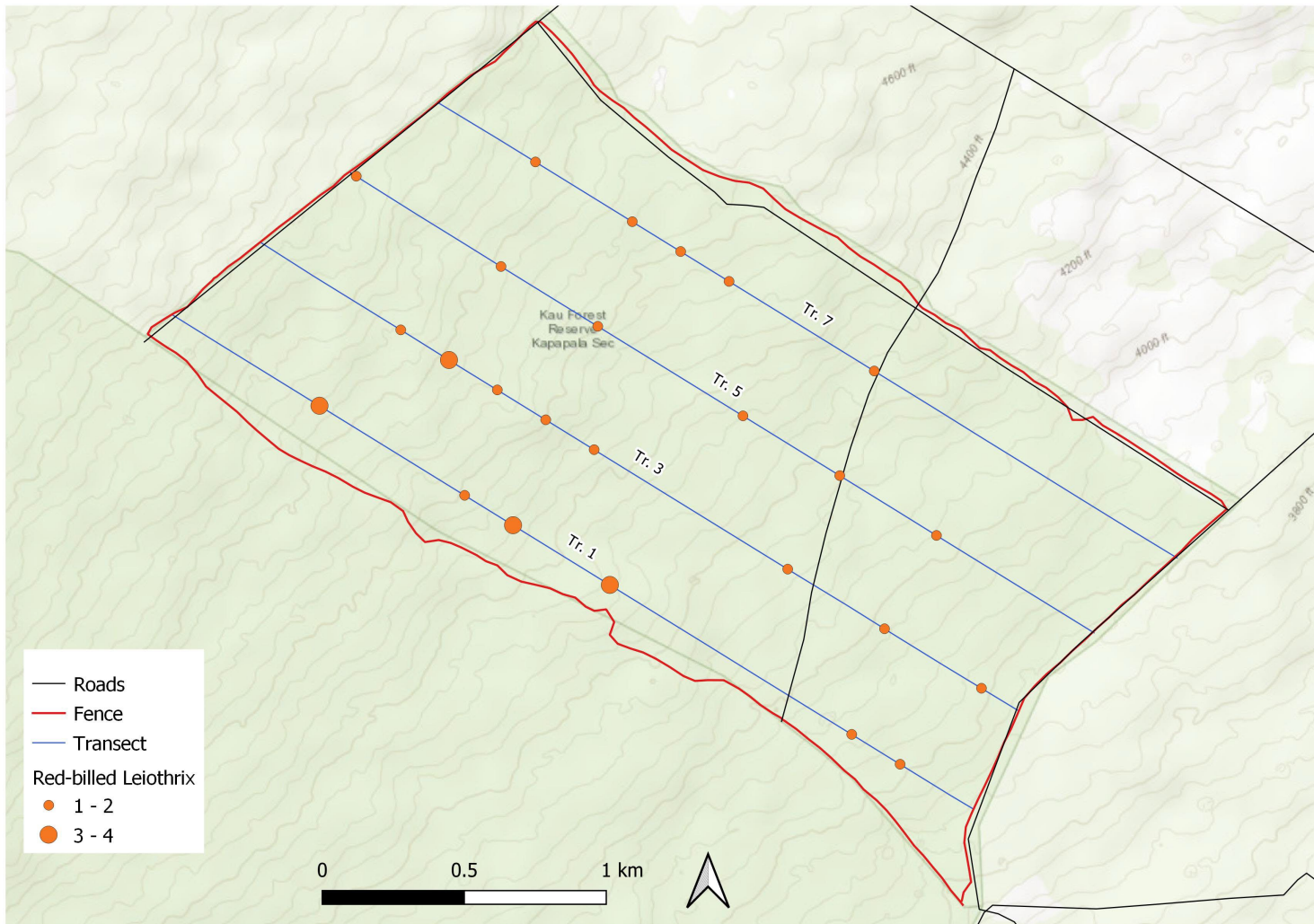


Figure 10. Detections of Red-billed Leiothrix (*Leiothrix lutea*) during the 2020 TMA forest bird surveys at the Kapapala Koa Canoe Forest.

Appendix E: DOFAW Management Guidelines Classification

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

	<ul style="list-style-type: none"> Permits for harvest of non-timber forest products will be considered on a case by case basis for research and education, improving forest science and health, watershed protection, traditional and customary practices, and conservation efforts. 	<ul style="list-style-type: none"> Prioritize protection of native species and native ecosystems; Permitted activities in these areas are minimally disruptive, and focused on improving forest and watershed health, native ecosystems, and other conservation efforts.
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Conservation Resources - Native Species Habitat, Water Resources – LNR 402/407		
Class Name	Class Definition: May have one, all, or a combination of conservation values	Management Strategy
C-1: High Conservation Resources	<ul style="list-style-type: none"> High level of native biological resources, native ecosystem intactness, and/or recovery potential; Essential to the conservation and/or recovery of native species; Important restoration areas, such as rare ecosystem remnants, native wildlife habitat, wetlands, and offshore islands; High degree of conservation related regulatory encumbrances - critical habitat, restricted watershed, conservation easements and/or zoning; High watershed conservation value per CWRM, USGS, BWS, and/or DOFAW. 	<ul style="list-style-type: none"> Intensive management applied, as necessary, to protect watershed values, and native species and ecosystems, as resources permit; Management may include animal exclusion fencing, predator control, vegetation/weed control; Work may include out-planting of native vegetation and reintroduction of native wildlife, as needed.
C-2: Medium Conservation Resources	<ul style="list-style-type: none"> Moderate level of native biological diversity and/or native ecosystem intactness; Contributes to the conservation and/or recovery of native species (i.e. T&E / native species habitat, water resources); Medium degree of conservation related regulatory encumbrances; Medium watershed conservation value. 	<ul style="list-style-type: none"> Management activities to control priority threats and improve watershed, native species or ecosystem outcomes; Work may include out-planting of native vegetation and reintroduction of native wildlife, as needed. Other uses may include forest products gathering, hiking, and liberal hunting.
C-3: Low Conservation Resources	<ul style="list-style-type: none"> Low level of native biological diversity and/or native ecosystem intactness; Low conservation and/or recovery of native species but may contribute to conservation (i.e. individual or small clusters of rare plants; genetic collection); Low degree of conservation related regulatory encumbrances; May have low watershed conservation value. 	<ul style="list-style-type: none"> Native species management occurs mostly in remnant patches and fenced units; Mixed use area with forest products gathering, hunting and non-hunting recreation, as appropriate.

C-4: Little to No Conservation Resources	<ul style="list-style-type: none"> • Little to no native biological diversity and/or native ecosystems highly degraded or absent; • Little to no contribution to the conservation and/or recovery of native species; • Very little or no conservation related regulatory encumbrances; • May have low watershed conservation value. 	<ul style="list-style-type: none"> • Area managed for a variety of uses not appropriate for more pristine environments, including timber harvest, regulated hunting and more intensive non-hunting recreation (hiking, equestrian and/or off-road vehicles).
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Conservation Management - Native Species Habitat, Water Resources – LNR 402/407

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

Vegetation Resources – LNR 402/407

Class Name	Class Definition
V-1: Highest Quality Native Vegetation	These areas consist of the highest quality native ecosystems and communities. They have minimal disturbance, with low levels (less than 10%) of non-native plants in any vegetative layer (91-100% native plant cover).
V-2: Predominantly Native Areas:	Areas in which native plants predominate in communities that are relatively intact, and are minimally disturbed. They have a significant component of non-native plants (51-90% native plant cover).
V-3: Considerably Degraded Native Vegetation Cover:	Areas have a considerable amount of disturbance to native vegetation. Non-native plants may predominate, however there may be pockets of remaining native plant communities (11-50% native plant cover).

V-4: Heavily Degraded Areas:	Areas where the native vegetation is severely degraded or highly altered from its natural state. There may be areas of severe erosion, former pasture or crop lands, forest plantations, areas of non-native grass or brush resulting from fires or intensive grazing. (0-10% native plant cover).
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Hunting Management – LNR 804		
Management for public recreation, subsistence hunting and animal damage control.		
Class Name	Class Definition	Management Strategy
H-1: Active Hunting Management:	<ul style="list-style-type: none"> Public hunting is a high priority land use; Area is suitable for a high degree of active management for public hunting; Management of the area is designed to provide maximum sustained yield of game animals. 	<ul style="list-style-type: none"> Hunting regulations for the area are designed to provide maximum sustained yield while minimizing environmental impacts; High degree of management to maintain or improve hunting program infrastructure; Habitat is managed to maintain or increase game animal carrying capacity, while maintaining healthy vegetative cover for proper range management and erosion control.
H-2: Moderate Hunting Management:	<ul style="list-style-type: none"> Area is suitable for a moderate degree of active management for animal enhancement and habitat management to increase animal productivity for public hunting; Public hunting opportunities may be improved or maximized; Public hunting is balanced with other objectives. 	<ul style="list-style-type: none"> Hunting regulations established to manage animal harvest; Moderate degree of infrastructure for animal management; Habitat modification for game animal production as appropriate for the area; Balance animal impacts with other resources.
H-3: Low Intensity Hunting Management:	<ul style="list-style-type: none"> Area not suitable for game enhancement and habitat management to increase animal densities - hunters play an important role in limiting animal impacts; Minimal public hunting restrictions provide maximum public hunting opportunity; Public hunting management includes maintaining access and monitoring hunter effort and success. 	<ul style="list-style-type: none"> Hunting seasons, bag limits and other hunting regulations liberalized to maximize hunting opportunity; Hunting opportunities may include permitted hunts if needed to improve access; No habitat modification for production and/or enhancement of game animals.
H-4: No Hunting Management:	<ul style="list-style-type: none"> Area is not suitable for open public hunting due to environmental sensitivity, access, or safety; No active management for public hunting; public hunting may be used for animal damage control on a permit basis; Public hunting is not a primary land management objective. 	<ul style="list-style-type: none"> Area not open to regular public hunting seasons for either management, access or safety reasons; Animal control to be conducted by staff, permitted and/or guided hunters, and other cooperators as appropriate.

Recreation Management – LNR 804

Class Name	Class Definition	Management Strategy
R-1: High Recreation Management:	<ul style="list-style-type: none"> • Areas where outdoor recreation is a primary objective; • High level of visitor use is received and accommodated; • May include recreation, transit and/or urban elements; • Approximate average daily use: 100 - 1000+ users. 	<ul style="list-style-type: none"> • Area can sustain heavy recreational use; recreation plays a major role in use of the area; • Trails maintained to sustain heavy use which may include hiking, mountain bike riding, equestrian and/or off-road vehicle use; • Improvements commensurate with use.
R-2: Medium Recreation Management:	<ul style="list-style-type: none"> • Areas where outdoor recreation is of moderate intensity, and may be integrated with other uses; • Includes a wide range of trails and roads requiring a moderate level of management and maintenance to meet user needs and balance other land use objectives; • Approximate average daily use: 0 – 500 (+/-) users. 	<ul style="list-style-type: none"> • Area can sustain moderate recreational use; recreation integrated with other management programs; • Roads and trails maintained to sustain moderate use which may include hiking, mountain bike riding, equestrian, and/or off-road vehicle improvements; • Improvements commensurate with use.
R-3: Low Recreation Management:	<ul style="list-style-type: none"> • Areas where outdoor recreation is of low intensity, and is integrated with other uses; • Trails and roads that receive limited use, or whose character and terrain require little maintenance relative to the usage; • Approximate average daily use: 0 – 100 (+/-). 	<ul style="list-style-type: none"> • Areas may be inaccessible or remote; facilities and improvements are limited, in keeping with the level of use; • Areas may be managed for multiple uses including forest protection, conservation, hunting, and hiking, or protected and managed to preserve natural conditions; activities may include hiking, biking, equestrian and/or off-road vehicles; • To protect both the trail environment and experience, improvements are typically minimal, and designed to fit the setting and need.

<p>R-4: Recreation Management (Restricted access):</p>	<ul style="list-style-type: none"> • Areas where outdoor recreation is restricted or controlled; • Areas sensitive to human disturbance due to natural, cultural or archaeological features; • Access primarily for management purposes, and/or limited or programmatic recreational or educational uses. 	<ul style="list-style-type: none"> • Areas may be classified “restricted” due to hazardous conditions, watershed protection, sensitive wildlife, fragile ecosystems, cultural resources, limited accessibility, or management practices incompatible with recreational activities; • Managed to limit impacts from human activities; • Facilities and improvements are very limited and generally associated resource management; • Trails will not feature extensive recreational amenities and will generally incorporate only facilities necessary to protect and manage the resource; • Access may be controlled via permits, group number limitations, or other restrictions as appropriate for the area.
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Appendix F: Best Management Practices for Maintaining Water Quality in Hawai'i

Due to the length of the Cultural Impact Assessment, the entire document has been made available online at the address below:

<https://dlnr.hawaii.gov/forestry/files/2023/01/DOFAW-Best-Management-Practices-for-Maintaining-Water-Quality-in-Hawaii-1996.pdf>

Exhibit B

FINAL ENVIRONMENTAL ASSESSMENT

Kapāpala Koa Canoe Management Area Plan

**Ka‘ū District, Island of Hawai‘i
TMK (3rd) 9-8-001:014**

October 2023

Prepared for:

**State of Hawai‘i
Department of Land and Natural Resources
1151 Punchbowl Street, Room 131
Honolulu, Hawai‘i 96813**

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DRAFT

FINAL ENVIRONMENTAL ASSESSMENT

Kapāpala Koa Canoe Management Area Plan

**Ka‘ū District, Island of Hawai‘i
TMK (3rd) 9-8-001:014**

PROPOSING/APPROVING AGENCY:

State of Hawai‘i
Department of Land and Natural Resources
1151 Punchbowl Street, Room 131
Honolulu, Hawai‘i 96813

CONSULTANT:

Geometrician Associates LLC
10 Hina Street
Hilo, Hawai‘i 96720

CLASS OF ACTION:

Use of State Lands and State Funds

This document is prepared pursuant to:
The Hawai‘i Environmental Policy Act,
Chapter 343, Hawai‘i Revised Statutes (HRS), and
Title 11, Chapter 200.1, Hawai‘i Department of Health Administrative Rules (HAR)

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TABLE OF CONTENTS

SUMMARY	ii
PART 1: PROJECT DESCRIPTION, PURPOSE AND NEED AND E.A. PROCESS.....	1
1.1 Project Location and Overall Objectives	1
1.2 Project Background Purpose and Need.....	6
1.3 Project Description	8
1.4 Environmental Assessment Process.....	17
1.5 Public Involvement and Agency Coordination	18
PART 2: ALTERNATIVES	19
2.1 No Action Alternative.....	19
2.3 Alternatives Evaluated and Dismissed from Further Consideration.....	19
PART 3: ENVIRONMENTAL SETTING, IMPACTS AND MITIGATION	20
3.1 Biological Resources	20
3.1.1 Vegetation and Flora.....	20
3.1.2 Native Wildlife	25
3.1.3 Wildfire, Pests and Invasive Species	28
3.2 Climate and Geology	31
3.3 Socioeconomic Conditions, Access, Hunting and Recreation	35
3.4 Cultural Resources	39
3.5 Air Quality, Noise and Scenic Resources	46
3.6 Consistency with Land Use Designations, Permits, Plans and Policies	47
3.6.1 Hawai‘i State Plan	47
3.6.2 Hawai‘i State Forest Reserve Laws, Regulations and Policies.....	50
3.6.3 Hawai‘i County General Plan	50
3.6.4 Ka‘ū Community Development Plan.....	53
3.7 Cumulative and Secondary Impacts.....	55
3.8 Summary of Mitigation Measures	56
PART 4: DETERMINATION	59
PART 5: FINDINGS AND REASONS	59
REFERENCES	61

LIST OF TABLES

TABLE 3-1 Summary of Mitigation Measures	56
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LIST OF FIGURES

FIGURE 1-1 Location Map	2
FIGURE 1-2 Satellite Image	2
FIGURE 1-3 Project Area Photos	3
FIGURE 1-4 Forest Management Units Categorized by Management Class	11
FIGURE 3-1 Forest Strata	21
FIGURE 3-2 Forest Understory Types.....	22
FIGURE 3-3 Critical Habitat Map	24
FIGURE 3-4 Sea Level Rise Map.....	34
FIGURE 3-5 Access Route to KKCMA.....	37

LIST OF APPENDICES

APPENDIX 1 Kapāpala Koa Canoe Management Area Plan (V. April 2023)

APPENDIX 2 Public Involvement

SUMMARY OF THE PROPOSED ACTION, ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The Division of Forestry and Wildlife (DOFAW) of the Department of Land and Natural Resources (DLNR) is developing a Management Plan for the Kapāpala Koa Canoe Management Area (KKCMA). The Plan is part of an effort to provide a sustainable, long-term supply of koa for the traditional and cultural use of building koa canoes, while minimizing impacts on the natural and cultural resources in the area.

KKCMA consists of roughly 1,257 acres of agriculturally-zoned land at about 3,000-5,000 feet in elevation on the southeastern slope of Mauna Loa, in the district of Ka‘ū and the ahupua‘a of Kapāpala. The area is covered almost entirely by a native koa and ‘ōhi‘a forest. This parcel is the only state land in Hawai‘i specifically designated for the purpose of producing koa canoe resources. Other management objectives include protection of native forest, watershed resources, and bird habitat; increased regeneration and restoration of koa trees; collaboration with educational groups and community groups; access for recreational activities; and integration of traditional Hawaiian stewardship models with western conservation practices. A harvest plan will guide harvest and extraction of canoe-quality trees while regenerating koa resources on a 100-year timeframe. Organizations in the State of Hawai‘i may apply for a permit to harvest a canoe log, which will be reviewed by a group of experts consisting of cultural practitioners; voyaging and racing canoe club members; kālaiwa‘a (canoe builders); forestry experts; conservationists; and community members, who will advise DOFAW on the final allocation of canoe log permits. Current plans call for organizations who have been selected to independently harvest and extract canoe logs with the guidance of DOFAW. It will be the ongoing job of DOFAW to implement stand improvement actions, such as pre-commercial and commercial thinning, that will enhance the ability of the forest to produce large, straight koa trees capable of being made into canoes. Some non-canoe quality timber resources may be sold to help fund the management of KKCMA.

Multiple protection measures will be implemented to ensure that area resources are not degraded due to project activities or ongoing threats such as non-native animals and invasive weeds. Best Management Practices will help avoid erosion. In order to minimize impacts on threatened and endangered species as well as archeological and historical sites, botanists, ornithologists and archaeologists will undertake surveys in all areas prior to any silviculture actions taking place in that unit. Areas of higher value native forest and bird habitat have been designated as lower priority harvest areas. Various cultural mitigation measures are an integral part of the Plan. Implementation of the Plan requires approval by the Board of Land and Natural Resources.

PART 1: PROJECT DESCRIPTION, PURPOSE AND NEED AND ENVIRONMENTAL ASSESSMENT PROCESS

1.1 Project Location and Overall Objectives

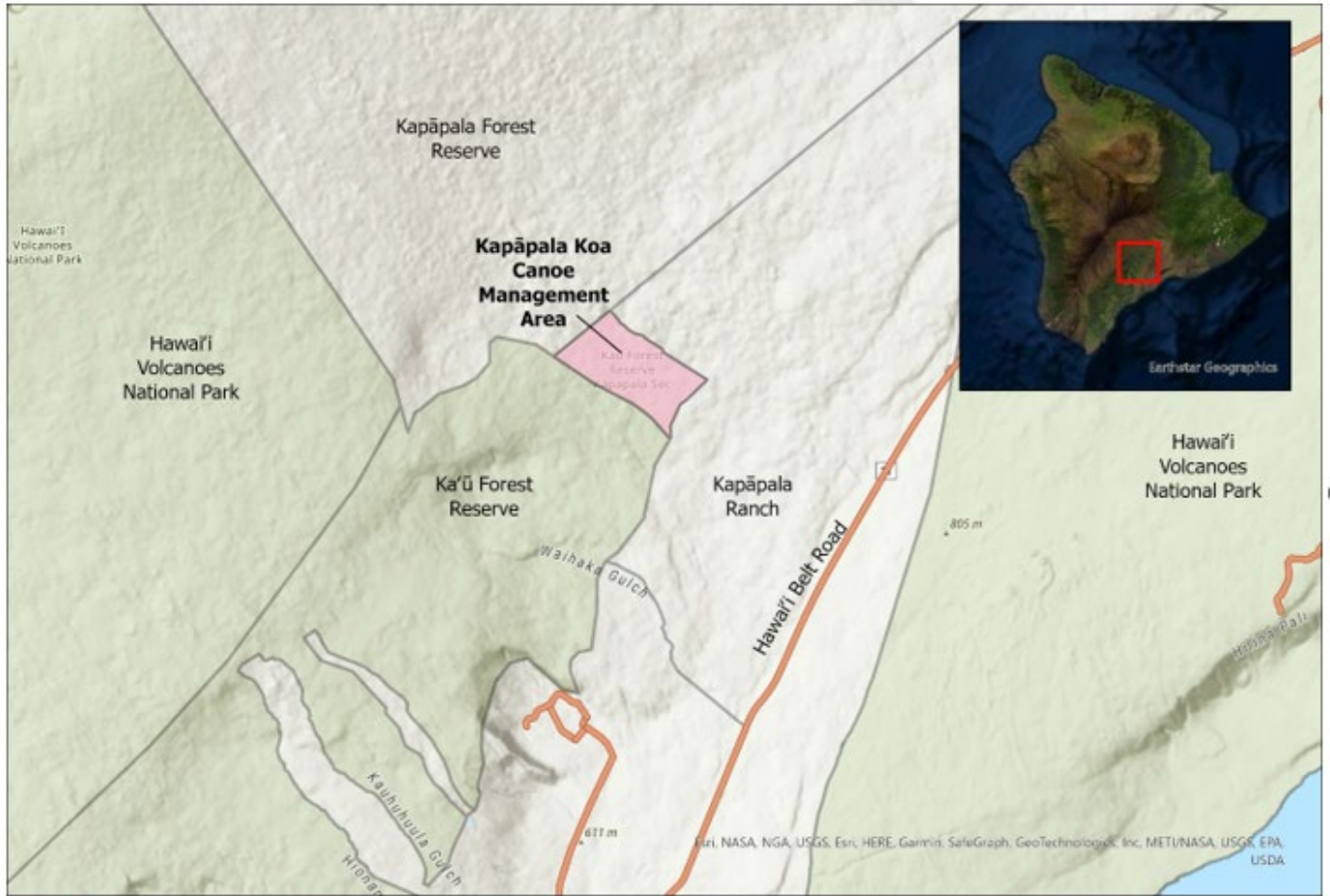
The Division of Forestry and Wildlife (DOFAW) of the Department of Land and Natural Resources (DLNR) is developing a Management Plan for the Kapāpala Koa Canoe Management Area (KKCMA). In overview, the Plan has the primary objective to provide a sustainable, long-term supply of koa (*Acacia koa*) for the traditional and cultural use of building koa canoes, while minimizing impacts on the natural and cultural resources. Other management objectives include protection of native forest, watershed resources, and bird habitat; increased regeneration and restoration of koa trees; collaboration with educational groups and community groups; access for recreational activities; and integration of traditional Hawaiian stewardship models with western conservation practices.

KKCMA consists of roughly 1,257 acres of agriculturally-zoned land within TMK 3-9-8-001:014, situated at about 3,000-5,000 feet in elevation on the southeastern slope of Mauna Loa, in the district of Ka‘ū and the ahupua‘a of Kapāpala. The area is depicted in the map in Figure 1-1, the satellite image in Figure 1-2 and the photos in Figure 1-3. Nearby major landowners or lessees include the State of Hawai‘i, the U.S. National Park Service (NPS), and Kapāpala Ranch. These lands are managed for natural and cultural resource protection and ranching. KKCMA area is covered almost entirely by a native koa and ‘ōhi‘a (*Metrosideros polymorpha*) forest and is the only State land in Hawai‘i specifically designated for koa canoe resources.

The current draft of the Plan is contained in full in Appendix 1. The Plan will be amended after consideration of public comments, and the next version of the Plan will be appended to the Final EA. Implementation of the Plan requires approval by the Board of Land and Natural Resources. The basic goals and objectives of the Plan will then be set, but management actions are meant to be updated through the dynamic process of incorporating community input and research results into resource protection and enhancement, which is called adaptive management. Ongoing refinement of the Plan will involve findings from ecosystem management and traditional ecological knowledge to improve the outcomes of management.

The Plan contains in-depth information that is summarized below to the extent required to provide a basis to evaluate impacts and develop proposed mitigation for adverse impacts. Readers interested in additional details may consult Appendix 1.

Figure 1-1 Location Map



State of Hawai'i
Department of Land and Natural Resources
Division of Forestry and Wildlife
(808) 587-0166
January 2022



Figure 1-2 Satellite Image

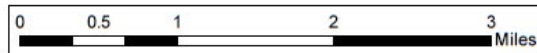
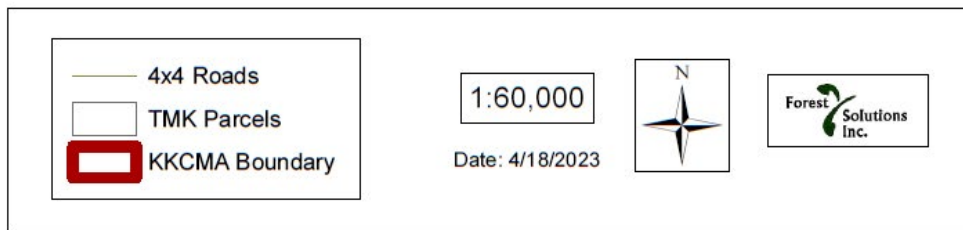


Figure 1-3 Project Area Photos



Oblique aerial of koa forest ▲
▼ Large koa tree



1.2 Project Background and Purpose and Need

Prior to European contact, the mauka regions of the ahupua‘a of Kapāpala, where KKCMA is located, were probably not heavily populated. Handy et. al (1991 p. 613) described Hawaiian communities in the moku of Ka‘ū and the history of cultivation and inhabitation. They stated that “there was never any cultivation, as far as we could learn . . . in the forests above the pali from Kapāpala to Ohaikea the bird snarers or feather hunters had their huts, but no taro was grown.” They further mention that the closest community was Hilea, a small grouping of homesteads southwest of Kapāpala.

KKCMA is located within the upper elevations of the ahupua‘a traditionally known as the wao akua and wao nahele/la‘au. These areas experienced less human activity as compared to the lower elevation wao kanaka or wao ilima, where more intensive gathering and cultivation occurred. The wao akua is typically the highest elevation forested area containing large trees and important watersheds. Entrance here was highly regulated, as people were required to be conscious of their place as kānaka, or humans, in the traditional realm of the gods. Specific protocols or offerings were often required before one could enter.

Early Western accounts of the area are few, but in 1846 Chester H. Lyman described encountering dwellings and canoe making activities in the Kapāpala area. As part of the Mahele in 1848, the entire ahupua‘a of Kapāpala was designated as crown lands under the control of King Kamehameha III. Around 1860, Frederick Lyman established a small ranch at ‘Ainapō, and in 1860 Charles Richardson and William H. Reed acquired Lyman’s ranch and greatly increased its size by leasing the entire ahupua‘a of Kapāpala from King Kamehameha IV. This expansion started their joint venture of Kapāpala Ranch.

Kapāpala Ranch became the largest working cattle ranch in Ka‘ū, producing meat, dairy, hides, and other commodities. Hunting and traditional maile gathering also took place here. Throughout its history the ranch has hosted many famous guests, such as travel writer Isabella Bird, and was a favorite spot of Queen Lili‘uokalani. Over time the ranch changed owners and its boundaries were altered, but it remained on public land either under a lease or permit. The land managed by the ranch has decreased from the original 1860 lease of the entire ahupua‘a, but the area that would become KKCMA was continuously under ranch management from 1860 until 1989. It was used for grazing and likely some timber harvest.

Starting in the late 1980s, DLNR began searching for native forests on State land appropriate for growing and harvesting koa as part of efforts to expand silviculture operations. The ample koa resources on KKCMA made it an ideal location, and on October 27, 1989, the Board of Land and Natural Resources approved the set-aside of approximately 1,257 acres “for commercial koa timber production, with consideration for recreation, forest bird habitat, and watershed values.” In the 1990s, following struggles by organizations to find koa trees suitable for the construction of voyaging canoes, the purpose of the area was further refined from broad koa management to focus on koa canoe logs.

In 2004, the 1,257-acre koa management area was officially subdivided by the County of Hawai‘i, removing it from the rest of the parcel that was still under lease by Kapāpala Ranch.

Subsequently, the Board of Land and Natural Resources approved redesignating the area as the Kapāpala Koa Canoe Management Area, and on June 27, 2005, Executive Order (EO) 4109 was issued, officially setting the area aside for the growth and production of koa trees for making traditional Hawaiian canoes. In order to ensure adequate statutes and rules to provide effective management, the BLNR on February 27, 2013 modified the management regime by incorporating the area as the Kapāpala section of the Ka‘ū State Forest Reserve (FR) in EO 4428.

In developing a harvest program for koa canoe logs, it was important to not only provide an adequate resource area, but also to ensure that harvesting koa logs for traditional canoes was conducted in a culturally appropriate manner. This is because of the deep significance of the wa‘a, or canoe, in Polynesian and Hawaiian culture. Wa‘a were the main transporter of people from one island to the next across Polynesia, and were utilized in many other aspects of life such as fishing, warfare and sport (Chun and Burningham 1995; Fornander 1878). When early Polynesian voyagers first landed on Hawai‘i, they continued to construct and utilize canoes and adapted their craft to the new environment of Hawai‘i. Koa, the second most common tree in the islands and a fast growing hardwood species, became the preferred tree used in canoe construction (Holmes 1981).

Canoe construction in Hawai‘i has traditionally been guided by the kahuna kālaiwa‘a, or master canoe carver. Kahuna kālaiwa‘a was considered the foremost of all traditional occupational trades, as they had to possess a wide range of technical skills from building to forestry to guiding ceremonies and protocols (Holmes 1981). The kālaiwa‘a was responsible for the entire process of building the wa‘a, from deciding when and how to undertake the process until the completed wa‘a was launched into the ocean. Historical accounts recounted in detail in the Cultural Impact Assessment (CIA, Appendix A of Appendix 1) detailed the process of canoe construction common in the South Kona and Ka‘ū areas:

- 1) Beginning rituals of the kahuna kālaiwa‘a
- 2) Ascent to the forest
- 3) Selecting the tree
- 4) Cutting and felling rituals
- 5) Rough hewing the canoe on site
- 6) Hauling the rough canoe to the coast
- 7) Final hewing and initial voyage rituals

The Plan presents details on the wide array of traditional and modern ways for selecting, felling and building a koa canoe. DOFAW supports organizations implementing their own traditional and cultural practices related to canoe tree selection, harvesting and construction at KKCMA, as long as the methods are safe and follow basic DOFAW guidelines for timber harvest.

In preparing the Plan for KKCMA, DOFAW has adopted the management objectives that were expressed in the Executive Orders that created the unit as the purposes of the Plan:

- Utilize the area for the growth and production of koa trees for making traditional Hawaiian canoes.

- Preserve Hawai‘i’s unique natural and cultural inheritance for future generations, by fostering knowledge and respect for Hawai‘i’s native forests in a way that inspires better care of its natural environment.
- Protect threatened tropical forest habitat and promote environmental policies and practices that address biological sustainability and human well-being, by identifying and integrating relevant traditional Hawaiian natural resource stewardship models with current Western management strategies.
- Develop natural resource stewardship models that involve a wide range of constituent groups.
- Involve youth through cooperative programs with the Department of Education, University of Hawai‘i, and other school and education institutions.
- Provide wood workers with portions of harvested trees that are not processed as canoe logs.
- Involve other constituency groups, e.g., canoe clubs, forest management entities, and cultural organizations.
- Provide compatible opportunities for public uses such as hunting and recreation.

1.3 Project Description

The current project builds on a history of research and management in KKCMA. DOFAW began managing KKCMA in 1989 and soon constructed a cattle-proof fenceline around the parcel. Even with a perimeter fence, maintaining fencing and gate closures to minimize the ingress of cattle from adjacent ranching remains a challenge. A variety of timber, flora and fauna surveys have been completed in KKCMA, including a 2000 inventory of koa and ‘ōhi‘a, partial timber surveys in 2006 and 2007, a full timber inventory in 2020 focused on koa canoe timber, and a roadside plant survey. Three Mountain Alliance (TMA) and DOFAW have collaborated annually on bird surveys in KKCMA since 2018. TMA also built a gathering platform in the northeast corner of KKCMA as part of its Youth Education Plan. In the southwest corner of the parcel, the Hawai‘i Agricultural Research Center (HARC) in collaboration with DOFAW created a seed orchard to provide koa seeds from trees screened to be resistant to koa wilt, a disease that often kills or heavily impacts koa trees. This orchard is still active.

In an effort to advance the sustainable management of KKCMA, TMA and DOFAW partnered in late 2014 to bring together key stakeholders including cultural practitioners; voyaging and racing associations, clubs, and members; canoe builders; forestry experts; conservationists; land managers; and residents of Ka‘ū. The KKCMA Working Group provides insight and guidance on the long-term stewardship of the forest and appropriate use and perpetuation of wa‘a and other forest resources in KKCMA. The first several meetings of the working group began by sharing knowledge that ultimately led to the development of a 2016 Preliminary Forest Management Plan. In 2017 and 2018, the working group supported DOFAW in drafting an application and allocation protocol for canoe logs from KKCMA. Based on feedback from the working group and the preliminary plan and allocation protocol, it was determined a forest inventory was needed, which was implemented in 2019-2020. The forest inventory provided DOFAW with the information needed to revise and finalize the forest management plan for KKCMA in consultation with the working group. The working group has met approximately one

to three times per year since its inception, for a total of ten meetings. Over the last seven years, the working group has been a source of diverse expertise and varied perspectives that are critical to the development of this Management Plan and the overall advancement of KKCMA.

DOFAW developed a set of management guidelines and maps to assist in evaluating and balancing human activities and resource management goals and objectives. The purpose of the guidelines is to provide administrative policy direction and prioritize resource management activities based on the integrity of existing natural resources and social needs in five principal classifications: Conservation Resources, Forest Products Management, Recreation Management, Vegetation Management, and Hunting Management. The reader is referred to Section 5.2 of the Plan for detailed discussion, but the summary conclusions were:

Forest Products Management: KKCMA is considered F-2, small, non-commercial scale use. Some small-scale commercial harvests will occur due to thinning operations in the area.

Conservation Resource Guidelines: KKCMA is listed as C-2, an important conservation area, as it consists of increasingly rare predominantly intact native forest. However, there are relatively few rare or endangered species and unique resources in the area that could be at risk from project activities.

Vegetation Management: KKCMA is listed as V-2, Predominantly Native Areas, which although not high quality native vegetation owing to some non-native grasses in lower areas and some invasive species along roadways, is superior to more degraded areas.

Hunting Management: KKCMA is listed as H-2, moderate hunting management, in recognition that public hunting is an encouraged and common activity in KKCMA. However, the main objective of providing a long term sustainable supply of koa timber is a higher management objective than providing continuous hunting opportunities, which is a secondary management objective.

Recreation Management: KKCMA is listed as R-3. Despite public access that allows for hiking, bird watching, hunting and forest product gathering, KKCMA is listed as low recreation management, due to its remote location and difficult accessibility.

A series of management objectives and actions that respond to the purpose and need and match the guidelines described above comprise the “action” elements of the Plan. Most of these actions could have beneficial and/or adverse effects and thus require examination in this EA. The actions listed below are brief summaries adapted from Chapter 5 of the Plan, which may be consulted for background and further details.

1.3.1 Timber Harvest

The primary goal for this area is to sustainably produce koa logs suitable for building canoes now and into the future, with suitable protection of watersheds, native ecosystems, threatened and endangered species and recreational opportunities. This will be done by using sustainable

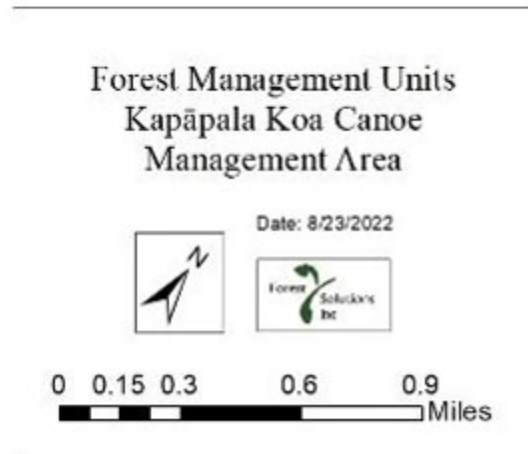
silviculture and forestry practices developed for a 100-year horizon. The Plan will be revisited at least every 10 years to integrate adaptive management strategies as needed.

The harvesting and forestry management proposed at KKCMA will follow the practice of disturbance-based or structural retention silviculture. This involves retaining various structures at the time of harvest, longer harvest rotations, and active creation of heterogeneity in the managed stand, matching conditions created by natural disturbances such as storms (Gustafsson et al. 2012).

Although the main resource targeted during harvest operations will be large koa trees capable of being made into canoes, harvest operations will avoid “high-grading”, which is the unsustainable practice of removing only large trees. Management will also include thinning or other stand improvements actions, including selective harvests of non-canoes trees. Canoe log harvests will be geographically paired with thinning and stand improvement operations to create openings for seedling recruitment. All timber management prescriptions will be guided by Hawai‘i’s Best Management Practices (BMP) policies to mitigate any potential negative impacts from forestry activities (see Appendix F of Appendix 1). These BMPs have a central focus on protection of water quality, and as such they commonly address maintenance of forest roads, timber harvesting, skid trails, reforestation, site preparation, and the protection and management of watersheds (Cristan et al. 2016).

As illustrated in Figure 1-4 and various maps in the Plan, the forest has been divided into ten tracked forest management units (FMUs). These FMUs are large enough to allow for efficient forest management operations yet small enough to be managed in a designated time frame. FMUs will be managed for a combination of 1) Restoration, 2) Forest Product Management, or 3) Resource Protection, based on their past history, current composition, koa canoe resource potential and threats. The lower elevation forests in the restoration management class contain an open ‘ōhi‘a forest with koa mostly in the sub-canopy. This area has a history of more cattle and timber harvests and is the most in need of restoration of forest structure. Suitable management activities may include pre-commercial thinning, commercial thinning, weed control, and enrichment planting of koa and/or other seedlings as needed. The mid-elevation in the forest product management class contains both open ‘ōhi‘a-koa forest and closed koa-‘ōhi‘a forest and has koa trees of all diameter classes. This appears to be the best area for promoting the growth of canoe logs, as there is a higher concentration of canoe trees in this area. Management activities may include pre-commercial thinning, commercial thinning, and forest stand improvements. The upper elevation forest contains remnant native, intact forest with mature koa trees. This area is critical to native bird populations, potential threatened and endangered (T&E) species habitat, and overall watershed functions. Many of the koa trees are large, mature, sprawling trees that would not be suitable for canoes, though they contain a large volume of wood. This area has high conservation value and management will mostly include forest protection and forest stand improvements, with limited harvesting to target specific resources. However, canoe tree harvest of desired resources will occur as needed in the area.

Figure 1-4 Forest Management Units Categorized by Management Class



The forest has also been classified into Priority Zones according to proximity to roadways in order to concentrate the harvest impact to specific areas at different times. Priority Zone 1 is located within 200 feet from roads, and canoe tree resources have already been identified to help

facilitate initial harvest activities. Priority Zone 2 is within 400 yards from roads, and Priority Zone 3 is the interior units that are more than 400 yards from the road. Both canoe tree harvests and stand improvement activities are planned to begin in the Priority Zone 1 in the first 10 years of the plan, then move into Priority Zone 2 management units, followed by Priority Zone 3 management units. However, Priority Zones are not restrictive and harvest activities can occur outside of the given Priority Zone as needed to allow for adaptive management. Priority 1 Zones have already been subject to an inventory of all living koa trees over 20 inches in diameter (see Plan for details). Within this zone alone there is a promising resource of 64 canoe trees and 123 potential/partial canoe trees. Additionally, 193 young canoe trees and 230 young potential/partial canoe trees will likely reach canoe size in 10-20 years. Only living trees were catalogued, although canoe builders have indicated that dead and downed trees can also be utilized.

Harvesting canoe trees will require site infrastructure including skid trails, which are narrow, temporary roads installed for infrequent access to conduct management activities such as the harvest of forest products. At KKCMA, skid trails will be used to extract logs from the forest and bring them to the main access roads. The objective of these trails is to allow suitable access while minimizing damage to the forest ecosystem, which can be accomplished by implementing the Best Management Practices specified in the Plan. Skid trail construction will include water bars for drainage and post-harvest cleanup and restoration activities.

1.3.2 Pre-Harvest Actions

DOFAW will take care to ensure that silviculture activities, such as skid road construction, timber harvest, and stand improvement operation, occur in such a way that the least amount of ecological damage occurs. Mitigation and avoidance of impacts to resources may include spatially and temporally avoiding sensitive and/or listed species, pre-harvest surveys of the areas, and ensuring staff are knowledgeable of sensitive natural and cultural resources and follow protocols to avoid unnecessary impacts. Specific potential impacts and mitigation measures are discussed in Chapter 3.

1.3.3 Harvest Volume Restrictions & Harvest Rotations

In order to ensure sustainable harvest levels and maintain other goals such as watershed protection and native ecosystem protections, harvest amount restrictions within KKCMA will be put in place. No more than 500,000 board feet, or approximately 10% of the 5.5 million board feet of koa estimated within KKCMA, will be removed from the forest within a 10-year period. The volume restriction includes all harvest and thinning operations, including harvesting of canoe trees and additional silvicultural activities.

Koa growth studies have found an average annual growth rate of 0.41 inches of growth per year, indicating that the average diameter in a 100-year-old stand of koa trees would be 41 inches (Baker et al. 2009). Therefore, DOFAW estimates that a typical racing canoe size log is attainable at or before a koa tree becomes 100 years of age by employing a healthy thinning regime. The harvest rotation is the planned number of years between the time a stand regenerates and its final cutting at a specific stage of maturity. The harvest rotation for a canoe tree is 100 years, meaning after a canoe tree is removed and an opening is created for a seedling to grow,

that seedling will be a canoe quality tree in 100 years. If 1% of the forest area is harvested each year, then the first 1% will be ready to harvest again after 100 years. This concept is scaled up to 10% of the forest area every 10 years, to account for variability in management intensity from year to year.

The expected harvest level would be approximately 5 to 15 canoe logs per year. It is likely that koa canoe trees will be in high demand initially, and then decrease significantly with each subsequent year. On average, a canoe tree is estimated to be between 3,000 and 5,000 bf, and therefore the harvest limit is more than enough to meet the needs of all the eligible organizations and sustain harvest activities to support the management of the forest. According to recent inventories and surveys, stand development theory, and anticipated stand improvement actions, a maximum volume of 500,000 board feet every 10 years is predicted to be a sustainable number that will not negatively impact the koa canoe resource and associated forest ecosystems. After each 10-year period, the plan shall be reviewed to ensure the harvest limit restrictions remain sustainable.

1.3.4 Canoe Tree Application Process

Organizations within the State of Hawai‘i may submit an application for the opportunity to harvest a koa tree or trees from KKCMA for the purpose of creating a koa canoe for cultural and traditional uses, such as racing canoes, voyaging canoes, and fishing canoes, among others. Details on the application, scoring and ranking system for applicants and the allocation process will be outlined in a separate submittal that will be brought before the Board of Land and Natural Resources (BLNR) for approval. However, the general application process and award of a canoe log from KKCMA will be as follows:

- 1) Organizations will submit an application for a canoe log from KKCMA.
 - a) Organizations must be able to demonstrate their financial capacity and means of processing the log into a canoe, demonstrate they have an experienced builder available with the capacity to utilize the log, and have a harvest plan approved by DOFAW.
 - b) Organizations must have a stewardship plan outlining forest conservation or land stewardship activities.
 - c) This is a separate application than any other requests for timber from DOFAW, such as the salvage timber waiting list.
- 2) Applications will be reviewed by a selected group of experts that will provide recommendations to DLNR/DOFAW to make final decisions and issue a special use collection permit to allow for harvest.
 - a) Applicant reviewers will consist of cultural practitioners; voyaging and racing associations, clubs, and members; wa‘a (canoe) builders; forestry experts; conservationists; land managers; and community members of Ka‘ū and Hawai‘i Island.
- 3) DOFAW will identify specific trees that are available for harvest according to the Plan. The number of trees and volume of koa harvested annually will depend on the number of qualified applicants, in accordance with the 10-year harvest volume restriction of 10% of the total volume of the area.

- 4) The organizations that are selected will be able to select the appropriate tree for harvest, and they will be provided a timeline of when they are allowed to perform the harvest. In order to reduce costs, the organizations are encouraged to collaborate with one another and/or work in conjunction with DOFAW's other management activities to determine a date for the harvest.
- 5) All harvest operations will be conducted according to the State's Best Management Practices (Appendix F of the Plan).

1.3.5 Canoe Tree Extraction Operations

The operations and costs associated with harvesting and extracting canoe logs will be the responsibility of the organization awarded a DOFAW Special Use Permit for canoe tree harvest. This allows organizations the flexibility to select the protocols and methods appropriate for their traditional and cultural use of harvesting canoe logs, and to allow for different organizations to have different processes for harvest.

Harvesting whole logs destined to become canoes requires different operational activities than harvesting short saw logs for parts or sale. The standard method is to use chainsaws or bulldozers to fell trees and heavy machinery to extract them. Pushing over a tree with a bulldozer can help slow its descent to the earth and thus protect the wood. Once a tree is felled, it is extracted via skid trails to a main access road where it can be loaded onto a highway truck. The extraction can potentially be damaging to the tree and should be supervised by an experienced forest manager to help preserve the condition of the log. Specialized heavy machinery may be needed to safely move these large logs without damaging them. Skid trails will be surveyed and marked ahead of time to avoid sensitive habitat such as mature 'ōhi'a trees. Typically, scarification of the soil by machinery on skid trails can be beneficial in that it activates koa seeds and stimulate regeneration of koa seedlings. It may also be feasible in some cases to extract timber using a helicopter.

The labor costs associated with harvesting include hiring an experienced cutter, ground man, and machine operator, will be the responsibility of the applicant for the canoe log. DOFAW will not be responsible for harvesting and delivering the logs to the applicant. Machine rentals may include an excavator, a forwarder, and/or a bulldozer. These machines need to be transported to and from the forest, which adds additional costs to the operation. Finally, the log is transported on the highway in an oversized load transportation vehicle, which requires a permit from the Department of Transportation that includes various requirements. The log may ultimately be shipped off the island to another location. The budget is estimated between \$6,000 and \$20,000, though it is highly variable and subject to change according to harvest operations and the destination of the log. As many organizations are not experienced foresters and timber harvesters, an existing advisory group, consisting partly of experienced foresters, as well as DOFAW staff, may be able to provide guidance and connections to capable extraction operators and best practices.

If and when possible, it will be cost-efficient and will reduce impacts on infrastructure and on the forest if operations between organizations or with DOFAW can be combined or done in quick succession with each other. All harvest and thinning operations must follow Hawaii Timber Best

Management Practices (Appendix F of Appendix 1) and any other guidelines included in the Special Use Permit for canoe log extraction, and will be done to minimize impacts on the forest.

1.3.6 Thinning & Stand Improvement Operations

Thinning is a stand improvement action designed to preserve a balance of tree sizes and genetic diversity in the forest by removing smaller and less well-formed trees. By removing sub-standard trees, thinning promotes a superior stock for future growth. The result is a balanced stand containing both large and small trees, which prevents the negative impacts of high grading (only harvesting the biggest and best trees). Thinning in KKCMA will target koa trees, as they are the most common and fastest growing native tree in the area. 'Ōhi'a and other natives will usually not be targets for thinning operations unless considered hazard trees. Thinning will favor a selection of dominant koa trees to grow into canoe quality trees quicker and at a higher frequency.

Details and diagrammatic illustrations of thinning and stand improvement are contained in Section 5.3.6 of the Plan. In summary, pre-commercial thinning is performed prior to trees reaching merchantable size, when small trees are cut and typically left in the forest, allowing the remaining trees to grow quicker due to less competition. The goal of all thinning operations is stand improvement, not resource extraction, but in order to avoid waste, wood from pre-commercial thinning may be collected and made available to woodworkers and community members through collection permits. Commercial thinning involves removing damaged or poor form trees that are of merchantable size and will provide growing space for future koa canoe trees. Commercially thinned trees may be sold for revenue to be used in the continued management of the forest. Additionally, both types of thinning could potentially provide material for canoe parts or other woodworking opportunities. Managers at KKCMA will continue to draw on the latest koa forestry research, combined with on-the-ground stand assessments, to develop and adapt a suitable thinning regime.

1.3.7 Non-Harvest Management Objectives

Several management objectives are not directly related to the harvest of koa canoe logs. These are described in detail in Section 5.4 of the Plan and are briefly summarized here:

- *Ungulate Control.* The control of ungulate populations, especially grazing cattle, is a high priority for KKCMA in order to minimize the primary threat to forest recovery. The entirety of KKCMA is fenced, but small, feral herds can occasionally emerge after fence damage or opened gates. Scheduled fence checks and game camera monitoring are currently ongoing and will continue in order to ensure cattle do not become established. If any cattle are found they will quickly be removed. Other planned measures include installation of cattle guards. Although sheep, mouflon, and goats are not currently found in KKCMA, monitoring will be done to ensure they do not enter the area and detrimentally browse native vegetation. Pig populations have the potential to grow and severely damage area cultural resources. Currently, KKCMA is open to public hunting, which provides some control on pig populations. In addition, staff will provide additional pig control either through trapping, staff hunting, or adding skirting to fence lines to

protect forest resources. DOFAW may adopt the goal of making the area 100% ungulate free, depending on periodic assessments of the forest health and the effects of ungulates on the koa resources for canoe construction.

- *Increased Koa Regeneration Activities.* The 2020 timber inventory showed very low natural recruitment of koa seedlings, partially from cattle browsing. Along with more intensive cattle control, other management actions that will be implemented to increase koa recruitment include scarification of seed coats during silviculture ground activities, enrichment planting from improved seed sources and seedling propagation, and site preparation and competition control in special circumstances such as grass patches or post-wildfire.
- *Invasive Plant Control.* Invasive weed populations are minimal throughout the forest. Ongoing weed management actions include eradication of palm grass (*Setaria palmifolia*) and monitoring for Early Detection and Rapid Response (EDRR) target species. Management activities and increased public access have the potential to increase weed populations. Integral to the project are practices to mitigate this on an ongoing basis. Informational signage and boot brushes at the forest entrance will encourage cleaning of gear. The ROD prevention protocol described in detail in the Plan will protect against ROD and also help prevent weed seedlings and propagules from entering the area. Built-in post-harvest monitoring after stand improvement actions will help detect and quickly control new weed populations. When needed, additional invasive weed management will be conducted via manual, limited chemical and biocontrol means to achieve the desired control of the target weed species.
- *Wildfire Management.* Management for wildfire prevention will involve maintaining the perimeter road and the interior crossroad as fuelbreaks by clearing the roads of vegetation or fallen trees. Drought and fire activity in surrounding areas will be monitored to determine the level of wildfire risk at KKCMA. Depending on fire risk, access to the area may be temporarily restricted. The existing helicopter landing zone (LZ) will be improved and maintained to prepare for wildfire response. Finally, water access will be secured to prepare for the control of a wildfire.
- *Access and Public Use.* Ongoing road maintenance and road improvements such as contouring and pothole filling will facilitate safe public access to the forest. Roadways can be utilized for hiking and bird watching opportunities, as well as access for hunting and forest collection. Hunting will be monitored and managed according to the Hawaii Administrative Rules Chapters 122-123. DOFAW requests all hunter takes be reported to contribute to monitoring efforts. Various non-timber products can be collected in the forest with the proper collection permit. When possible, non-commercial timber resources from silvicultural activities in the area will be made available to the public for woodworking, focused on traditional and cultural uses. Furthermore, DOFAW will be collaborating with cultural and educational groups to integrate traditional and cultural practices and work jointly on KKCMA management.
- *Forest Monitoring and Research.* Forest monitoring is critical to determine the success of management activities and to facilitate adaptive management at KKCMA. DOFAW staff will conduct regular fence checks and monitoring for ungulates and invasive species. Periodic inventories, regeneration plots, photo points near harvest areas, and permanent

sample plots will track the long-term growth and recovery of trees in the area. All monitoring activities will include forest health assessments of priority insects and diseases. The plots and photo points will provide both quantitative and qualitative data tracking forest development over time. This forest provides an excellent opportunity for the research community to collect continuous data to create various predictive biometric equations for use in koa forest management. Additionally, DOFAW will continue to collaborate with the Hawai'i Agriculture Research Center (HARC) on koa research by maintaining the existing seed orchard and research plot within KKCMA. For the protection of T&E bird species, DOFAW will continue to collaborate with Three Mountain Alliance in annual forest bird monitoring.

1.3.8 Cost and Schedule

Many elements of the Plan can be accomplished using existing DOFAW staff and equipment, as detailed in Table 12 of Appendix 1, reducing the overall costs of implementation. One-time costs for infrastructure (primarily fence and road construction and repair) are estimated at between \$1.5 and 2.5 million. Yearly costs for stand improvement, forest inventory, resource protection and infrastructure maintenance are currently estimated at between \$100,000 and \$130,000. This excludes the current salary and fringe costs of state employees that work to manage KKCMA. These cost estimates will be refined as the project is further developed. Some non-canoe quality timber resources may be sold to help fund the management of KKCMA. Completion of planning and permitting process is expected in late 2023 or early 2024; pre-harvest surveys should be accomplished within one year of that date; infrastructure improvement, stand improvement activities, and the first harvests should be ready to take place in 2025 or soon after.

1.4 Environmental Assessment Process

Basis for Environmental Assessment

This Environmental Assessment (EA) was prepared in accordance with Chapter 343 of the Hawai'i Revised Statutes (HRS) by the Division of Forestry and Wildlife of the Hawai'i Department of Land and Natural Resources, the proposing and approving agency. Chapter 343, HRS, along with its implementing regulations, Title 11, Chapter 200.1, of the Hawai'i Administrative Rules (HAR), is the basis for the environmental impact assessment process in the State of Hawai'i. An EA is prepared to determine impacts associated with an action, to develop mitigation measures for adverse impacts, and to determine whether any of the impacts are significant according to thirteen specific criteria. Part 4 of this document states the finding (anticipated in the Draft EA) that no significant impacts are expected to occur, and Part 5 lists each criterion and presents the findings by the approving agency. If the approving agency finds after considering comments to the Draft EA that no significant impacts would be expected to occur, then it issues a Finding of No Significant Impact (FONSI), and the action will be permitted to occur. If the agency concludes that significant impacts are expected to occur as a result of the proposed action, then it determines that an Environmental Impact Statement (EIS) must be prepared for the action to proceed.

Implementation of the Plan will require approval by the Board of Land and Natural Resources as well as periodic Chapter 6e, HRS approvals related to protection of historic sites.

1.5 Public Involvement and Agency Coordination

As discussed in Section 1.3, TMA and DOFAW partnered in late 2014 to bring together key stakeholders including cultural practitioners; voyaging and racing associations, clubs, and members; canoe builders; forestry experts; conservationists; land managers; and residents of Ka'ū. The KKCMA Working Group provides insight and guidance on the long-term stewardship of the forest and appropriate use and perpetuation of koa canoe logs and other forest resources. The first several meetings of the working group began by sharing knowledge that ultimately led to the development of a 2016 Preliminary Forest Management Plan. The working group has met approximately one to three times per year since its inception, for a total of ten meetings.

In addition, the project team held outreach with general community members through an informational event held at the Ka'ū Gym on the morning of April 1, 2023. The event was advertised via newsletter and social media promotion as well as in person at the Naalehu market two weeks before. Over 25 people attended in person and one joined via Zoom. Participants included members of various canoe clubs, Ka'ū community members, and other organizations such as the Hawai'i Science and Tech Museum. There were three tables and large posters featuring information on forest conditions, koa and wa'a and process and timeline. The response was positive and appreciative, with interest in applying for koa canoe log permits. Some members shared concern about down trees going to waste while local woodworkers would like access to that material. A few groups expressed interest in developing an educational program around canoe carving and the forestry associated with log selection, as well as field trips.

Public outreach was also conducted through formal early consultation letters to the following:

County Agencies and Officials:

- Department of Parks and Recreation
- Department of Public Works
- Planning Department
- Police Department
- Fire Department
- Game Management Advisory Commission

State Agencies and Officials:

- University of Hawai'i, College of Tropical Agriculture and Human Resources
- Office of Hawaiian Affairs
- Department of Health
- State Senator Dru Kanuha
- County Council Member Michelle Galimba
- Department of Transportation
- Mayor Mitchell Roth
- State Representative Jeanne Kapela

Federal Agencies and Officials:

- Hawai'i Volcanoes (HAVO) National Park

- U.S. Fish and Wildlife Service
- U.S. Natural Resources Conservation Service

Individuals and Organizations:

- | | |
|---------------------------------------|---------------------------------------|
| • Kapapala Ranch | Big Island Invasive Species Committee |
| • Three Mountain Alliance | The Nature Conservancy |
| • Edmund C. Olson Trust | Polynesian Voyaging Society |
| • Friends of Hōkūle‘a and Hawai‘i Loa | Sierra Club |
| • Na Kalai Wa‘a | Kamehameha Schools |

Copies of written communications received in response to early consultation efforts are included in Appendix 2a. Notice of the Draft EA was published in the May 8, 2023 edition of *The Environmental Notice*. Appendix 2 contain a section with the one written comments on the Draft EA and DLNR response to it. Additional/modified text related to EA review is denoted by double underlines.

PART 2: ALTERNATIVES

2.1 No Action Alternative

Under the No Action Alternative, the suite of actions described in the KKCMA Plan would not be undertaken. General management would continue under the status quo, and a variety of new, minor actions might also be undertaken on a piecemeal basis. This EA considers the No Action Alternative as the baseline by which to compare environmental effects from the project.

2.3 Alternatives Evaluated and Dismissed from Further Consideration

As part of conceptualizing the action alternative described and evaluated in detail in this EA, DOFAW also evaluated potential alternative actions that could satisfy the purpose and need of the project. As the purpose is to provide koa canoe logs, all such alternatives would involve land that either currently supports koa forests or on which koa could be grown. In order to avoid high land costs that would make the project too expensive to implement, the land needed to belong to the State or be donated by a private or other government agency. Furthermore, to conform most closely with the purpose of the State Land Use Law and Conservation District rules, DOFAW sought land within the Agricultural District. Only a few parcels around the State meet all these requirements, and nearly the only one with mature koa trees capable of harvest within the next 10 years was the current site. This is the precise reason the parcel was initially designated for koa forestry and later dedicated as the Kapapala Koa Canoe Management Area. Another State property on Mauna Kea at Keanakolu was also initially considered but determined to be too environmentally sensitive and also less suitable for the level of production required to satisfy the demand for traditional canoes. In DOFAW’s view, there are no other State-owned properties in Hawai‘i that are nearly as suitable for the proposed use and would not involve substantially greater environmental concerns. For this reason, no other alternative sites or strategies have been advanced for detailed consideration in this EA.

PART 3: ENVIRONMENTAL SETTING, IMPACTS AND MITIGATION MEASURES

Unless otherwise noted, the impact discussion for a resource only relates to the proposed project alternative, because the No Action Alternative has no effects on that resource.

3.1 Biological Resources

The discussion of biological resources below is divided for convenience into sections on Vegetation and Flora, although it is recognized that these resources are part of an integrated ecosystem whole. A related section on the special topic of Wildfire, Pests and Disease follows.

Included in these sections are discussions of threatened and endangered species. Federal and State of Hawai'i endangered species laws require government agencies to ensure that their actions are not likely to jeopardize the continued existence of federal or State listed threatened endangered species (16 U.S.C. §1536(a)(2) and (4); Chapter 195D, HRS). The U.S. Endangered Species Act defines Critical Habitat as areas that may or may not be occupied by a threatened or endangered species, but are essential to the conservation of the species. These areas may require special management considerations or protection (16 U.S.C. §1532 (5)). Federal and State agencies also have an interest in protecting rare species that do not yet have legal protection under the Endangered Species Act.

Biological resources are treated in greater detail in the Plan; readers interested in additional information are referred to Appendix 1.

3.1.1 Vegetation and Flora

Existing Environment

The vegetation at KKCMA is classified as Montane Wet Forest (Wagner et al 1990). Based on field observations and data collected during forest inventories, the parcel can be further classified into four strata (Figures 3-1 and 3-2), largely based on vegetation cover:

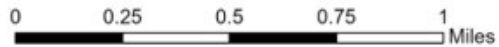
- K01: Open 'Ōhi'a Forest (324 acres)
- K02: Open Koa-'Ōhi'a Forest (386 acres)
- K03: Closed Koa-'Ōhi'a Forest (323 acres)
- K04: Mature Koa Forest (207 acres)

The forest canopy in K01 is characterized as an even-aged stand of 'ōhi'a. Koa are present but generally as a subcanopy species. The forest canopy of K02, K03 & K04 is mixed with both koa and 'ōhi'a. Trees are generally larger and the canopy becomes more closed with increasing elevation. K04 has the largest, most mature koa trees and is overall the most intact native forest in KKCMA. Common subcanopy species in all strata include pilo (*Coprosma rhynchocarpa*), kōlea (*Myrsine lessertiana*), kawa'u (*Ilex anomala*), kōpiko (*Psychotria hawaiiensis*), naio (*Myoporum sandwicense*), and ōlapa (*Cheirodendron trigynum*).

Figure 3-1 Forest Strata



State of Hawai'i
Department of Land and Natural Resources
Division of Forestry and Wildlife
(808) 587-0166
January 2022



The ground cover in the lower elevation strata, including all of K01 and the lower parts of K02, is less intact. It is dominated by non-native grass species such as kikuyu (*Cenchrus clandestinus*), meadow-rice grass (*Ehrharta stipoides*), and various fern species. This extends into K02, a few hundred yards mauka of the crossroad. Above this, in upper K02, K03, and K04 the percent cover of non-native grass in the understory decreases, and species like Hawai'i sedge (*Carex alligata*), i'ō nui (*Dryopteris wallichiana*), ma'ohi'ohi (*Stenogyne microphylla*), hairgrass (*Deschampsia nubigena*) and 'ala'ala wai nui (*Peperomia* sp.) can be found. Common shrubs and ground cover in all strata include 'ōhelo (*Vaccinium* sp.), uluhe (*Dicranopteris linearis*), and abundant maile (*Alyxia stellata*). Native shrub and fern species that are found primarily in K03 and K04 include kanawao (*Hydrangea arguta*), pāpala (*Charpentiera obovata*), 'ākala (*Rubus hawaiiensis*), and hapu'u (*Cibotium* sp.). A working plant list of KKCMA is found in Appendix C of Appendix 1.

Figure 3-2 Forest Understory Types



3-2a) Higher elevation areas have more intact native understory ▲

▼ 3-2b). Lower elevation areas are more likely to have non-native grass in understory



The thick sward of alien grasses, lack of native understory and remains of old cattle fence lines in K01 and lower K02 all suggest that the lower forests have been heavily impacted in the past, either by grazing, logging, fire, or a combination of the three. Further, in the 2020 inventory K02, K03, and K04 were found to have about double the species richness of K01. Overall, the parcel is considered to contain relatively intact native ecosystems with minimal pressure from invasive plant species, with the exception of non-native grasses present at lower elevations.

Currently no rare or T&E plant species are known to occur within KKCMA. A comprehensive vegetation roadside survey of the parcel was completed in 2020 and found no T&E plant species. One individual of *Rubus macraei*, which although not listed is considered rare, was found growing in an old rare plant enclosure just outside of KKCMA in Ka'ū FR. *R. macraei* is known from approximately 3,000-5,000 individuals and is relatively common in the supalpine slopes of Mauna Loa. A wild population of *Phyllostegia velutina*, an endangered native Hawaiian mint with roughly 30 individuals left in the wild, is known to exist about two miles from KKCMA.

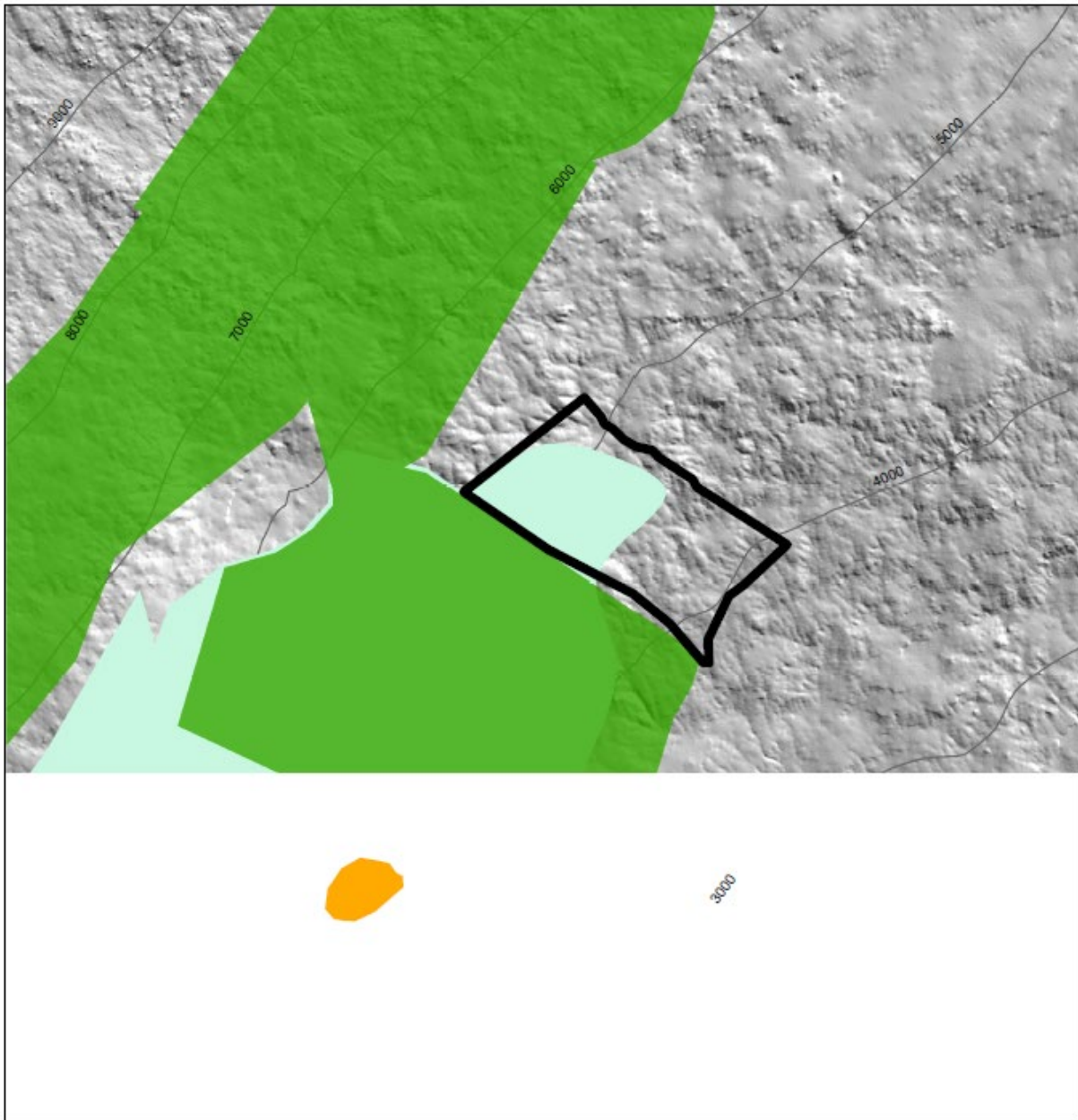
No designated or proposed plant Critical Habitat as defined by the U.S. Endangered Species Act – areas that may or may not be occupied by a threatened or endangered species, but are essential to the conservation of the species – is present within KKCMA (Figure 3-3). However, various units within adjacent areas in the Ka'ū and Kapapala Forest Reserves as well as Hawaii Volcanoes National Park contain Critical Habitat for various plants. These include Mauna Loa silversword (*Argyroxiphium kauense*), alani (*Melicope zahlbruckneri*), *Asplenium peruvianum* var. *insulare*, and kuahiwi laukahi (*Plantago hawaiiensis*). The proposed management actions within KKCMA will not adversely affect these units.






Impacts and Mitigation Measures: Action Alternatives



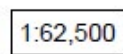
Many elements of the Plan have at least some potential for some adverse effects to native vegetation and flora, even if the Plan is overall beneficial. These elements include timber harvest, thinning and stand improvement, ungulate control, invasive plant control, road and fuelbreak maintenance, access and public use, and forest monitoring and research. As noted by the Big Island Invasive Species Committee in their April 23, 2023 comment in response to early consultation (see Appendix 2), biosecurity measures are vital to reduce the risk of introducing weed spread and ROD. Integral to the Plan are precautions to ensure that silviculture activities, such as skid road construction, timber harvest, and stand improvement operation, occur in such a way that the least amount of ecological damage occurs. Harvest restrictions will limit the amount of disturbance to the ground surface and forest structure. DOFAW's experience working with native vegetation and rare plants around the State indicates that any adverse effects from most of the above will be limited and non-significant with the implementation of mitigation. These measures will be built into all management activities and include the following:

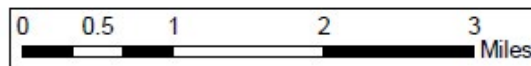
- Prior to activities with the potential to impact rare or T&E plants, botanists will conduct surveys to check all affected areas and identify and map any such species.
- Should any sensitive plants be found, buffers of at least 50 feet in radius will be instituted, and greater if warranted to keep the population safe, and the area will be

Figure 3-3. Critical Habitat Map



	KKCMA Boundary
	Picture-wing fly Critical Habitat
	Plant Critical Habitat
	l'iwi Proposed Critical Habitat
	1,000 ft. Contour Lines

KKCMA Critical Habitat		
		Date: 4/17/2023
		



flagged. Within the buffer, no harvest, tree fall or skid roads will be allowed. Agencies will be advised of and consulted for further mitigation steps. Facilities will be built and roads and trails will be routed in non-sensitive areas or in ways that protect rare plants.

- Weed control will be conducted in a manner to avoid impacts to non-target species.
- DOFAW staff, volunteers and contractors will be required to follow protocols for cleaning of boots, equipment and vehicles in order to avoid introducing or spreading invasive plant species that may compete with native plants and degrade wildlife habitat. In addition, kiosks for education and action will be provided for members of the public accessing the area.
- Follow-up monitoring of harvest areas will be conducted to track the presence and potential establishment of invasive weed populations.

3.1.2 Native Wildlife

Existing Environment

KKCMA contains a variety of wildlife including endemic species of birds and invertebrates and the ‘ōpe‘ape‘a, or the Hawaiian hoary bat (*Lasiurus cinereus semotus*). Non-native species include birds, mammals and invertebrates. The following is a discussion of the faunal resources by group:

Birds

The native tree canopy and fruit bearing understory plants in KKCMA provide excellent habitat for native birds. Bird surveys have been conducted annually since 2018 by the Three Mountain Alliance (TMA) and DOFAW. Fifteen bird species have been detected, eight of which are native (see Table 8 of the Plan for details). ‘Apapane, followed by Hawai‘i amakihi and ‘ōma‘o, are the most abundant native birds in KKCMA. Native birds are present throughout the entire area, with decreasing abundance at lower elevations.

Populations of native Hawaiian forest birds have declined across the State due to habitat loss and the ecological impacts of introduced species. Of the 46 historically known forest bird species in Hawai‘i, only 24 species still survive, and of these, 13 species are listed as endangered. The native birds detected in KKCMA include one listed threatened species, i‘iwi (*Drepanis coccinea*), and three endangered species, ‘akiapola‘au (*Hemiganthus wilsoni*), Hawai‘i creeper/‘alawī (*Loxops mana*), and the ‘io/Hawaiian hawk (*Buteo solitarius*). The ‘io is no longer a federally listed species but is still listed as endangered by the State of Hawai‘i. Ten species of endemic Hawaiian birds have likely gone extinct over the past 25 years – an average of one extinction every two years (Pratt et al 2009). Consideration of the conservation of native birds and bird habitat is thus critical for any activity occurring in native forests.

The Plan contains detailed information on the distribution of T&E species from the surveys conducted from 2018-2021 (see Figures 16-18 and Table 8 of Appendix 1). In summary, i‘iwi were consistently detected and heavily associated with higher elevation areas. This is not surprising given that they are highly sensitive to avian malaria, a disease spread by mosquitoes at lower elevations. The three endangered bird species were all detected in very low numbers. The

‘akiapola‘au was detected only once, in the highest elevational transect of the parcel. The ‘alawī was detected four total times, all in the northwest section of strata K03 & K04.

No designated bird Critical Habitat as defined by the U.S. Endangered Species Act is present within or directly adjacent to KKCMA (Figure 3-3). However, there is a proposed unit for i‘iwi that comprises approximately 275,647 acres of federal, State, and private lands, including large areas of the Ka‘ū and Kapapala Forest Reserves as well as Hawaii Volcanoes National Park, and also includes the mauka portion of KKCMA (USFWS 2022). If Critical Habitat is designated for i‘iwi in the area, it would not at this point appear to directly affect management for koa canoe logs. As the proposed listing states:

Critical habitat designation generally will not affect activities that do not have any Federal involvement; under the Act, designation of critical habitat only affects activities conducted, funded, permitted, or authorized by Federal agencies (USFWS 2022: 79954).

If finalized, the critical habitat designation may affect the ability of management actions to receive federal funding, as federal agencies would be required to consult with the USFWS under Section 7 of the Endangered Species Act on activities they fund, permit, or implement that may affect the species. Consultations include an evaluation of measures to avoid the destruction or adverse modification of critical habitat, which may for practical purposes preclude or greatly increase the cost of harvest and stand improvement actions.

‘Io occurs throughout the island of Hawai‘i from sea level to 8,530 feet in elevation. ‘Io are known to use a variety of habitats, and the mix of forested areas and small gaps in KKCMA is ideal for feeding and roosting. ‘Io were observed most frequently in K02, potentially because of the opening in the canopy created by the road. These hawks nest in tall trees within their large territories from early March through the end of September. There is a high probability that hawks could nest on or near KKCMA. Grading, tree harvest and some forest maintenance activities could disturb nesting. Mitigation measures are necessary to avoid impacts or minimize them to negligible levels.

In addition to birds that have been observed in KKCMA in systematic surveys, other species that have not been detected, including the threatened nēnē or Hawaiian goose (*Branta sandvicensis*), the endangered ‘ua‘u or Hawaiian petrel (*Pterodroma sandwichensis*) and ‘akē‘akē or band-rumped storm-petrel (*Oceanodroma castro*), the endemic pueo or short-eared owl (*Asio flammeus sandwichensis*), and the indigenous kōlea or pacific golden-plover (*Pluvialis fulva*), may use small portions of the area; the importance of KKCMA to these species is low or unknown.

Hawaiian Hoary Bat

The ‘ōpe‘ape‘a or the Hawaiian hoary bat (*Lasiurus cinereus semotus*) is the only native terrestrial mammal in Hawai‘i. The ‘ōpe‘ape‘a is listed as endangered under the U.S. Endangered Species Act. Hawaiian hoary bats have not been detected in KKCMA but they are probably present. The thick ‘ōhi‘a canopy interspersed with open grassy areas and nearby pasture offers ideal habitat for bats, which can use a variety of land cover types. They have been found to

utilize corridors such as hiking trails and roads for hunting and flying through dense forest (Bonaccorso et al. 2015). Hawaiian hoary bats are solitary and roost in both native and non-native tree species with a broad height range (Gorresen et al. 2013). They are vulnerable to disturbance during the summer pupping season, when female bats carrying pups may be unable to rapidly vacate a roost site when the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage, and pups may be unable to flee a tree that is being felled. There is special concern for tree harvest and forest improvement operations that remove multiple trees, as this increases the likelihood of removing one that potentially has a day-roosting bat. Hawaiian hoary bats thus require special mitigation measures.

Invertebrates

Invertebrates in Ka‘ū, and indeed throughout the Hawaiian Islands, have not been fully surveyed. New species are constantly being discovered and distributional information of known species is continually being updated. Adjacent areas of the KFR that support nearly undisturbed native forest are known to contain various species within the Hawaiian picture-wing fly group in the genus *Drosophila*. It consists of 106 known species, most of which are relatively large and have elaborate markings on their wings. The picture-wings have been referred to as the “birds of paradise” of the insect world because of their relatively large size, colorful wing patterns, elaborate courtship displays and territorial defense behaviors. Each species is found only on a single island, and the larvae of each are dependent upon only a single or a few related species of native host plants. The Ka‘ū FR contains 245 acres of designated critical habitat in two separate areas for one endangered species of picture wing fly (*Drosophila heteroneura*), neither of which are inside KKCMA (USFWS 2008) (see Figure 3-3). Habitat for this species is in wet, montane, ‘ōhi‘a and ‘ōhi‘a-koa forest, and larval stage host plants include ‘ōlapa and *Clermontia* sp. (USFWS 2006b). The composition of the forest and the history of grazing disturbance reduces but does not eliminate the possibility of picture-wings habitat. A recent reconnaissance by Dr. Karl Magnacca indicated that although it is unlikely that T&E invertebrates are present, some rare *Drosophila silvestris* and *D. silvarentis* may occur, given the prevalence of large and healthy ‘ōlapa and naio (their respective host plants). In addition, lava tubes and caves associated with pāhoehoe lava flows in KKCMA most likely contain subterranean invertebrate communities. Though there are no T&E lava tube-associate invertebrates on Hawai‘i Island, these communities contain unique species that have not been well inventoried.

Impacts and Mitigation Measures

Native Birds

Native birds can be subject to adverse effects when their habitat is disrupted by forestry activities, vehicles, etc., particularly during nesting and fledging periods, when their mobility is restricted. Because of the large size of the property and the relatively small zone of disturbance at any one time, birds will generally have ample undisturbed habitat. However, in consideration of the native bird populations, mitigation measures will be taken to minimize impacts to T&E bird species. Recent surveys indicate that most of the T&E species have been detected at higher elevations in KKCMA. Harvest activities will be generally be less intense in these areas, especially in the northwest corner where ‘akiapola‘au and ‘alawī have been detected.

To minimize impacts to native birds:

- Extra caution will be taken between March 1 to September 30 during the nesting and fledging season of several native bird species, including ‘i‘iwi. Prior to harvest, the immediate area will be surveyed by DOFAW staff for native bird nests in or near trees being felled. If hawks are nesting within 330 feet, the harvest will not proceed until the juvenile hawk has fully fledged.
- Bird surveys will continue to be conducted annually to verify the distribution of all species and particularly T&E species in order to optimize mitigation.
- There are currently no plans to implement rodent control in the area, but non-native animal control could include the use of rodenticides and other toxic baits for rats and mice, which could potentially poison non-target animals. The use of toxic baits will be done in accordance with the toxicant registration. If implemented, DOFAW will use approved baits with a low toxicity to non-target wildlife and enclosed bait stations to limit the availability of bait blocks to rodents only. The controls and practices will avoid impacts to endangered animal species as well as plants and water resources.

Hawaiian Hoary Bats

As discussed above, Hawaiian hoary bats are vulnerable to disturbance in the pupping season. To minimize impacts to bats:

- No tree harvest or thinning operations that disturb trees or shrubs taller than 15 feet will occur between June 1 and September 15.
- In addition, DOFAW will avoid installing of new top-strand barbed wire, which can entangle bat wings and injure or kill them.

Invertebrates

To gain greater information concerning native invertebrates, and particularly rare or T&E species, DOFAW is embarking on a systematic survey of these species and their obligate host plants. DOFAW will seek to avoid habitat and host plants that are key to these species as part of adaptive management.

3.1.3 Wildfire, Pests and Invasive Fauna

This section discusses several threats to the integrity of the natural biota of KKCMA, each of which is already present and can also be exacerbated or reduced by project activities.

Existing Environment

The main natural ignition sources for wildlife in Hawai‘i are lightning and lava flows. Hawai‘i’s flora evolved with relatively infrequent naturally occurring fire, so most native species are not fire-adapted and are unable to recover quickly after wildfires. Wildfires can leave the landscape bare and vulnerable to erosion and non-native weed invasions. Continued feral ungulate damage

to native ecosystems can convert native forest to non-native grasslands or shrublands, which provide more fuel for fires. Invertebrate pests and disease can weaken and defoliate vegetation, leaving it more vulnerable to fire. Weeds, particularly grasses, are often more fire-adapted than native species and will quickly exploit suitable habitat after a fire. Wildfire in Ka‘ū is generally associated with the urban areas, pastures, and wild grass and shrub lands, which are drier than moist KKCMA. However, wildfire can pose a genuine threat to KKCMA, particularly during times of drought and in areas adjacent to human activity. Wildfire has occurred at the adjacent Kapāpala Ranch. Mitigation for fire prevention and response is thus necessary.

KKCMA has various invertebrates and fungi that may consume native plants, interfere with plant reproduction, predate or act as parasites on native species, transmit disease, affect food availability for native birds, disrupt ecosystem processes, and reduce production of koa canoe logs:

- *Fusarium oxysporum* f.sp. *koa* causes koa wilt, which induces dieback and/or decline of koa, especially in low elevations/warmer areas.
- *Tetraleurodes acacia*, or acacia whitefly, leads to decreased plant vigor, leaf yellowing/defoliation of varying hosts.
- *Accizia uncatoides*, or acacia psyllid, causes decline or poor growth form of koa.
- *Xylosandrus compactus*, or black twig borer, stunts growth or kills more than 100 tree and shrub species.
- *Ceratocystis luku‘ōhi‘a*, and *C. huli‘ōhi‘a* are fungal species that cause widespread and rapid ‘ōhi‘a death (ROD). Spores of both *Ceratocystis* species are circulating widely on Hawai‘i Island and ROD is now found throughout the island. Tree wounds that occur during trimming or heavy equipment operation raise ROD risk considerably.
- *Klambothrips myopori*, or naio thrips, defoliate and can kill naio.
- *Plasmodium relictum* is a mosquito-transmitted single-celled parasite that causes avian malaria, which is deadly to many species of birds, especially native Hawaiian species.
- *Scotoryhta paludicola*, or koa moth, is an endemic insect that occasionally experiences large population increases and can cause severe defoliation of koa trees.

A number of non-native animals are present at KKCMA. None have conservation value and all are deleterious to native flora and fauna, but they are generally found at densities that can be controlled with effective management to levels consistent with a healthy forest and production of koa canoe timber. Regular surveys have found eight species of non-native birds, with the warbling white-eye (*Zosterops japonicus*), most abundant (see Table 8 of Appendix 1). A variety of non-native mammals such as feral pigs (*Sus scrofa*), occasional feral cattle (*Bos taurus*), rats (*Rattus* spp.), mice (*Mus musculus*), cats (*Felis catus*), and small Indian mongooses (*Herpestes auropunctatus*) are present in KKCMA. Other ungulates including mouflon sheep (*Ovis musimon*), sheep (*Ovis aries*), feral sheep-mouflon hybrids (*Ovis aries-Ovis musimon*) and feral goats (*Capra hircus*) are not known from KKCMA, but may be present in directly adjoining areas. No non-native amphibians or reptiles are currently documented at KKCMA.

Impacts and Mitigation Measures

Wildfire may be generated as a result of project actions, and fires generated elsewhere can also spread to KKCMA, threatening forest integrity and the koa canoe resources that the project seeks to utilize. The principal human-caused wildfire ignition threats are catalytic converters and other hot surfaces of vehicles or heavy equipment, along with any tool use that causes sparks during high fire hazard conditions. DOFAW is the primary responder to fires within the Ka‘ū Forest Reserve, including KKCMA. DOFAW is responsible for fire protection within DOFAW lands and also cooperates with the Hawai‘i Fire Department and federal fire control agencies in developing plans, programs and mutual aid agreements for wildfire prevention assistance on other lands. An integral component of the project is the following mitigation:

- Maintain the perimeter road and interior crossroad as fuelbreaks, including clearing the road of vegetation or fallen trees.
- Closely monitor drought and fire activity in surrounding areas to determine the level of wildfire risk at KKCMA. Depending on the level of fire risk, access to the area may be temporarily restricted.
- Improve and maintain the helicopter landing zone to prepare for wildfire response.
- Secure and identify water access to prepare for wildfire control.

Ongoing infestations as well as new and sudden increases of insects and diseases can pose a serious threat to the native forest and management goals at KKCMA. With globalization and an increased dependence on imports, approximately 20 insect species become established in Hawai‘i every year (State of Hawai‘i 2010). Of particular concern in KKCMA are those listed above that have the potential to cause widespread dieback of predominant forest canopy species such as koa and ‘ōhi‘a. They can be hard to control or have limited control options, and a sudden outbreak may drastically alter the forest composition. If an outbreak of one of these diseases does occur, it may drastically alter the management goals for the area.

The Plan includes built-in management actions that counter alien species and promote native species. These will help maintain the overall health of the forest and make it more resistant to threats from insects and disease. Nonetheless, the infrastructure improvement, harvest and stand-improvement elements of the Plan, if implemented improperly and/or without appropriate mitigation, could increase the adverse effects of pests and disease. For this reason, the Plan includes integral and specific management objectives meant to counteract the adverse effects of pests and disease. They include the following:

- Conduct assessment of koa pest insects and diseases as part of all monitoring activities, including timber inventory.
- Assist and collaborate with partners to secure essential technical information and understanding of new threats.
- Include ROD sanitation and prevention procedures in all project activities conducted by DOFAW and also for all collection permits issued for KKCMA. This includes minimizing wounds to ‘ōhi‘a trees during harvest operations.

- Avoid damaging ‘ōhi‘a trees by hand-clearing a path for the machinery ahead of time. Place the path where valuable trees are less dense and make the path only as wide as needed to fit the machine.
- Monitor for signs of increased ROD distribution within KKCMA.
- Utilize forest bird surveys to monitor distribution of avian malaria in the area.
- Ensure that all pesticide use strictly follows labeling requirements.

As discussed in Section 1.3, above, control of non-native mammal populations, especially grazing cattle, is an integral and high priority part of the Plan meant to minimize the primary threat to forest recovery of forests. The following mitigation measures will be implemented to reduce the threats of ungulates and other invasive mammals:

- Continue ongoing regular fence checks, monitor for cattle in order to prevent ingress and identify and remove any invading cattle.
- Install cattle guards at strategic locations.
- Monitor for sheep, mouflon, and goats, which are not currently found in KKCMA, via staff observations and game cameras to ensure they do not enter the area and detrimentally browse native vegetation.
- Increase pig control in the area. This will include utilizing public hunting, and implementing staff control through the use of trapping, staff hunting, and adding skirting to the fenceline as funds are available.
- Monitor and control rats, cats and mongooses in order to reduce their populations.

3.2 Climate and Geology

Existing Environment

Due to its mid-elevation location between 3,150 and 5,160 feet above mean sea level, KKCMA has an average annual temperature of 60°F (49-72°F) and an average annual rainfall of 80 inches (Giambelluca et al 2013). Rainfall is fairly consistent throughout the year, with wetter months during the winter, similar to most of Hawai‘i (UHH 1998). Dense clouds and fog are common, reducing incident sunlight and providing additional moisture via fog drip. Despite the adequate moisture regime, drought is also possible. Rainfall totals from a few large winter storms can be greater than all other rain events during the year combined, which can pose an erosion hazard on cleared slopes. As with most areas in windward Hawai‘i, there is a distinctive diurnal wind regime (daytime upslope, nighttime downslope) overlaid on the prevailing trade wind flow, which is across the slope at KKCMA.

The geologic substrate of the KKCMA is 750-1500-year old volcanic eruptions from Mauna Loa volcano that emerged from the caldera at Moku‘āweoweo (Wolfe and Morris 1996). Mauna Loa is still active and has erupted 33 times between 1843 and 1984 (Lockwood and Lipman 1987) and once since then, in 2022. Forty percent of Mauna Loa’s surface is covered by lava flows less than 1,000 years old, and flows in 1950 reached the upper elevation of Ka‘ū Forest Reserve, south of Kapāpala. As with all areas on Mauna Loa, KKCMA could potentially be covered by lava from future volcanic eruptions. However, it is within an area that is relatively less risky than

many other locations on the flanks of Mauna Loa (including Hilo) because of its topographic position relative to the most active rift zone areas. KKCMA is classified within Volcanic Hazard Zone 6 on an ascending scale of risk from 8 to 1, where there have been no lava flows during the past 750 years (Heliker 1990).

Kīlauea Volcano is also currently active. Trade winds blow the volcanic emissions from Kīlauea to the southwest, towards KKCMA, particularly when there is activity within Halema‘uma‘u Crater. These emissions contain sulfur dioxide and other pollutants and are commonly called vog. On occasion, they have built up to levels that are hazardous to human health and damaging to agriculture. Vog may also adversely affect the health of some native plant and animal species (USGS 1997; UH 2008), but the forest at KKCMA does not appear to suffer significantly from vog exposure.

Ka‘ū experiences frequent seismic activity related to the movement of magma within Kīlauea and Mauna Loa or settling and shifting of earth along numerous fault lines. This activity occasionally leads to landslides and tsunamis. In 1868, an earthquake caused a destructive landslide that buried a village in Wood Valley and also caused a sudden tsunami that swept away many settlements along the coast (Stearns and MacDonald 1946). DOFAW managers have not detected any areas of landslides or rockfall to date at KKCMA that could be activated by earthquakes.

Soils in Ka‘ū have developed from volcanic rocks, cinders, and ash. Soil age and composition, along with climate, are a major influence on plant community composition and hydrology. Pāhoehoe, ‘a‘ā, cinders, and weathered ash provide varying contributions of minerals and drainage characteristics (Mitchell et al 2005). Accumulations of organic matter in the soil and ground litter are the most important factor in soil development on the relatively young substrates at KKCMA.

Three similar soil series are present within KKCMA, with the deepest soil generally found on the lower half of the property. All of these soils are andisols, meaning they were derived from volcanic ash, and are thus relatively fertile and acidic, with 0-60% organic material at the surface. These soils are highly erodible, which must be considered during forestry operations, especially harvesting. Because of the thin soils and high infiltration rates in the parent material, there is limited water holding capacity in the soil profile. This increases stress on plants during occasional droughts.

Due to the recent geology, no true streams or watercourses are present. The area is not classified by FEMA as within a Special Flood Hazard Area (Hawai‘i DLNR: <http://gis.hawaiiinfip.org/FHAT/>). Normally, rainfall rapidly soaks into the ground. However, KKCMA can also experience heavy runoff from storms that cause minor erosion that can worsen where slopes are cleared. The area provides an important watershed that helps ensure the sustainability of groundwater, which is vital for human use. Forests collect and filter water into the aquifers and streams. A healthy forest without soil disturbance limits aquatic pollutants (e.g. siltation, suspended solids, turbidity, nutrients, organic enrichment, toxins and pathogens) due to erosion and runoff. Forests may also reduce the impacts of flooding and erosion by slowing down water as it flows down the mountain.

Impacts and Mitigation Measure

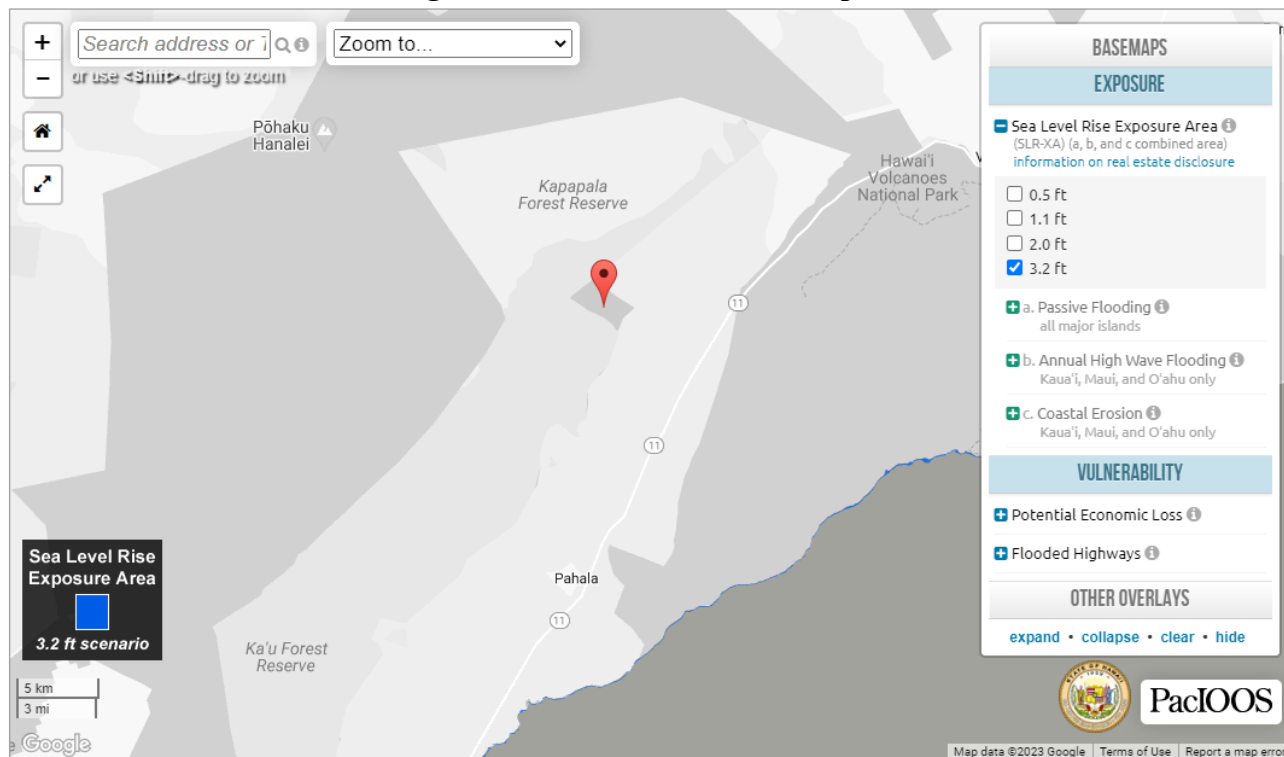
There is a scientific consensus that the earth is warming due to manmade increases in greenhouse gases in the atmosphere, according to the United Nations' Intergovernmental Panel on Climate Change (UH Manoa Sea Grant 2014). Global mean air temperatures are projected to increase by at least 2.7°F by the end of the century. This will be accompanied by the warming of ocean waters, expected to be highest in tropical and subtropical seas of the Northern Hemisphere. For Hawai'i, where warming air temperatures are already quite apparent, not only is the equable climate at risk but also agriculture, ecosystems, the visitor industry and public health. Guidance to federal agencies for addressing climate change issues in environmental reviews was released in August 2016 by the Council on Environmental Quality (US CEQ 2016). The guidance urged that when addressing climate change, agencies should consider: 1) the potential effects of a project on climate change as indicated by assessing greenhouse gas emissions in a qualitative, or if reasonable, quantitative way; and 2) the effects of climate change on a project and its environmental impacts. It recommends that agencies consider the short- and long-term effects and benefits in the alternatives and mitigation analysis in terms of climate change effects and resiliency to the effects of a changing climate. The State of Hawai'i in Hawai'i Revised Statutes §226-109 encourages a similar analysis, and both Act 17 of the 2018 Hawai'i Legislature and Title 11, Chapter 200.1 now require analysis of sea-level rise and greenhouse gases in environmental impact statements.

In terms of precipitation, wet and dry season contrasts will increase, and wet tropical areas in particular are likely to experience more frequent and extreme precipitation. In general, rainfall in Hawai'i has been variable in the recent past with some years drier and some wetter than average. The El Niño Southern Oscillation (i.e., periodic variation in winds and sea surface temperatures in the Pacific, the warming phase of sea temperature known as El Niño and the cooling phase as La Niña) will likely continue to dominate precipitation patterns from year to year in the tropical Pacific. Climate change-related increases in air temperatures will lead to more evaporation and more moisture in the air. As a result, the variability in El Niño-related precipitation is likely to increase, making rainfall predictions difficult. However, it is very likely that warmer temperatures and larger and more frequent tropical storms and hurricanes will affect the Hawaiian Islands in the future. It is thus important that project activities factor in not only current extreme rainfall events but more volatile future events.

Due to the elevation of the project site at more than 3,150 feet above sea level, there is no risk to the project from sea level rise (Figure 3.4). Carbon emissions as a result of operating the project would be considered negligible and are not expected to contribute significantly to global climate change. The project will lead to a perpetually sustainable growth of koa trees, recycling sequestered carbon and reducing the carbon footprint.

The project involves substantial investment in forest management and infrastructure to support the goal of providing koa canoe logs. There is a small but not discountable risk that must be factored into decisions to proceed that the area will be overrun with lava from Mauna Loa. Lava flows, extremely effusive eruptions, heightened volcanic gas production from Kīlauea, and earthquakes could all pose dangers to workers, koa canoe organizations, and public access users

Figure 3.4 Sea Level Rise Map



Source: <https://www.pacioos.hawaii.edu/shoreline/slr-hawaii/>

engaged in hiking, biking, gathering or hunting. DOFAW will monitor use through the harvest procedures and check-in stations for hunters and recreational users. Warning signs may be installed at trailheads to advise potential users about geologic hazards, along with other hazards such as steep slopes, disorientation, dehydration and hypothermia, and other conditions.

The principal potential impact related to climate and geology is erosion on access roads, skid trails, and other cleared areas. Several factors will act to reduce impact. The perimeter and cross-roads will be re-contoured in order to reduce the constant need for road maintenance and to help facilitate management activities. Road contouring is a grading technique that decreases the slope of the road in areas that are severely impacted by erosion. The road is re-routed along a contour, making a small turn in the road, reducing the slope of the road. Road contouring increases the longevity of the road by mitigating erosion and improves overall water quality in the area. Road contouring will be limited to within the 200-ft road buffer and will not extend into the interior of the forest. In contrast to other forest operations options like clearcutting, the scale of disturbance associated with harvest and stand thinning at KKCMA will be relatively small. Research on harvest access systems found skid trails impact between 1.6% to 10% of the harvest area in temperate and tropical forests (DeArmond et al. 2021). KKCMA is a small-scale, selective harvest system, and the skid trails and the disturbance they involve will not be extensive, and the subsequent impact will be minimal. Skid trails will be designed and located to minimize disruption of natural drainage and prevent excessive soil displacement.

In addition, the project will be managed to ensure all harvest operations follow harvest Best Management Practices (Appendix F of Appendix 1). Among other measures, the following will be implemented as an integral part of the Plan in order to minimize erosion:

- Conduct regular road maintenance, especially re-grading dirt roads and gravel-filling potholes in rocked/gravel roads, as necessary.
- Skid trails will generally have a slope of three to five percent and will not be permitted to exceed a slope of ten percent.
- Skid trails on the steeper slopes will include water bars or drainage features.
- In general, management will maintain and re-use existing skid trails, instead of removing mature trees to clear a new skid trail, especially if needed for ongoing weed control, enrichment planting, thinning, etc. Skid trails will always be GPS-marked to maintain a location record.
- Post-harvest clean-up may include the retirement of skid trails that will no longer be needed. This will involve covering with slash piles (treetops, small branches) from the harvest to mulch erosion-prone areas and to discourage continued use of the trail.
- To reduce erosion and for safety, all operations will be halted during heavy rain and storm events and may be postponed until staff deem roadways safe.

3.3 Socioeconomic Conditions, Access, Hunting and Recreation

Existing Environment

U.S. Census of Population and American Community Survey records indicate that the population of the Ka‘ū District grew steadily over the last four decades, from 3,034 in 1980, to 4,048 in 1990, to 5,554 in 2000, to 8,451 in 2010, and to 8,855 in 2020. This growth rate averaging over 30 percent each decade masks the fact that Ocean View, a community on the western edge of Ka‘ū with inexpensive subdivision lots that attract residents from around the country and world, has accounted for most of that growth. The traditional core of Ka‘ū anchored by Nā‘ālehu and Pāhala was severely affected by the closure of sugar plantations at the end of the last century. Pāhala and Nā‘ālehu both experienced negative population growth during this same time period (-13.3% and -20.1%, respectively). The U.S. Census Bureau estimated the 2021 median household income at \$38,505 in the Ka‘ū District, where 23 percent of households are below the poverty level (U.S. Census Bureau 2021; American Community Survey 5-year estimates. <http://censusreporter.org/profiles/06000US1500191170-kau-ccd-hawaii-county-hi/>>).

Economic generators in the Ka‘ū District are limited. Commercial centers are located in Pāhala, Nā‘ālehu, Wai‘ōhinu and Ocean View. Development in Ka‘ū includes residential, small retail commercial centers, and family-owned or commercial farms. Major government facilities include schools, a police station, a fire station and a hospital. The primary economic drivers in Ka‘ū are currently macadamia nut farms, schools, medical services, retail, cattle ranching, tourism and construction.

Tourism is a growth industry in Ka‘ū largely because it is home to Hawai‘i Volcanoes National Park. Although KKCMA is technically accessible to visitors, the remoteness and lack of

attractions that tourists usually choose to visit means that it is not a common visitor destination. In the KKCMA area, Kapāpala Ranch is the major economic land use. It is important to note that in 2004, the 1,257-acre koa management area was withdrawn with the strong support of the ranch from the ranch's lease area. The ranch is comprised of some 34,000 acres, with about 2,000 head of cattle along with goats which are rotated among various pastures to manage vegetation.

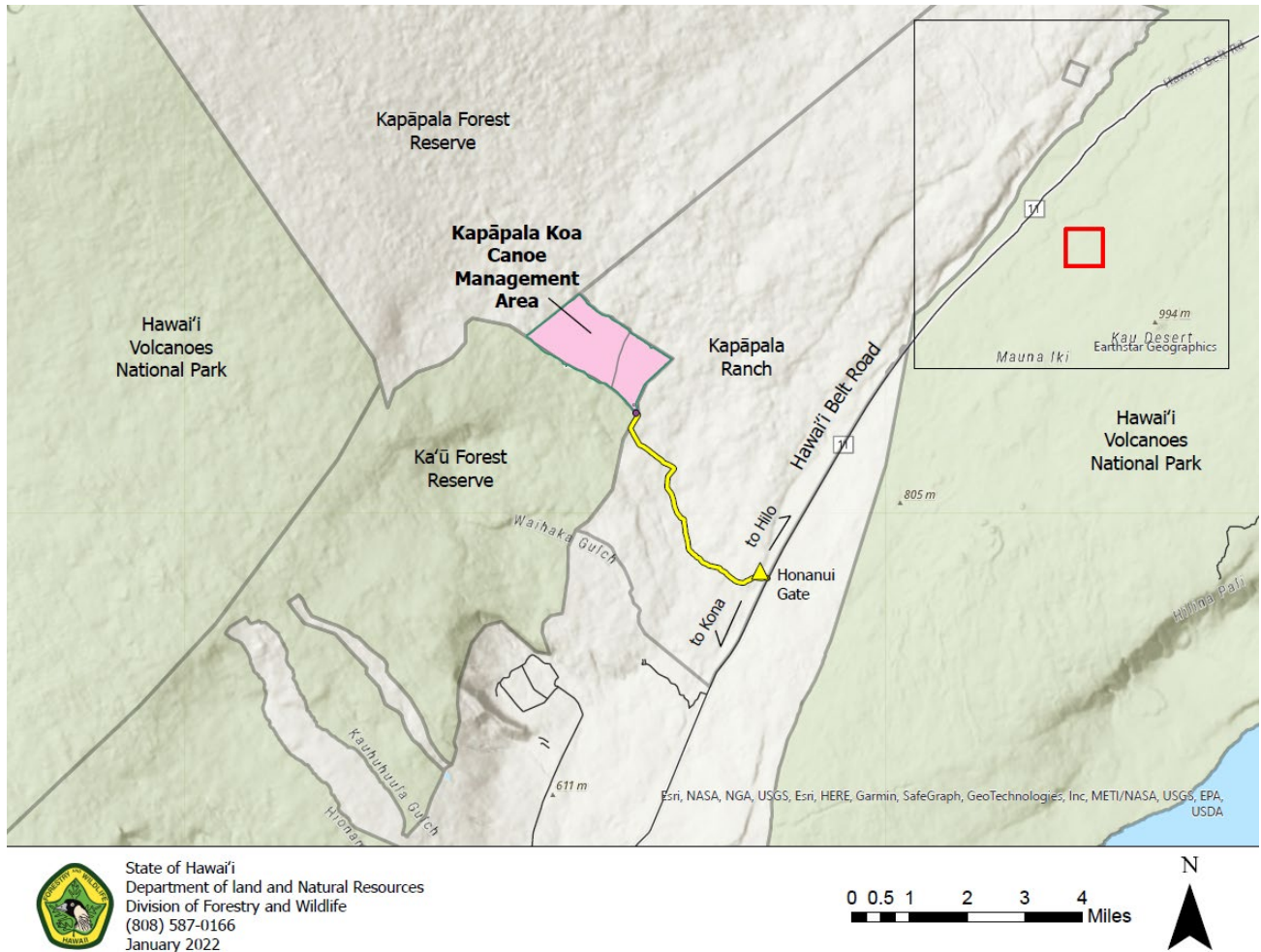
Highway access to KKCMA is via the Honanui gate near the 44-mile marker on State Highway 11, which is 44 miles from Hilo in the north and 11 miles from Pāhala in the south. From here, the access route utilizes a roughly 3.5-mile long 4WD road that crosses the leased lands of Kapāpala Ranch (see Figure 3-5).

Socioeconomic information is useful but not sufficient for describing the relationship of the people of Ka'ū to the upper elevations, including KKCMA and the entire Ka'ū Forest Reserve. In pre-Western Contact times, as described elsewhere in this document, the forest was in the wao, the wilderness. It was generally not inhabited, but was important as the source of life-giving waters and the resources of wood, fiber, medicine and ceremonial products. Its integrity was fundamentally tied to the general wellbeing of Hawaiian society. After Western contact, ecological degradation occurred as the forests became overrun by cattle and were exploited for sandalwood, timber and hāpu'u pulu. Western patterns began to dominate the economy and land use and tenure, particularly plantation sugar. These interests realized that the forest was a vital to protecting their economic water interests, and the concept of "forest reserves" was born. The principal purpose was to protect watersheds from erosion and ensure a steady supply of water for sugar plantations. Fences were erected to keep cattle out and the cattle were removed in many sections.

Although the close association of Forest Reserves in Hawai'i with watersheds slowly diminished along with the demise of sugar and its water infrastructure, the Ka'ū Forest Reserve continues to be used for watershed protection, hunting and gathering practices. More subtly, the forests retain their critical cultural value, for they are still the wao akua and their health is felt to be inextricably linked to the well-being of the ahupua'a and the people. The Ka'ū Listening Project found that the subsistence economy of fishing, gathering and hunting remains important today for many families (James Kent Associates 2007). For many, hunting, along with fishing, is an essential element of being a real kama'āina of Ka'ū. Hunting is a rite of passage, a bonding time among the densely interwoven network of friends and family, a treasure trove of stories for retelling, and a tradition that the community feels needs to be protected for many reasons. Accordingly, the Ka'ū Community Development Plan includes objectives that seek to preserve and enhance what is termed the *nā 'ohana* economy, reflecting the importance of the subsistence and sharing system prevalent in Ka'ū, which depends on gathering, hunting, fishing, and small scale agriculture.

The entirety of KKCMA is within Hunting Unit B. Hunting in state forest reserves is regulated by Hawai'i Administrative Rules (HAR) Chapter 13-121 Hunting General Regulations, Chapter 13-122 Game Bird Hunting, and Chapter 13-123 Game Mammal Hunting (administrative rules for hunting and licenses around found at <https://dlnr.hawaii.gov/recreation/hunting/>). The area is said to experience moderate levels of hunting.

Figure 3-5 Access Route to KKCMA



In addition to hunting, KKCMA is open to hiking and birding as well as gathering forest resources (with a DOFAW permit), such as maile and palapalai ferns. There are no designated hiking trails within KKCMA, but interior roadways can be, and very occasionally are, used to hike and mountain bike around the area. Hikers in the Kapāpala area are more likely to utilize ‘Ainapō Trail to the north of KKCMA, a celebrated historical trail depicted on various paper maps and digital hiking apps.

Illegal, unpermitted harvesting of non-timber forest products has also been documented in the area. DOFAW staff have seen evidence of maile propagation activities, including fertilizer and other cultivation paraphernalia within KKCMA and other parts of the Ka’ū Forest Reserve. Bringing soil, compost, or fertilizer into the forest is environmentally unsound, as it can spread insects and diseases such as little fire ants and rapid ‘ōhi‘a death. Unpermitted collection of forest products diminishes resources for those who collect pono, with permits and in non-commercial quantities. Other human activities of concern are drug use and unsanctioned camping, which can create an unsafe environment for educational groups or the public and lead to wildfire.

Impacts and Mitigation Measures

DOFAW management of recreational uses will emphasize low-impact activities, such as hunting, gathering for personal use, and hiking, with minimal improvements consistent with the remote, wilderness nature of KKCMA. Harvest, stand improvement and infrastructure improvements will tend to be focused in small areas at any one time and will be implemented so as to induce minimal interference with these public activities within KKCMA as a whole. Pig hunting will continue to be permitted in accordance with the regulations governing Hunting Unit B in forest reserves, with the goal of reducing the pig population to levels consistent with the KKCMA management goals. Occasionally, during the transfer of heavy equipment and logs, portions of the access route may be closed for safety reasons. DOFAW will install signs that inform the public during such closures. DOFAW will encourage recreational uses but will work to enforce regulations and laws against illegal plant propagation, camping and drug use on KKCMA.

Environmental justice is a term that refers to social inequity in bearing the burdens of adverse environmental impacts. Certain socioeconomic groups in the U.S., including ethnic minorities and low-income residents, have historically experienced a disproportionate share of undesirable side-effects from locally undesirable land uses such as toxic waste dumps, landfills, and freeway projects (Cutter 1995). Executive Order (EO) 12898 requires federal agencies to take appropriate and necessary steps to identify and avoid disproportionately high and adverse effects of federal projects on the health and environment of minority and low-income populations. Although the Plan for KKCMA is not a federal action subject to NEPA, in Act 294 of 2006, the Hawai'i Legislature called for agencies to implement similar policies, directing consideration of environmental justice concerns where there are disproportionate impacts on the environment, human health, and socioeconomic conditions of Native Hawaiian, minority, and/or low-income populations. As with nearly all parts of the State of Hawai'i, minority populations in Ka'u are actually the majority, with over 60 percent of the population identified as other than white. The proportion of the population in Ka'u below the poverty line is estimated at over 23 percent, one of the lowest-income districts in the State of Hawai'i. It is clear that low-income and minority populations are present. The Plan is focused on providing resources that are critical for cultural practices involving wa'a for racing, fishing, voyaging and other purposes. It also involves protection of many of the resources in KKCMA, including culturally important plants for gathering and watershed values. These are benefits that are shared across all socioeconomic strata. No disproportionate impacts on low-income and minority populations would occur as a result of the action.

In a letter in response to early consultation of March 2, 2023 (see Appendix 2), the Hawai'i Department of Transportation (HDOT) provided the following comment:

Please identify the location of the access and route on the State highway to be utilized for the harvesting and transport of trees. The proposed access and route should be designed and constructed for the appropriate vehicle characteristics and utilization. If any work is proposed within the State Highway Right-of-Way, an approved Permit to Perform Work Upon State Highways shall be obtained prior to construction. If the vehicle and/or load exceed the limitations of HRS 291-34 and -35 an approved Application to Operate or

Transport Oversize and/or Overweight Vehicles and Loads over State Highways will be required.

Access routes are depicted in Figure 3.5. There are no current plans to conduct improvements within the HDOT right-of-way. DOFAW will ensure through the Special Use Permit process that heavy equipment and logs are transported in accordance with all applicable regulations and that DOFAW and/or canoe organizations obtain the appropriate approvals. DOFAW will ensure that truck weight loads are professionally estimated prior to transport on highways and to ports for off-island shipment.

3.4 Cultural Resources

Lokelani Brandt, M.A. and S. Kau'i Lopes, B.A., of ASM Affiliates prepared a comprehensive Cultural Impact Assessment (CIA) for the project, which is attached as Appendix A of Appendix 1 and briefly summarized below. Interested readers are referred to the full CIA for detailed discussion. The purpose of the CIA is to assist in compliance with the Chapter 343, HRS requirements for consideration of cultural impacts, in furtherance of Act 50, which specifically acknowledged the State's responsibility to protect native Hawaiian cultural practices. Act 50 states that environmental studies "... should identify and address effects on Hawaii's culture, and traditional and customary rights" and that:

...native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the 'aloha spirit' in Hawai'i. Articles IX and XII of the state constitution, other State laws, and the courts of the State impose on governmental agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.

Guidelines to assist in conducting the required cultural analysis are contained in the *Office of Environmental Quality Control (OEQC) Guidelines for Assessing Cultural Impacts* (OEQC 1997). These guidelines are particularly helpful for projects that involve sensitive, undeveloped land or clearly have potential cultural impacts. A key element of a CIA is consultation of individuals with knowledge of cultural resources and practices. The current CIA consulted the KKCMA Working Group and also published a public notice in the November 2022 edition of *Ka Wai Ola*, the monthly newspaper of the Office of Hawaiian Affairs (OHA), to solicit broader involvement from any interested parties.

The geographical extent of the inquiry for CIAs should be large enough to ensure consideration of cultural practices that, while not necessarily occurring within boundaries of the project area, may nonetheless be affected. The CIA considered not only KKCMA but also the ahupua'a of Kapāpala and the entire moku of Ka'ū to some extent.

To generate a set of expectations regarding the nature of cultural resources and customary practices that might be encountered within the area, and to establish a context within which to assess the significance of such resources, the CIA began with a general cultural-historical review. The culture-historical context includes a discussion about the theories and beliefs associated with the settlement of the islands, an overview of traditional land management

strategies, and a discussion on the intensification and development of Hawaiian land stewardship practices.

While the question of when Hawai‘i was first settled by Polynesians remains contested, scholars working in the fields of archaeology, folklore, Hawaiian studies, and linguistics have offered several theories. With advances in palynology and radiocarbon dating techniques, Kirch (2011) is among those who argue that Polynesians arrived in the Hawaiian Islands sometime between A.D. 1000 and 1200. This initial migration sailing on intricately crafted wa‘a kaulua (double-hulled canoes) to Hawai‘i from Kahiki, the ancestral homelands of Hawaiian deities and peoples from southern Pacific islands, lasted until at least the 13th century. According to Fornander (1969), Hawaiians brought from their homeland certain Polynesian customs and beliefs: the major gods Kāne, Kū, Lono, and Kanaloa (who have cognates in other Pacific cultures); the kapu system of political and religious governance; and the concepts of pu‘uhonua (places of refuge), ‘aumakua (ancestral deity), and mana (divine power).

A critical concept from the CIA for comprehending the cultural context of the project and its impacts relates to traditional land stewardship systems, especially the concept of ahupua‘a. The ahupua‘a was the principal land division that functioned for tribute or taxation purposes and furnished its residents with nearly all subsistence and household necessities. Ahupua‘a are land divisions that typically include multiple ecozones from mauka (upland mountainous regions) to makai (shore and near-shore regions), assuring a diverse subsistence resource base (Hommon 1986). Although the ahupua‘a land divisions typically incorporated all of the eco-zones, their size and shape varied greatly (Cannelora 1974). Noted Hawaiian historian and scholar Samuel Kamakau summarized the ecozones that could be found in a given ahupua‘a:

Here are some names for [the zones of] the mountains—the mauna or kuahiwi. A mountain is called a kuahiwi, but mauna is the overall term for the whole mountain, and there are many names applied to one, according to its delineations (‘ano). The part directly in back and in front of the summit proper is called the kuamauna, mountaintop; below the kuamauna is the kuahea, and makai of the kuahea is the kuahiwi proper. This is where small trees begin to grow; it is the wao nahele. Makai of this region the trees are tall, and this is the wao lipo. Makai of the wao lipo is the wao ‘eiwa, and makai of that the wao ma‘ukele. Makai of the wao ma‘ukele is the wao akua, and makai of there is the wao kanaka, the area that people cultivate. Makai of the wao kanaka is the ‘ama‘u, fern belt, and makai of the ‘ama‘u the ‘apa‘a, grasslands.

A solitary group of trees is a moku la‘au (a “stand” of trees) or an ulu la‘au, grove. Thickets that extend to the kuahiwi are ulunahele, wild growth. An area where koa trees suitable for canoes (koa wa‘a) grow is a wao koa and mauka of there is a wao la‘au, timber land. These are dry forest growths from the ‘apa‘a up to the kuahiwi. The places that are “spongy” (naele) are found in the wao ma‘ukele, the wet forest.

Makai of the ‘apa‘a are the pahe‘e [pili grass] and ‘ilima growths and makai of them the kula, open country, and the ‘apoho hollows near to the habitations of men. Then comes the kahakai, coast, the kahaone, sandy beach, and the kalawa, the curve of the seashore—right down to the ‘ae kai, the water’s edge.

That is the way ka po‘e kahiko [the ancient people] named the land from mountain peak to sea (Kamakau 1976:8-9).

Kapāpala is a massive ahupua‘a that once contained well over 223,000 acres, when the lands of Keauhou were still included as an ‘ili kūpono, and even today has over 150,000 acres. It comprised vast tracts of forest occupying the central region and flanked on either side by numerous lava flows originating from Mauna Loa and Kīlauea (Maly and Maly 2004). The coastline was dry and remote with only limited habitation. In their appraisal of native horticultural practices in the 1930s, Handy et al. provided the following geographical description of Kapāpala Ahupua‘a:

Between the northeasterly ahupua‘a of Kapapala and Kilauea, the upland area of active volcanic craters, there was never any cultivation, so far as we could learn. Below Kao-iki Pali the country is covered with lava, and in the forest above the pali from Kapapala to Ohiakea the bird snarers or feather hunters had their huts, but no taro was grown. On the land flanking the present Kapapala Ranch, which is now in sugar cane, dry taro used to be grown on the sloping kula, on the steep hillsides of gulches, and in the forest lying behind. Forest taro was here referred to as ulu la‘au (forest growth), and that on steep slopes as pi‘ina (climbing) (Handy et al. 1991:613).

The name Kapāpala may refer to the endemic pāpala plant (*Charpentiera* sp.), which is found on all of the main Hawaiian Islands in both mesic and dry forests (Pukui et al. 1974; Rock 1913). Often used in the practice of ‘ōahi (firebrand tossing), the buoyant, soft fibrous wood of the pāpala was carried to coastal precipices on dark moonless nights, lit on fire, then tossed over the cliff where it was carried on the wind to create a fiery aerial display enjoyed by the people (Krauss 1993).

The treatment of the cultural history of Kapāpala Ahupua‘a in the CIA includes information on the relationship of the environmental setting and resilient kinship networks and ‘aumākua worship. There are a number of legendary and historical accounts in which Kapāpala figures prominently, many involving the goddess Pele. Kapāpala’s place in the succession of ruling lines is also discussed, from ‘Umi a Līloa through Lonoikamakahiki down to Kīwala‘ō and Kamehameha. Again, readers are referred to Appendix A of Appendix 1 for details.

Since the scope of the project is the sustainable harvest of koa for making various types of traditional canoes, the principal focus of the CIA are the practices and customs of traditional Hawaiian canoe making. The research included accounts by David Malo, Abraham Fornander, Tommy Holmes, Edgar Henriques, and Kalokuokamaile. The process of selecting, felling and extracting a canoe log was an intricate undertaking, arduous in both the physical and spiritual senses. It began with the initial rituals of the kahuna kālaiwa‘a, the ascent to the koa forest and consulting the ‘elepaio, cutting and felling rituals, and the final hewing process. The continuous use of wa‘a koa today and into the future stands as a testament to the significance of this practice and the necessity of obtaining appropriate koa trees to ensure the continuation of this long-standing customary tradition.

Finally, the CIA provides a summary of relevant accounts of visitors to Kapāpala during this period along with pertinent prior archaeological and cultural studies conducted near the project area. Of special interest was a CIA prepared in 2012 by the firm Ke Ala Pono (Uyeoka et al 2012) on behalf of the Department of Land and Natural Resources for a Management Plan for the Ka‘ū Forest Reserve (Hawai‘i DLNR 2012). Based on ethnographic interviews and historical sources cited throughout their study, Uyeoka et al. (2012:151) stated:

...the forested mauka regions of the Ka‘ū Forest Reserve were commonly used for specialized resource procurement activities....[that]....were likely centralized in specific area that contained important resources for catching/collecting birds, harvesting hardwoods for crafts and other uses, collecting medicinal plants, and spiritual practices.

They added that cultural practices continue within the Ka‘ū Forest Reserve, including the gathering of plant resources, gathering of wai from springs for ceremonial purposes, and hunting for subsistence purposes. The analysis ultimately concluded that DOFAW’s proposed activities “...should have little impact on the known cultural, resources, and beliefs...” and that several of the activities “have the potential to benefit the cultural resources of the Reserve.” To mitigate the potential impacts and community concerns about lifestyles changes and restricted access, the CIA conveyed the importance of maintaining the Ka‘ū way of life, ensuring continued and increased access into the forest reserve to allow for continued subsistence and gathering activities, and protection of the watershed through ungulate removal, invasive species control, and propagating native plants.

Identified Cultural Resources and Practices

The review of culture-historical background information in conjunction with the results of the consultation process revealed the following traditional and customary practices and valued cultural resources.

Forest Resources and Harvesting of Avian and Plant Resources

Kapāpala’s forest and all of its tangible and intangible elements have long been and continue to be recognized as a valued cultural resource. Generations of local residents have traveled to the forests of Kapāpala for a variety of bird and plant resources. Capturing birds for subsistence and artisanal purposes, most notably feathers for fashioning spectacular royal insignia including ahu‘ula (feathered cape), mahi‘ole (feathered helmet), lei (garland), kāhili (feathered standard), and other adornments, was an important practice (Gomes 2016). Although the capture of native birds, including nēnē, ‘ua‘u, ‘ō‘ō, and mamō, is no longer practiced, nēnē was identified by one of the consulted parties as still present on Kapāpala Ranch and likely in the project area. Traditional plant gathering practices that were identified through the historical record included koa harvesting for canoes, ‘iliahi, māmaki, maile and pulu.

Kālaiwa‘a and Māmaki Cultivation Settlement

Historical records indicate that settlements (kauhale) specifically for kālaiwa‘a and māmaki cultivation were established in the forest areas of Kapāpala, likely centered near Pu‘uhoakalei near Keauhou. Historians who wrote about canoe building noted that carving sites were often temporary in nature and were usually located near a water source. While culturally-related organic matter does not preserve well in the forest environment, if stone features were constructed as part of these forest settlements, it may still be possible to identify their archaeological remnants.

Trails

Historical maps identify a trail dating from at least as far back as the 1920s that extends along the southern boundary of the project area and the northeastern boundary of the Ka‘ū Forest Reserve (see Figures 29 and 30 of Appendix A of Appendix 1). This trail connects to the historic Mauna Loa and ‘Āinapō trails, both of which lie outside of the current project area and were utilized during the Precontact and Historic periods. Given the unusual curvature of the Ka‘ū Forest Reserve boundary, it is hypothesized that this trail may have been built when the boundaries of the forest reserve were formalized. It is also possible that the forest reserve boundary followed a pre-existing trail.

Caves

The mo‘olelo (story) of Nānāele recounted in the CIA includes a cave system that reportedly extended from Ka‘ālaiki to Kapāpala, specifically to “a spot back of the Kapāpala stock ranch.” Furthermore, in the battle of Kaua‘awa, upland caves were used as temporary refuges. Although the cave noted in the story of Nānāele is likely not within the project area, other refuge or temporary shelter caves may be present.

Water Resources

Traditional stories and historical maps take note of some of the most valued natural resources in Kapāpala: water holes. A mo‘olelo involving Pele, Waka, and Puna‘aikoa‘e (half man and half bird) tells of Waka’s passage through Kapāpala and the water holes he visited – important to a creature who manifested as a mo‘o. Maps show a number of water holes near but outside KKCMA, including Koiki and various unnamed features. Similar undocumented resources may be present within the project area and could be found during project activities.

Ranching

Ranching has been a part of the history and traditions of Kapāpala since the 1860s. Although not generally considered a traditional cultural practice per se, ranching is recognized as an important Historic-era activity that was and still is a major part of Hawai‘i’s history. Since the establishment of the KKCMA in 1989, ranching activities have ceased on the parcel itself, but the ranching lifestyle continues to thrive at adjacent Kapāpala Ranch. One of the KKCMA

Working Group participants works at and manages Kapāpala Ranch. Many other members have memories of the ranch or horseback riding in the area.

Hunting

Subsistence hunting was identified by several of the consulted parties as an ongoing practice at KKCMA as well as within the adjacent forest reserves. While hunting feral pigs and other game for subsistence or sport is not considered an ancient traditional cultural practice (see Burrows et al 2007), it has developed to be integral to the subsistence and sharing cultural system prevalent in Ka‘ū, which depends on gathering, hunting, fishing, and small scale agriculture.

Impacts and Mitigation Measures

The Plan has been designed in close coordination with cultural experts to ensure that each of the identified cultural resources and practices will be protected as part of management of KKCMA.

The upland forest of Kapāpala has been utilized since the Precontact and Historic periods for a variety of practices, including harvest of koa for the construction of koa canoes. All consultees for the CIA felt that the sustainable harvest of koa from the KKCMA for the construction of koa canoes used customarily for fishing, outrigger canoe racing, and voyaging would likely yield net positive cultural impacts. Furthermore, nearly all of the consulted parties spoke about the importance of responsible human interaction and management with forest resources as a way to mitigate further loss and improve connection and respect for such spaces.

Harvesting of koa for canoe construction has quietly persisted for many generations. Canoe builders with the knowledge and capacity to transform a log into a usable canoe expressed concern about canoe construction as a dying art, as only a handful continue to practice. They spoke about the challenges of obtaining a suitable log and having to work with various landowners, all of whom can impose different restrictions on canoe builders. Because of the difficulties in obtaining a suitable koa log, canoe building is often left to the experts, with little room to include upcoming builders who need experience working with koa. In the view of the consultees, Hawai‘i’s koa forest has for hundreds of years sustainably furnished native builders with the materials needed to make canoes. It was the canoe that allowed early Polynesian voyagers to cross vast oceans and establish Hawai‘i as their permanent home. The canoe allowed them to travel from place to place around these islands, engage in inter-island warfare, and procure food from the shallow and deep seas. Its importance in Hawaiian culture cannot be overstated. Now would appear to be a critical time if the practice of traditional koa canoe-making is to endure.

Nonetheless, consultees stressed that the project needed to be implemented thoughtfully in order to avoid adverse impact to other cultural-natural resources. Given that this is the first project of this nature in Hawai‘i, the consensus is that the State must explore traditional and non-traditional methods of forest management. New partnerships must be forged, existing partnerships improved, and strategies for sustainable funding to manage the KKCMA must be sought. For a project of this nature, DLNR-DOFAW must draw equally upon both traditional and scientific knowledge to strike a balance that will sustain the resources, including kānaka on this ‘āina. The

following actions that were recommended during consultation and evaluated in the CIA are being adopted in the Plan to mitigate for potential impacts on the above-identified valued resources and cultural practices.

- Pending funding approval, DOFAW will seek to hire at least one full-time staff member dedicated to managing KKCMA in order to facilitate access, reduce potential impacts to the area's resources and associated practices, and coordinate communication with the community.
- To identify and protect historic resources that may be located in the KKCMA project area, DOFAW will ensure that archaeological surveys of affected areas are conducted. DOFAW will consult with the DLNR-State Historic Preservation Division to determine the proper scope of the survey area(s). At a minimum, an archaeological survey will be undertaken once a potential harvest area is defined and before any harvesting activities are carried out. This action will ensure that any historic resources (i.e. potential settlements, caves, trails, or ranching era resources) potentially located within the harvest area are properly identified and documented, and that protective measures are implemented. Areas where historic resources are identified will be demarcated on a map and made identifiable in the field. Efforts will be made to preserve in place all historic resources that may exist in the KKCMA project area.
- DOFAW will seek to utilize traditional place names and Hawaiian environmental zones (wao) in its management. Proper utilization of place names, as well as the names of associated individuals such as former konohiki, is one way to ensure the place-based knowledge of Kapāpala is carried forth into the future.
- In keeping with a prevalent theme that emerged from the cultural consultation process, DOFAW will seek to collaborate in the development of educational and stewardship opportunities specific to Kapāpala and Ka'ū. DOFAW will strongly encourage hālau (organizations) who receive logs from the KKCMA to participate in such educational and stewardship activities. DOFAW will promote community involvement in educational and stewardship opportunities and may partner with Ka'ū-based organization organization(s) with capacity to carry out such activities.
- DOFAW will require all hālau to include and implement a plan for culturally appropriate forms of reciprocity when applying for the harvest of a koa log. This could include assisting with stewardship activities, participating in educational opportunities, and/or making culturally appropriate offerings.
- The existing working group will continue to be utilized and will be formalized through the BLNR approval of the management plan and the canoe log allocation process, both of which highlight the integration of the working group. This group can help ensure appropriate cultural protocols are being followed and advise on planned activities. DOFAW will reach out to builders, kūpuna and kama'āina of Kapāpala and Ka'ū, canoe clubs, and other stakeholders.
- Harvest of koa logs inevitably involves some damage to nearby native plants. To make up for this, DOFAW will encourage utilization of the existing collection permit process to allow for gathering of usable forest products, including those damaged during harvest operations.

- DOFAW will post ample notice at the entrance into the KKCMA and any other appropriate outlets notifying the public when harvest activities are scheduled. DOFAW will schedule and coordinate harvest activities to avoid unnecessary disruption to other planned (i.e. education or stewardship activities) or unplanned (subsistence or commercial gathering) activities, and to allow the forest to rest and regenerate until the next harvest.

The Draft EA was made available to agencies and groups who might potentially have additional cultural information or concerns. No party reviewing the Draft EA supplied any additional cultural information.

3.5 Air Quality, Noise and Scenic Resources

Existing Environment

Manmade air pollution in the Kapāpala area is minimal. The principal influence on air quality there is volcanic emissions of sulfur dioxide, which convert into particulate sulfate and produce a volcanic haze (vog) that chronically blankets the district when Kīlauea Volcano is erupting, as discussed in Section 3.2.

Sound levels at KKCMA are currently minimal and are derived from natural sources such as wind and birdsong. Helicopters engaged in sightseeing tours or conservation actions infrequently pass over the site and briefly produce moderate levels of noise. No sensitive human noise receptors such as residences, schools, hospitals, etc., are present nearby, but a wilderness, upper elevation section of Hawaii Volcanoes National Park is located about three miles to the west.

As detailed in the Hawai'i County General Plan, Ka'ū is notable for containing most of Hawai'i Volcanoes National Park, a vast natural area with great contrasts between open lava land with little or no vegetation, dense native 'ōhi'a-lehua forests, extensive shrublands and grasslands, and spectacular coastlines. In the southern part of Ka'ū the natural beauty of the landscape is characterized by vistas from the mountain slopes to the ocean. The coast is highlighted by Manukā Bay, Green Sands Beach, and Punalu'u Black Sand Beach. Crowning views from most *makai* vantages are the misty uplands of the Ka'ū Forest Reserve, containing scenic eroded mountain forms that contrast with the immense shield of the remainder of Mauna Loa, truly the largest mountain on earth. KKCMA itself, although supporting a healthy, scenic forest, is not readily visible from public viewpoints due to the distance from the highway and gradual slope of Mauna Loa. Where visible, it blends into the background of Kapāpala and the Ka'ū Forest Reserve.

Impacts and Mitigation Measures

Harvest, stand improvement and road maintenance would each produce minor impacts to air quality, primarily through engine emissions. All equipment will be maintained to meet emissions specifications. Negligible quantities of dust may be produced during grading and maintenance operations. The remote nature of the area far from water sources will preclude utilizing water

trucks for dust suppression, but this would be unnecessary because of the very small scale of work at any given time.

Several aspects of the project will produce periodic noise, including harvest, stand improvement and road maintenance that are not expected to substantially impact any human activity. The timing and location of harvest operations, which will generally involve felling trees with chainsaws and or bulldozers, will be planned to avoid noise that affects sensitive native fauna, as discussed in Section 3.1. The optional extraction method of helicopter operations would similarly produce brief but intense noise in the harvest area, and also some level of noise while transiting between Hilo or other locations to the harvest site. Due to the limited local availability of machinery capable of helicopter extractions, and the lack of local experience in operations, helicopter extraction is not a likely near-term option. If these circumstances change, helicopter extraction would still be quite infrequent (<5-10/year max) and would not significantly alter the regions' soundscape or affect other users in a significant way.

Implementation of the Plan would preserve the native vegetation of KKCMA, the principal element that contributes to its scenic value. Although stand improvement and harvests will alter the forest's appearance in limited areas, no general scenic impact is expected, and no mitigation measures are necessary.

3.6 Consistency with Land Use Designations, Permits, Plans and Policies

The KKCMA property is within the State Land Use Agricultural District and is zoned A-20a (Agriculture, minimum lot size 20 acres) by the County of Hawai'i. All proposed activities are permitted uses within these designations.

The Plan requires approval by the Hawai'i State Board of Land and Natural Resources before any harvest or silvicultural operations are implemented. Prior to each harvest operation, a Special Use Permit will be required of applicant organizations from DOFAW that will detail measures to minimize impacts to natural and cultural resources. As a part of the Special Use Permit, organizations must have an approved harvest plan that meets DLNR/DOFAW requirements as outlined in section 5 of Appendix 1. In addition to permits and approvals, the following sections detail general consistency with State and County plans.

3.6.1 Hawai'i State Plan

Adopted in 1978 and last revised in 1991 (Hawai'i Revised Statutes, Chapter 226, as amended), the Plan establishes a set of themes, goals, objectives and policies that are meant to guide the State's long-run growth and development activities. The three themes that express the basic purpose of the *Hawai'i State Plan* are individual and family self-sufficiency, social and economic mobility and community or social well-being.

The "overall direction" of the Hawai'i State Plan is to improve the quality of life through proper management of the State's land resources, as presented in Section 226-102:

The State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in five major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education.

Among the sections of the Hawai'i State Plan most relevant to the Plan are the following. Section 226-11 deals with land-based, shoreline and marine resources in the physical environment:

Objectives: Planning for the State's physical environment with regard to land-based, shoreline and marine resources shall be directed towards achievement of the following objectives: (1) prudent use of Hawai'i's land-based, shoreline and marine resources and (2) effective protection of Hawai'i's unique and fragile environmental resources. To achieve those objectives, the Plan notes it shall be the policy of the state to:

- (a) Exercise an overall conservation ethic in the use of Hawai'i's natural resources.
- (b) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.
- (c) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.
- (d) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.
- (f) Pursue compatible relationships among activities, facilities, and natural resources.
- (g) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.

Section 226-12 states objectives for the scenic, natural beauty, and historic resources of the physical environment:

Objective: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawai'i's scenic assets, natural beauty, and multi-cultural/historical resources. To achieve that objective, it shall be the policy of this State to:

- (a) Promote the preservation and restoration of significant natural and historic resources.
- (b) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.
- (c) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.
- (d) Protect those special areas, structures, and elements that are an integral and functional part of Hawai'i's ethnic and cultural heritage.

Also relevant is Section 226-13, which concerns land, air and water quality of the physical environment:

Objectives: Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following: (1) Maintenance and pursuit of improved quality in Hawai'i's land, air, and water resources, and (2) Greater public awareness and appreciation of Hawaii's environmental resources. To achieve those objectives it shall be the policy of the State to:

- (a) Foster educational activities that promote a better understanding of Hawai'i's limited environmental resources.
- (b) Promote the proper management of Hawaii's land and water resources.
- (c) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.
- (d) Foster recognition of the importance and value of the land, air and water resources to Hawai'i's people, their cultures and visitors.

The following objective and policies are taken from Section 226-25, relating to culture:

Objective: Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people. To achieve the objective, it shall be the policy of this State to:

- (a) Foster increased knowledge and understanding of Hawai'i's ethnic and cultural heritages and the history of Hawai'i.
- (b) Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawai'i's people and which are sensitive and responsive to family and community needs.
- (c) Encourage increased awareness of the effects of proposed public and private actions on the integrity and quality of cultural and community lifestyles in Hawai'i.

Also relevant to the Plan project is the objective and policy from Section 226-27 pertaining to government and socio-cultural advancement:

Objective: Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of efficient, effective, and responsive government services at all levels in the State. To achieve that objective, it shall be the policy of this State to:

- (a) Provide for necessary public goods and services not assumed by the private sector.

Evaluation of Consistency: In general, implementation of the KKCMA Plan would be highly consistent with State goals and objectives that call for preservation and restoration of natural, cultural and recreational resources. It would help fulfill the overall direction of the Hawai'i State Plan by contributing to management of land resources that balances natural resource protection with responsible human uses that support important cultural purposes, particularly the call to support the cultural identities, traditions, values, customs, and arts of Hawai'i's people.

3.6.2 Hawai'i Forest Reserve Laws, Regulations and Policies

Chapter 183, Part II, Hawaii Revised Statutes, Forest Reserves

This law provides for the establishment and maintenance of Forest Reserves. Most relevant to the discussion of consistency are the duties of DLNR and the ability to remove feral cattle and horses.

§183-1.5 Duties in general.

- (3) Have the power to manage and regulate all lands which may be set apart as forest reserves;
- (4) Devise ways and means of protecting, extending, increasing, and utilizing the forests and forest reserves, more particularly for protecting and developing the springs, streams, and sources of water supply to increase and make that water supply available for use;
- (5) 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 in whole or in part;

§183-19 Exclusion of livestock from forest reserves, game management areas, public hunting areas, and natural area reserves; notice. When branded wild cattle or horses are found on any forest land, game management area, public hunting area, or natural area reserve in the State, which land is duly set apart and established as a forest reserve, game management area, public hunting area, or natural area reserve, or if the land is privately owned and surrendered as defined in section 183-15, the department, in all cases where the land is so set apart and established as a forest reserve, game management area, public hunting area, or natural area reserve, whether from privately owned lands or public lands, may remove, shoot, or destroy the cattle or horses without compensation to the owner, after thirty days' public notice of the intended action in the county where the cattle or horses are found.

Evaluation of Consistency: The Plan has been specifically designed by the agency entrusted with managing the State's Forest Reserves to fulfill and be consistent with all aspects of Chapter 183, Part II, including the sections cited above.

3.6.3 Hawai'i County General Plan

The *General Plan* for the County of Hawai'i is a policy document expressing the broad goals and policies for the long-range development of the Island of Hawai'i. The plan was adopted by ordinance in 1989 and revised in 2005 (Hawai'i County Planning Department). The *General Plan* itself is organized into thirteen elements, with policies, objectives, standards, and principles for each. There are also discussions of the specific applicability of each element to the nine judicial districts comprising the County of Hawai'i. Most relevant to the proposed project are the following Goals, Policies and Standards of particular chapters of the General Plan:

Economic – Goals

- Promote and develop the island of Hawaii into a unique scientific and cultural model, where economic gains are in balance with social and physical amenities. Development should be reviewed on the basis of total impact on the residents of the County, not only in terms of immediate short run economic benefits.

Economic – Goals

- Provide an economic environment that allows new, expanded, or improved economic opportunities that are compatible with the County's cultural, natural and social environment.

Environmental Quality – Goals

- Define the most desirable use of land within the County that achieves an ecological balance providing residents and visitors the quality of life and an environment in which the natural resources of the island are viable and sustainable.
- Maintain and, if feasible, improve the existing environmental quality of the island.
- Control pollution.

Environmental Quality – Policies

- Take positive action to further maintain the quality of the environment.
- Advise the public of environmental conditions and research undertaken on the island's environment.

Environmental Quality – Standards

- Pollution shall be prevented, abated, and controlled at levels that will protect and preserve the public health and well being, through the enforcement of appropriate Federal, State and County standards.
- Incorporate environmental quality controls either as standards in appropriate ordinances or as conditions of approval.
- Federal and State environmental regulations shall be adhered to.

Natural Beauty – Goals

- Protect, preserve and enhance the quality of areas endowed with natural beauty, including the quality of coastal scenic resources.
- Protect scenic vistas and view planes from becoming obstructed.
- Maximize opportunities for present and future generations to appreciate and enjoy natural and scenic beauty.

Natural Resources and Shoreline – Goals

- Protect and conserve the natural resources from undue exploitation, encroachment and damage.
- Protect and promote the prudent use of Hawaii's unique, fragile, and significant environmental and natural resources.
- Protect rare or endangered species and habitats native to Hawaii.
- Protect and effectively manage Hawaii's open space, watersheds, shoreline, and natural

areas.

Natural Resources and Shoreline – Policies

- Encourage a program of collection and dissemination of basic data concerning natural resources.
- Coordinate programs to protect natural resources with other government agencies.
- Encourage public and private agencies to manage the natural resources in a manner that avoids or minimizes adverse effects on the environment and depletion of energy and natural resources to the fullest extent.
- Encourage an overall conservation ethic in the use of Hawaii's resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawaii.
- Encourage the protection of watersheds, forest, brush and grassland from destructive agents and uses.
- Work with the appropriate State, Federal agencies, and private landowners to establish a program to manage and protect identified watersheds.
- Create incentives for landowners to retain and re-establish forest cover in upland watershed areas with emphasis on native forest species.

Natural Resources and Shoreline – Standards

- The following shall be considered for the protection and conservation of natural resources:
 - Areas necessary for the protection and propagation of specified endangered native wildlife, and conservation for natural ecosystems of endemic plants, fish and wildlife.
 - Lands necessary for the preservation of forests, park lands, wilderness and beach areas.

Land Use – Public Lands - Goal

- Utilize publicly owned lands in the best public interest and to the maximum benefit for the greatest number of people.

Land Use – Public Lands – Policy

- Encourage uses of public lands that will satisfy specific public needs, such as housing, recreation, open space and education.

Land Use – Public Lands - Standard

- Public lands with unique recreational and natural resources shall be maintained for public use.

Evaluation of Consistency: The Plan will fulfill the specifications of the Hawai'i County General Plan in many ways. The harvest of koa canoe logs is an exemplary economic opportunity that is compatible with the County's goals of promoting local culture while also maintaining and improving the environmental quality of the island through protecting native forest habitat and watershed values. Implementation of the Plan would not affect important vantages and vistas. It is in keeping with goals, objectives and policies related to native forests

and watersheds, specifically fulfilling the Natural Resources and Shoreline elements of the Hawai‘i County General Plan. It preserves recreational opportunities directly, through ensuring the supply of the most important raw material for traditional Hawaiian canoes, and indirectly, through preserving hiking and hunting.

3.6.4 Ka‘ū Community Development Plan (CDP)

This CDP encompasses the judicial district of Ka‘ū, and was developed under the framework of the February 2005 County of Hawai‘i General Plan. Community Development Plans are intended to translate broad General Plan Goals, Policies, and Standards into implementation actions as they apply to specific geographical regions around the County. CDPs are also intended to serve as a forum for community input into land-use, delivery of government services and any other matters relating to the planning area. The intention and scope of the Ka‘ū CDP is best summarized in its Community Objectives, which are explicitly intended for, among others, agencies seeking to implement forestry (Hawai‘i County Planning Department 2017:15):

ENCOURAGE SUSTAINABLE SETTLEMENT PATTERNS

- Objective 1: Encourage future settlement patterns that are safe, sustainable, and connected. They should protect people and community facilities from natural hazards, and they should honor the best of Ka‘ū’s historic precedents: concentrating new commercial and residential development in compact, walkable, mixed-use town/village centers, allowing rural development in the rural lands, and limiting development on the shorelines.
- Objective 2: Preserve prime and other viable agricultural lands and preserve and enhance views that exemplify Ka‘ū’s rural character.

CONSERVE AND MANAGE NATURAL AND CULTURAL RESOURCES

- Objective 3: Protect, restore, and enhance ecosystems, including mauka forests and the shorelines, while assuring responsible access for residents and for visitors.
- Objective 4: Protect, restore, and enhance Ka‘ū’s unique cultural assets, including archeological and historic sites and historic buildings.
- Objective 5: Establish and enforce standards for development and construction that reflect community values of architectural beauty and distinctiveness.
- Objective 6: Encourage community-based management plans to assure that human activity doesn’t degrade the quality of Ka‘ū’s unique natural and cultural landscape.

ENHANCE COMMUNITY INFRASTRUCTURE

- Objective 7: Identify viable sites for critical community infrastructure, including water, emergency services and educational facilities to serve both youth and adults.
- Objective 8: Establish a rural transportation network, including roadway alternatives to Highway 11, a regional trail system, and an interconnected transit system.

BUILD A RESILIENT LOCAL ECONOMY

- Objective 9: Preserve and greatly enhance nā ‘ohana economy.

- Objective 10: Encourage and enhance agriculture, ranching, and related economic infrastructure.
- Objective 11: Increase the number and diversity of income sources for residents, including jobs and entrepreneurial opportunities that complement Ka‘ū’s ecology, culture, and evolving demographics.
- Objective 12: Establish or expand retail, service, dining, and entertainment centers in rural villages and towns capable of supporting Ka‘ū-appropriate growth.

All objectives require consideration of the concept of the ‘ohana institution. In the words of the CPD (Ibid: 7):

Embedded in this understanding is an innate awareness that the three pillars of rural life – land, community, and livelihood – are inseparable. In *The Polynesian Family System in Ka‘ū*, Mary Kawena Puku‘i referred to this as the “management of the household,” known in Hawaiian as the institution of ‘ohana. According to Tūtū Puku‘i, features of ‘ohana include a cohesive force tied by ancestry to the ‘āina, genuine community spirit of mutual benefit, economic exchange regulated by relationships, and voluntary giving of food, possessions, services, and communal labor.

The ‘ohana system sustained generations of families in Hawai‘i and remains a vital force that gives the people of Ka‘ū their resilience. People live off the land, and the medium of exchange is reciprocity. The people of Ka‘ū grow food in gardens, gather it from the shoreline and forest, fish for it in the ocean, and hunt for it mauka. More importantly, the people of Ka‘ū share what they have. Bounty from the garden or hunt is shared with ‘ohana, which includes far more people than those connected by blood. As one resident put it, “Only in Ka‘ū. We share, that’s the Ka‘ū style – with our family, our neighbors, everyone.”

These practices feed families, bring communities together, and create a means for sharing cultural wisdom from one generation to the next. By sustaining and nurturing this relationship with ‘āina that families have used to survive and thrive in Ka‘ū for generations, the local economy is built on the foundation of the region’s unique natural, cultural, and social assets.

Evaluation of Consistency: The KKCMA Plan is highly consistent with the Ka‘ū Community Development Plan, in that, among other actions, it 1) involves a community-based management plan vital for a culturally-based land use that also ensures that human activity doesn’t degrade the quality of Ka‘ū’s unique natural and cultural landscape; 2) protects of mauka forests while ensuring responsible access for and use by residents; and 3) preserves and enhances the nā ‘ohana economy and incorporates the concept of reciprocity as part of koa canoe timber harvest. No aspect of the KKCMA Plan is inconsistent with the CDP.

3.7 Cumulative and Secondary Impacts

Cumulative effects may occur when the adverse effects of a proposed action are added to other past, present, and reasonably foreseeable future actions of any government or private entity. In some cases, the direct effects of a project may be minor but the cumulative effects significant.

In analyzing cumulative effects, it is important to first identify actions in nearby areas with the potential to have impacts that interact with those of the proposed project. As shown in Figure 1, KKCMA is near three areas – Hawaii Volcanoes National Park, the Kapāpala Forest Reserve and the Ka‘ū Forest Reserve – that are undergoing uses aimed primarily at conservation, although recreational, subsistence and gathering uses also occur there, particularly in the State of Hawai‘i units. KKCMA is also adjacent to Kapāpala Ranch, where the primary activity with potential to have interactive effects is cattle ranching. No major projects are known to be in planning for nearby areas. The localized, short-term disturbances at KKCMA caused by tree harvest, stand improvement, infrastructure and invasive species response may include effects to biota, noise, erosion, emissions, and scenic values, which are expected to be extremely minor, temporary and insignificant. These would not tend to accumulate with the ongoing conservation and ranching activities on the other nearby properties, where similar actions are highly dispersed over a very large area and have generally minor effects that are fully mitigated through their own management plans and/or standard management practices.

However, the harvest process can produce two categories of effects that while minor do have at least some potential to interact with those of other activities in Ka‘ū: helicopter extraction (which may occasionally occur) and transport of logs on oversize load large trucks on Highway 11 (which will occur for each harvested tree). The potential for significant cumulative effects from truck transport of logs is small. The expected harvest level would be 5 to 15 canoe logs per year, and it will frequently be the case that for logistical purposes, multiple trees will be harvested in the same operation. The number of days with oversize loads will thus likely be considerably fewer than 15, or approximately once per month. Furthermore, unlike other parts of the island where oversize loads are more common because of military, astronomy or wind turbine related transport, few oversize loads travel Highway 11 between Kapāpala and Hilo. Nonetheless, as discussed in Section 3.3, DOFAW will utilize the Special Use Permit process to coordinate during harvest operations with the Department of Transportation and the oversize load permit application to determine if any alternate scheduling is needed to reduce interaction with other planned oversize loads. As discussed in Section 3.5, helicopter operations are currently not a near-term operation expected to be implemented at KKCMA. If they were, they could produce brief but intense noise that is localized in the harvest area, and also brief, moderate noise while transiting from Hilo or other locations to the harvest site. However, even if implemented, the occasional helicopter extraction would not significantly alter the region’s soundscape or affect other users in a significant way, even when combined with tourist and resource management helicopter operations that are known to occasionally occur in Hawaii Volcanoes National Park, the Kapāpala Forest Reserve and the Ka‘ū Forest Reserve.

In sum, cumulative effects are negligible for most categories of effect and extremely minor for noise and oversize traffic.

Secondary impacts occur when projects induce physical and social impacts that are only indirectly related to the project – e.g., effects on housing scarcity when a major resort is constructed in a rural area. The project will not create a large number of new jobs that could lead to in-migration and will not cause stresses on government infrastructure or induce any other type of adverse secondary effects.

3.8 Summary of Mitigation Measures

DOFAW will implement or supervise the implementation of the following mitigation measures as part of KKCMA management. These mitigation measures may be modified as a result of feedback during adaptive management. Table 3 provides a summary of measures.

Table 3-1. Summary of Mitigation Measures

Subject (Reference)	Mitigation
Vegetation and Flora (3.1.1)	<ul style="list-style-type: none"> • Prior to activities with the potential to impact rare or T&E plants, botanists will conduct botanical surveys and identify and map any such species. • Inform regulatory agencies if T&E species found and implement further mitigation if needed. • Establish buffers of at least 50 feet in radius around any sensitive plants and flag area. No harvest, tree fall or skid roads allowed inside buffer. • Build facilities and route roads and trails in non-sensitive areas or in ways that protect rare plants. • Conduct weed control to avoid impacts to non-target species. • Staff, volunteers and contractors will follow protocols for cleaning of boots, equipment and vehicles to avoid introducing or spreading invasive plant species. <ul style="list-style-type: none"> • Provide kiosks for invasive species education and action for members of the public accessing the area. • Follow up monitoring of harvest areas will be used to track the presence and potential establishment of invasive weed populations.
Native Wildlife (3.1.2)	<ul style="list-style-type: none"> • Utilize extra caution between March 1 to September 30 during nesting and fledging season of several native bird species. Survey immediate area prior to harvest for native bird nests in or near trees being felled. • If hawks are nesting within 330 feet, the harvest will not proceed until the juvenile hawk has fully fledged. • Conduct annual bird surveys to verify the distribution of all species and particularly T&E species in order to optimize mitigation. • To protect Hawaiian hoary bats, no tree harvest or thinning operations that disturb trees or shrubs taller than 15 feet will occur between June 1 and Sept. 15. • Avoid installing any new top-strand barbed wire, which can entangle bat wings and injure or kill them. <ul style="list-style-type: none"> • Survey for rare or T&E native invertebrates and seek to avoid habitat and obligate host plants as part of adaptive management.
Wildfire, Pests and Invasive Fauna (3.1.3)	<ul style="list-style-type: none"> • Maintain perimeter road and interior crossroad as fuelbreaks. • Monitor drought and fire activity in surrounding areas to determine level of wildfire risk at KKCMA. Depending on fire risk, access to the area may be temporarily restricted. • Improve and maintain the helicopter landing zone to prepare for wildfire response.

	<ul style="list-style-type: none"> • Secure and identify water access to prepare for wildfire control. • Conduct assessment of koa pest insects and diseases as part of all monitoring activities, including timber inventory. • Assist and collaborate with partners to secure essential technical information and understanding of new threats. • Include ROD sanitation and prevention procedures in all project activities conducted by DOFAW and also for all collection permits issued for KKCMA, including minimizing wounds to ‘ōhi‘a trees during harvest operations. • Avoid damaging ‘ōhi‘a trees by hand-clearing a path for the machinery ahead of time. Place the path where valuable trees are less dense and make the path only as wide as needed to fit the machine. • Monitor for signs of increased ROD distribution within KKCMA. • Utilize forest bird surveys to monitor distribution of avian malaria. • Ensure that all pesticide use strictly follows labeling requirements. • Continue ongoing regular fence checks, monitor for cattle in order to prevent ingress and identify and remove any invading cattle. • Install cattle guards at strategic locations. • Monitor for sheep, mouflon, and goats via staff observations and game cameras to ensure they do not enter area and browse native vegetation. • Increase pig control in the area, including utilizing public hunting; implementing staff control through the use of trapping and staff hunting; and adding skirting to the fenceline as funds are available. • Monitor rats, cats and mongooses in order to reduce their populations. If control of rodents is implemented to protect native wildlife, it will use toxic baits with a low toxicity to non-target wildlife in enclosed bait stations carefully and in strict compliance with toxicant registration.
Climate and Geology (3.2)	<ul style="list-style-type: none"> • Conduct regular road maintenance, especially re-grading dirt roads and gravel-filling potholes in rocked/gravel roads, as necessary. • Keep skid trails generally at 3-5% slope and not over 10%. • Include water bars or drainage features on steeper skid trails. • In general, maintain and re-use existing skid trails, instead of clearing a new skid trail, especially if needed for ongoing weed control, enrichment planting, thinning, etc. GPS-marked all skid trails to maintain a location record. • If skid trails are retired, cover with harvest slash piles (treetops, small branches) as mulch to prevent erosion and use of discontinued trail. • To reduce erosion and for safety, halt operations during heavy rain and storm events and postpone until staff deem roadways safe.
Socioeconomic Conditions, Access, Hunting and Recreation (3.3)	<ul style="list-style-type: none"> • Harvest, stand improvement, and infrastructure improvements will focus on small areas at any one time and implemented so as to induce minimal interference with hunting, hiking, birding and forest resource gathering in KKCMA as a whole. • Pig hunting will continue to be permitted per regulations governing Hunting Unit B in forest reserves, with the goal of reducing the pig population to levels consistent with maintaining KKCMA management goals. • Ensure through the Special Use Permit for harvest that heavy equipment and logs are transported in accordance with all applicable regulations and that DOFAW and/or canoe organizations obtain the appropriate approvals per an Application to Operate or Transport Oversize and/or Overweight Vehicles and Loads over State Highways. • Ensure that truck weight loads are professionally estimated prior to transport on highways and to ports for off-island shipment.
Cultural Resources (3.4)	<ul style="list-style-type: none"> • If funding is approved, seek to hire at least one full-time staff member dedicated to managing KKCMA in order to facilitate access, reduce potential impacts to the

	<p>area's resources and associated practices, and coordinate communication with the community.</p> <ul style="list-style-type: none"> • Ensure that archaeological surveys of affected areas are conducted. DOFAW will consult with the DLNR-State Historic Preservation Division to determine the proper scope of the survey area(s). At a minimum, an archaeological survey will be undertaken once a potential harvest area is defined and before any harvesting activities are carried out. Areas where historic resources are identified will be demarcated on a map and made identifiable in the field. Efforts will be made to preserve in place all historic resources that may exist in the KKCMA project area. • Seek as part of management to utilize names of traditional places, Hawaiian environmental zones (wao) and associated individuals such as former konohiki in order to perpetuate the place-based knowledge of Kapāpala. • Collaborate in the development of educational and stewardship opportunities specific to Kapāpala and Ka'ū. Strongly encourage hālau who receive logs from the KKCMA to participate in such educational and stewardship activities. Promote community involvement in educational and stewardship opportunities and may partner with Ka'ū-based organization organization(s) with capacity to carry out such activities. • Require all hālau (organizations) to include and implement a plan for culturally appropriate forms of reciprocation when applying for the harvest of a koa log. This could include assisting with stewardship activities, participating in educational opportunities, and/or making culturally appropriate offerings. • The existing working group will continue to be utilized and will be formalized through the BLNR approval of the management plan and the canoe log allocation process, both of which highlight the integration of the working group. This group can help ensure appropriate cultural protocols are being followed and advise on planned activities. DOFAW will reach out to builders, kūpuna and kama'āina of Kapāpala and Ka'ū, canoe clubs, and other stakeholders. • Encourage utilization of the existing collection permit process to allow for gathering of usable forest products, including those damaged during harvest operations. • Post ample notice at the entrance into the KKCMA and any other appropriate outlets notifying the public when harvest activities are scheduled. Schedule and coordinate harvest activities to avoid unnecessary disruption to other planned (i.e. education or stewardship activities) or unplanned (subsistence or commercial gathering) activities, and to allow the forest to rest and regenerate until the next harvest.
Air Quality, Noise and Scenic Resources (3.5)	<ul style="list-style-type: none"> • Maintain all equipment to meet emissions specifications.
Consistency with Plans and Policies (3.6)	None warranted (Plan is consistent).
Secondary and Cumulative (3.7)	<ul style="list-style-type: none"> • Utilize the Special Use Permit process to coordinate during harvest operations with the Department of Transportation and the oversize load permit application to determine if any alternate scheduling is needed to reduce interaction with other planned oversize loads.

PART 4: DETERMINATION

Based on the findings below, and upon consideration of comments to the Draft EA, the Hawai‘i State Department of Land and Natural Resources (DLNR) has determined that the proposed action will not have any significant effect in the context of Chapter 343, Hawai‘i Revised Statutes and Chapter 11-200.1-13 of the State Administrative Rules, as impacts will be minimal, and will accordingly issue a Finding of No Significant Impact (FONSI).

PART 5: FINDINGS AND REASONS

Chapter 11-200.1-13, Hawai‘i Administrative Rules, outlines those factors agencies must consider when determining whether an Action has significant effects:

- (a) In considering the significance of potential environmental effects, agencies shall consider and evaluate the sum of effects of the project on the quality of the environment.
- (b) In determining whether an action may have a significant effect on the environment, the agency shall consider every phase of a project, the expected impacts, and the proposed mitigation measures. In most instances, an action shall be determined to have a significant effect on the environment if it may:
 1. *Irrevocably commit a natural, cultural, or historic resource.* Implementation of the Plan would substantially protect natural resources and benefit cultural practices and involve a balanced use of cultural and natural resources. Historic resources would be protected through incremental archaeological surveys that successively cover the small areas of harvest and infrastructure prior to any disturbance.
 2. *Curtail the range of beneficial uses of the environment.* No restriction of beneficial uses would occur and implementation would sustain beneficial cultural uses and habitat protection uses into the future.
 3. *Conflict with the State’s environmental policies or long-term environmental goals established by law.* The State’s long-term environmental policies are set forth in Chapter 344, HRS. The broad goals of this policy are to conserve natural resources and enhance the quality of life. The project is environmentally beneficial and minor, and it is thus consistent with all elements of the State’s long-term environmental policies.
 4. *Have a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community and State.* The project would not have any substantial adverse effect on the economic or social welfare of the Big Island community or the State of Hawai‘i. No valuable natural resources or cultural or recreational practices such as forest access, gathering, hunting, or access to ceremonial sites would be substantially affected. The social and economic welfare of the area would be enhanced through culturally appropriate and environmentally sustainable harvest of koa canoe logs.
 5. *Have a substantial adverse effect on public health.* The project would not affect public

health and safety in any adverse way.

6. *Involve adverse secondary impacts, such as population changes or effects on public facilities.* The project would not produce any major secondary impacts, such as population changes or effects on public facilities.
7. *Involve a substantial degradation of environmental quality.* The project is minor and environmentally benign, and thus it would not contribute to environmental degradation.
8. *Be individually limited but cumulatively have substantial adverse effect upon the environment or involves a commitment for larger actions.* Nearby areas where ongoing activities or new projects could generate adverse impacts that could accumulate with those of the proposed project include Hawaii Volcanoes National Park, the Kapāpala Forest Reserve, the Ka‘ū Forest Reserve and Kapāpala Ranch. The first three are undergoing uses aimed primarily at conservation, although recreation, subsistence uses and gathering also occur there. The latter supports cattle ranching. No major projects are known to be in planning for any of these nearby areas. The localized disturbances at KKCMA caused by tree harvest, stand improvement and invasive species response may include effects to biota, noise, erosion, emissions, and scenic values, which are expected to be extremely minor, temporary and insignificant. These would not tend to accumulate with the ongoing conservation and ranching activities on the other nearby properties, where similar actions are highly dispersed over a very large area and have generally minor effects that are fully mitigated through their own management plans and/or standard management practices. However, the harvest process can produce two categories of effects that while minor do have at least some potential to interact with those of other activities in Ka‘ū: helicopter extraction (which may occasionally occur) and transport of logs on oversize load large trucks on Highway 11 (which will occur for each harvested tree). The infrequent occurrence of truck transport related to KKCMA and the relative infrequency of other oversize loads on Highway 11 will minimize the potential for significant cumulative effects. If implemented in the future, helicopter operations could produce brief but intense noise that is localized in the harvest area, and also brief, moderate noise while transiting from Hilo or other locations to the harvest site. These operations would occur very infrequently, if at all (<5-10/ times year), and would not significantly alter the regions’ soundscape or affect other users in a significant way, even when combined with tourist and resource management helicopter operations that are known to occasionally occur in Hawaii Volcanoes National Park, the Kapāpala Forest Reserve and the Ka‘ū Forest Reserve. In sum, cumulative effects are negligible for most categories of effect and extremely minor for noise and oversize traffic.
9. *Have a substantial adverse effect on a rare, threatened, or endangered species, or its habitat.* Overview biological surveys have determined that various species of rare and T&E fauna are present and will require mitigation in order to avoid impacts. This mitigation is an integral component of the Plan. Rare and T&E plants have not been observed, but all actions will be preceded by a full botanical survey and mitigation measures will be implemented to prevent impacts.
10. *Have a substantial adverse effect on air or water quality or ambient noise levels.* No substantial effects to air, water, or ambient noise would occur. Localized and temporary effects

would occur during harvest, stand improvement and road maintenance. If any logs are extracted by helicopters in the future, more wide-ranging but minor, brief and infrequent noise impacts could occur. Erosion and sedimentation impacts will be avoided by implementation of Best Management Practices during Plan operations.

11. *Have a substantial adverse effect on or be likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.* Although the project would be located in an area with minor volcanic and moderate seismic risk, the entire Island of Hawai‘i shares this risk, and the Plan is not imprudent to implement. The project site is not located in a flood zone nor sensitive waters and would not affect any such areas. The project site is more than 3,000 feet above sea level and will not be affected directly by sea level rise. The project has adapted to climate change by accounting for the potential for larger storms in its extensive erosion BMPs.

12. *Have a substantial adverse effect on scenic vistas and viewplanes, during day or night, identified in county or state plans or studies.* The proposed action is not anticipated to adversely affect any vistas or viewplanes identified in county or State plans or studies and will benefit visual quality through maintenance of native forests. No lighting is involved.

13. *Require substantial energy consumption or emit substantial greenhouse gases.* While non-negligible amounts of energy input and greenhouse gas emission would be required for implementation, the Plan involves a sustainable forestry operation that will assist in carbon capture and storage.

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ENVIRONMENTAL ASSESSMENT

Kapāpala Koa Canoe Management Area Plan

APPENDIX 1

Kapāpala Koa Canoe Management Area Plan

For BLNR review copy of Final EA, the Management Plan has been submitted separately

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ENVIRONMENTAL ASSESSMENT

Kapāpala Koa Canoe Management Area Plan

APPENDIX 2a

Public Involvement, Response to Early Consultation

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geometrician

ASSOCIATES, LLC
integrating geographic science and planning

phone: (808) 969-7090 10 Hina Street Hilo Hawai'i 96720 rterry@hawaii.rr.com
geometricianassociates.com

February 17, 2023

Dear Neighbor or Agency/Organization Official:

Subject: Early Consultation for Environmental Assessment for Kapāpala Koa Canoe Management Area Management Plan, Island of Hawai'i

My firm is in the process of preparing a Draft Environmental Assessment (EA) for a proposed State of Hawai'i activity, in compliance with Chapter 343, Hawai'i Revised Statutes, and Title 11, Chapter 200.1, Hawai'i Administrative Rules. The Division of Forestry and Wildlife (DOFAW) of the Department of Land and Natural Resources (DLNR) is developing a Management Plan for the Kapāpala Koa Canoe Management Area (KKCMA). The Plan is part of an effort to provide a sustainable, long-term supply of koa for the traditional and cultural use of constructing koa canoes, while minimizing impacts on the natural and cultural resources in the area.

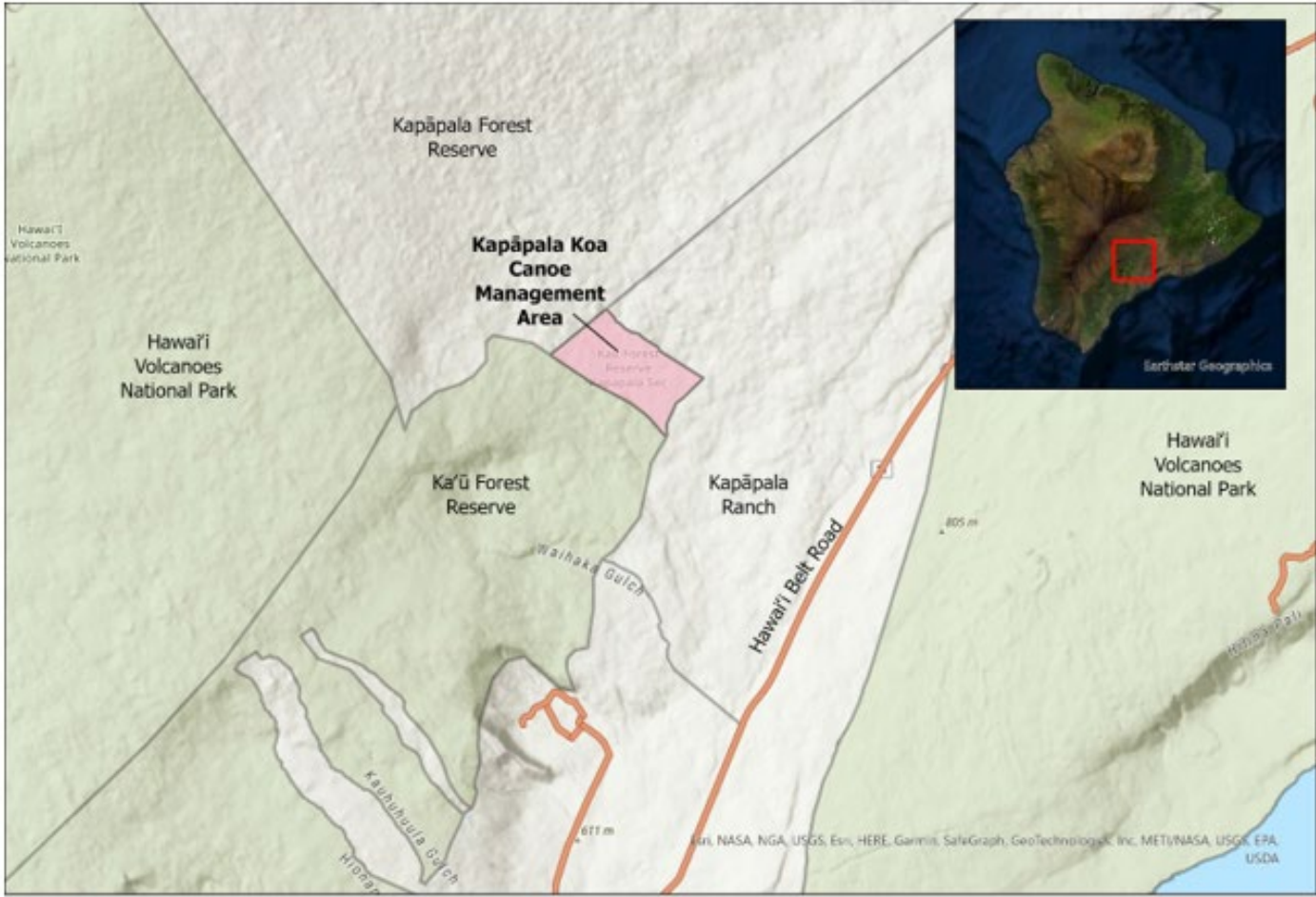
KKCMA consists of roughly 1,257 acres at about 3,000-5,000 feet in elevation on the southeastern slope of Mauna Loa, in the district of Ka'ū and the ahupua'a of Kapāpala (see map below). The area is covered almost entirely by a native koa and 'ōhi'a forest. This parcel is the only state land in Hawai'i specifically designated for the purpose of producing koa canoe resources. Other management objectives include protection of native forest, watershed resources, and bird habitat; increased regeneration and restoration of koa trees; collaboration with educational groups and community groups; access for recreational activities; and integration of traditional Hawaiian stewardship models with western conservation practices. A harvest plan will guide harvest and extraction of canoe-quality trees while regenerating koa resources on a 100-year timeframe. Organizations in the state of Hawai'i may apply for a permit to harvest a canoe log, which will be reviewed by a group of experts consisting of cultural practitioners; voyaging and racing members; kālaiwa'a (canoe builders); forestry experts; conservationists; and community members, who will advise DLNR and DOFAW on the final allocation of canoe log permits. Current plans call for organizations who have been selected to independently harvest and extract canoe logs with the guidance of DOFAW. It will be the ongoing job of DOFAW to implement stand improvement actions, such as pre-commercial and commercial thinning, that will enhance the ability of the forest to produce large, straight koa trees capable of being made into canoes. Some non-canoe quality timber resources may be sold to help fund the management of KKCMA.

Multiple protection measures will be implemented to ensure that the resources in the area are not degraded due to threats such as non-native animals, invasive weeds, human impacts, climate change, and/or erosion. In order to minimize impacts on threatened and endangered species as well as archeological and historical sites, botanists, ornithologists and archaeologists will undertake surveys in all areas prior to any silviculture actions taking place in that unit. Areas of higher value native forest and bird habitat will be designated as lower priority harvest areas.

The areas of investigation in the Environmental Assessment will include but not be limited to the following: health and safety; water quality assurance; flora, fauna, and ecosystems; access, road and traffic impacts; geology, soils, and hazards; flooding and drainage impacts; social, cultural and community impacts; historic sites; and economic impacts. I would appreciate your comments on any special environmental conditions or impacts related to the development. Please contact me at (808) 969-7090, or rterry@hawaii.rr.com, if you have any questions or require clarification. Kindly indicate whether you wish to receive notification of the EA's availability when it is completed.

Please note also that a first public release draft of the plan will be available online for public review within the next one to three months. Finalization of the management plan and the draft EA will occur after consideration of comments and suggestions from reviewing parties. If you wish to review this initial draft, please reply to this letter indicating so, and we will add you to the mailing list. On behalf of DOFAW, I thank you in advance for your attention and cooperation.

Ron Terry
Ron Terry, Ph.D.



JOSH GREEN, M.D.
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

HAWAII DISTRICT
50 MAKAALA STREET
HILO, HAWAII 96720
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March 2, 2023

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IN REPLY REFER TO:

HWY-H 23-2.0037

VIA EMAIL: rterry@hawaii.rr.com

Mr. Ron Terry
Geometrician Associates, LLC
Principal
10 Hina Street
Hilo, Hawaii 96720

Dear Mr. Terry:

Subject: Early Consultation for Environmental Assessment
Kapapala Koa Canoe Management Area Management Plan
Route 11 – Mamalahoa Highway
Kapapala, Kau, Hawaii
Tax Map Key: (3) 9-8-001:014

This is in response to your February 17, 2023, letter requesting comments on the Early Consultation for Environmental Assessment for Kapapala Koa Canoe Management Area Management Plan, Island of Hawaii.

Please identify the location of the access and route on the State highway to be utilized for the harvesting and transport of trees.

The proposed access and route should be designed and constructed for the appropriate vehicle characteristics and utilization. If any work is proposed within the State Highway Right-of-Way an approved Permit to Perform Work Upon State Highways shall be obtained prior to construction.

If the vehicle and/or load exceed the limitations of HRS 291-34 and -35 an approved Application to Operate or Transport Oversize and/or Overweight Vehicles and Loads over State Highways will be required.

Please contact me at (808) 933-8866 or by email at harry.h.takiue@hawaii.gov if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Harry H. Takiue".

HARRY H. TAKIUE
Hawaii District Engineer

April 21, 2023

23 E. Kawili St
Hilo, HI 96771
BIISC@hawaii.edu
www.biisc.org



Aloha Mr. Terry,

Thank you for reaching out in regards to the proposed Koa Canoe Management Plan for Kapāpala. We have no opposition to the proposed land use, but we must caution about the importance of stringent biosecurity measures to prevent the accidental introduction of invasive plants and animals to Kapāpala. This area is a relatively pristine native forest, and extra vigilance should be undertaken to ensure that any equipment, vehicles, and gear are completely free of seeds, vegetative material, and soil before proceeding into the area.

Our team has observed Rapid Ohī'a Death to be spreading in this area, particularly in the unfenced sections, so special consideration should be given to avoiding wounding of ohī'a as much as is possible during any activity. Bark wounding is the known point of entry for the fungi that cause ROD. Recommendations for cleaning equipment and vehicles here: <https://www.youtube.com/watch?v=CU6GH4PH-7I> and on the RapidOhiaDeath.org site.

Mahalo for the opportunity to comment on this project. Please do not hesitate to contact me for further information.

Franny Brewer
Manager
fbrewer@hawaii.edu

ENVIRONMENTAL ASSESSMENT

Kapāpala Koa Canoe Management Area Plan

APPENDIX 2b

Public Involvement, Comments to Draft EA and Responses



Siglo Tonewoods | PO Box 26 | Papa'aloa, HI 96780-0026

07 June 2023

Andy Cullison
Hawai'i Island Forestry Planner
Department of Land and Natural Resources
1151 Punchbowl Street #131
Honolulu, Hawai'i 96813

Re: Draft Environmental Assessment, Kapāpala Koa Canoe Forest (full support)

Aloha Mr. Cullison,

Siglo Tonewoods is a Hawai'i company focused on securing responsibly grown tropical hardwoods to manufacture guitars while improving native forest health. I am a forester with 23 years of Hawai'i forest management experience and have dedicated my professional career to planting and caring for native forests, particularly koa trees. I have also been involved in several projects that combine tree harvesting with native forest regeneration over thousands of acres.

Due to this commitment to native forest management, I have consistently participated in the Kapāpala Koa Canoe Forest (KCF) working group over the years and have eagerly awaited the release of the Draft Environmental Assessment and related Management Plan for KKCF.

This is a well-thought-out management plan for the KKCF. I believe it will achieve its goal of producing koa canoe logs consistently and in perpetuity while also improving the native forest.

Balancing the needs of native forest health with community needs and public access in the context of climate change and endangered species is challenging. However, you successfully balance these needs within the KCF by carefully setting out management regimes by forest type, reasonable restrictions on management practices, no-cut periods, and achievable harvest goals, and allowing sufficient flexibility for safe and efficient harvest operations.

I urge you to accept this draft Environmental Assessment and Finding of No Significant Impact.

Regards,

Nicholas Koch,
General Manager

geometrician

ASSOCIATES, LLC
integrating geographic science and planning

phone: (808) 969-7090 10 Hina Street Hilo Hawai'i 96720 rterry@hawaii.rr.com
geometricianassociates.com

July 11, 2023

Nicholas Koch, General Manager
Siglo Tonewoods
PO Box 26
Papa'aloa, HI 96780-0026

**Subject: Comment to Draft Environmental Assessment for 'Kapāpala Koa
Canoe Management Area Plan, TMK (3) 9-8-001:014, Kapāpala,
Ka'ū, County of Hawai'i, State of Hawai'i**

Dear Mr. Koch:

Thank you for your comment letter on the Draft EA dated June 7, 2023, in which you stated your opinion that that the management plan was well-thought-out and would achieve its goal of producing koa canoe logs consistently and in perpetuity while also improving the native forest. You also urged the BLNR to accept the Draft EA and issue a Finding of No Significant Impact. We very much appreciate your review of the document. If you have any questions, please contact Andy Cullison at (808) 436-8122 and james.a.cullison@hawaii.gov, or me, Ron Terry, the preparer of the EA, at (808) 969-7090, or rterry@hawaii.rr.com.

Sincerely,



Ron Terry, Principal

Cc: Andy Cullison, DLNR

Exhibit C

Summary of Comments Received and Responses Provided for the Kapāpala Koa Canoe Management Area (KKCMA) Management Plan

In total, four comments were received. Full copies of all comments are included as Appendix G of the final KKCMA Management Plan, and Exhibit C of this board submittal. Summary of comments are as follows:

Partner Comments:

Comment received from the US Fish and Wildlife Service

Comment: Ensure protection of watershed resources and federal and state-listed species and the essential habitat features they depend on. In particular, they expressed specific concerns and recommendations for avoiding harvesting activities in sections of KKCMA to avoid impacting habitat for ‘I‘iwi and other listed bird species. Recommended actions included redesignating the management class of select forest management units (FMU) 301-304 to resource protection, avoid harvesting in forest strata K04, and prioritizing harvesting to selected minimal FMUs, avoiding interior and higher elevation sections of KKCMA.

Response: DOFAW concurs that protection of watershed values, listed species and their habitat is important to the success of KKCMA and the goals of the area.

Public Comments:

Overall, three public comments were submitted about the draft KKCMA plan.

Native Tenants Protection Council

Comment: Wants to send a demand that absolutely no herbicides of any kind are to be used in the area, noting that numerous cultural practitioners visit the forest for Kahuna Lapa‘au.

Response: DOFAW appreciates and recognizes the use of the area for Kahuna Lapa‘au and their non-timber harvesting practices in the area. DOFAW does not plan any widespread use of herbicides on native understory species or other plants typically collected by Kahuna Lapa‘au, and all herbicide use would be targeted on controlling invasive, non-native species that threaten the integrity of the native ecosystems in the area that support Kahuna Lapa‘au, koa growth, and other natural and cultural resources. DOFAW believes the selective, targeted use of herbicides and other weed control efforts such as manual control or biocontrol as appropriate, are needed to maintain a healthy ecosystem that supports the resources in the area.

Mary Metcalf

Comment: Overall agrees that the plan is extremely well thought out and presented but would like to highlight the potential for skid roads and any actions that produce bare soil to be entry points for invasive plants to enter into KKCMA. It also mentioned that DOFAW best management practices for timber harvesting, Appendix F in the plan, does not mentioned invasive plant risks.

Response: DOFAW appreciates that creating skid roads and timber harvesting does lead to the

potential for disturbed habitat that invasive plants can colonize. In the plan, DOFAW mentions specific target weeds and DOFAW's goals for containment, eradication, or monitoring, this list of which includes weeds not currently in the reserve but found in nearby areas, as ones to monitor for and control. Monitoring before and after harvest and skid road construction is also planned, which will allow for rapid response to any incipient weed populations. Regarding the DOFAW best management practices for timber harvesting, DOFAW staff are currently planning to update this document which was created in the 1990s.

Bill Rosehill

Comment: Believes the harvest priority areas are backwards, and that higher elevation areas with older growth of koa trees should be targeted first. He states that environmentalists and protectionists trying to preserve T&E plants and animals have a misrepresentation of how forests should be managed and cites some specific times when dozers and harvesting have helped with certain species' recovery. Also believes all logs should be harvested at the same time instead of individually.

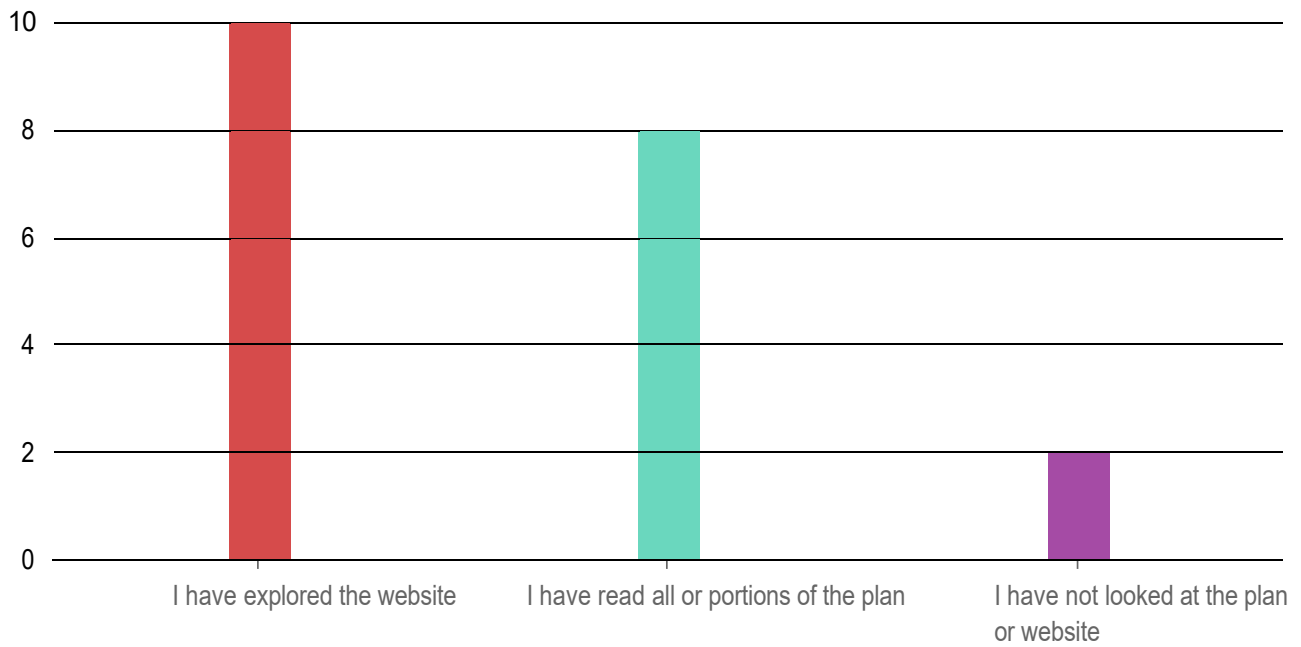
Response: Mr. Rosehill has been a part of the Kapāpala Koa Canoe Working Group, and the statements written in his comment have been heard and considered in previous planning meetings. DOFAW agrees that as allowable, logs by different groups should be harvested at the same time, and agrees that this will decrease cost to the organizations and impact on the forest. However, to allow flexibility for how individual organizations would like to practice their cultural and traditional practices during harvesting, DOFAW will keep the option open for organizations to implement different harvesting techniques that may require separate or individual harvesting from the area as needed.

Results of the Kapapala Koa Canoe Management Area Community Input Survey

A community input survey was also made available through the online platform, and 12 individuals responded. Management actions in the plan are in line with views expressed by the survey. Notably, 84% of survey respondents support timber harvest in the area, and when ranking management priorities, results of the survey followed the priorities outlined in the management plan. Full results of the survey are included below.

Kapāpala Koa Canoe Management Area Community Survey 2023

Have you reviewed the virtual guides or draft plan? *



Answers

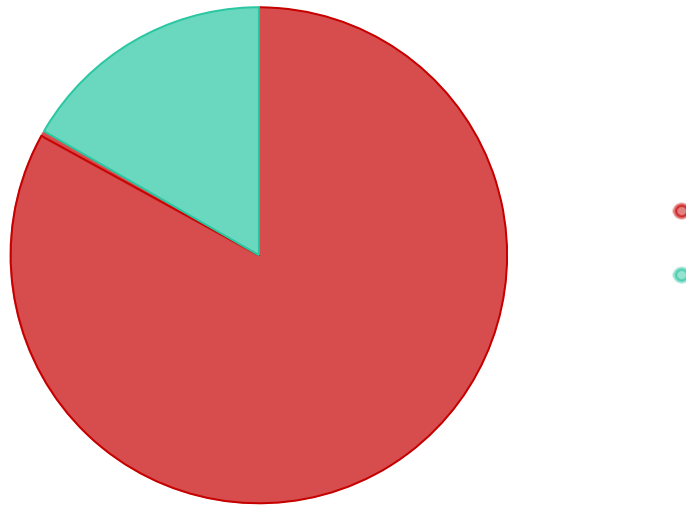
Count

Percentage

I have explored the virtual information guides on the website	10	83.33%
I have read all, or portions of the draft management plan and/or environmental assessment	8	66.67%
I have not looked at the draft plans or virtual information guides	2	16.67%

Answered: 12 Skipped: 0

*

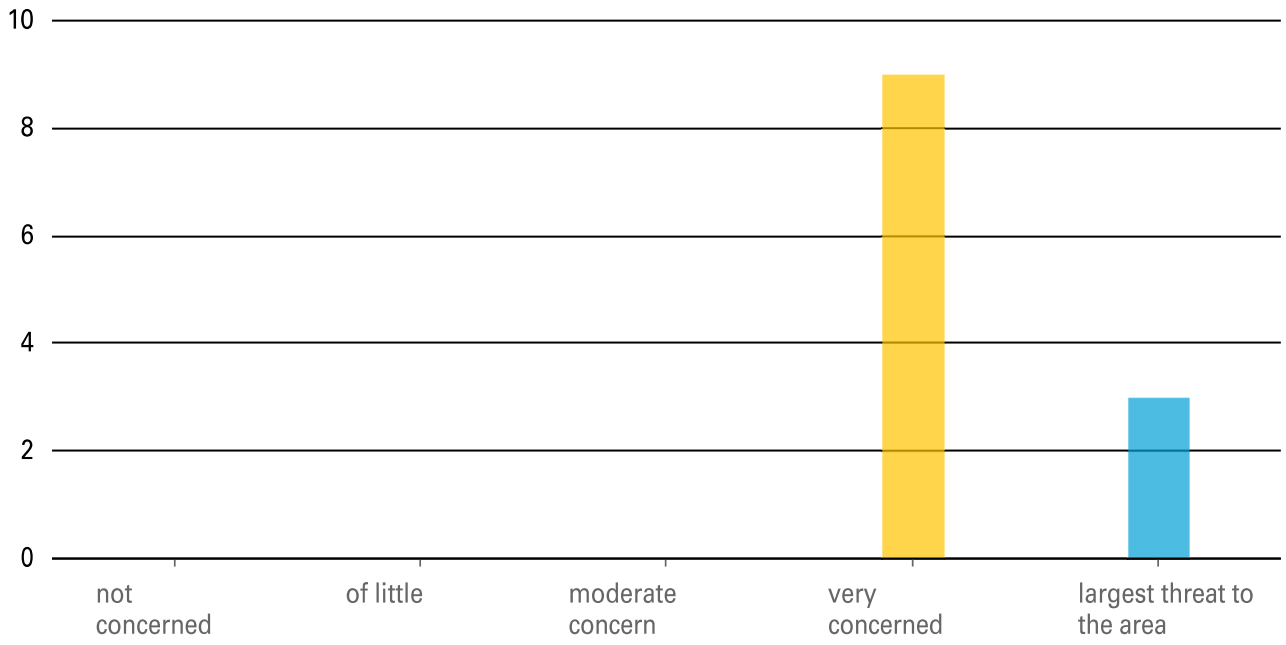


No	10	83.33%
Yes	2	16.67%

Please indicate your level of concern for the following threats to the natural resources of Kapāpala Koa Canoe Management Area:

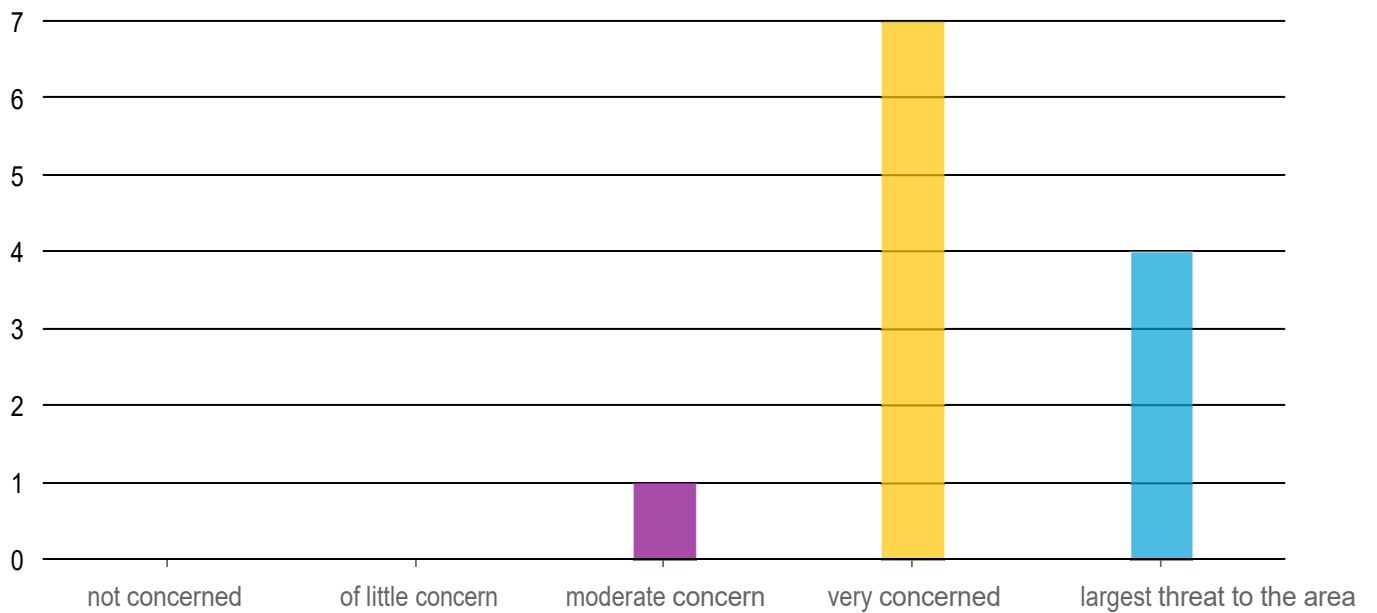
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not concerned	0	0%
of little concern	0	0%
moderate concern	0	0%
very concerned	9	75%
largest threat to the area	3	25%

○ *

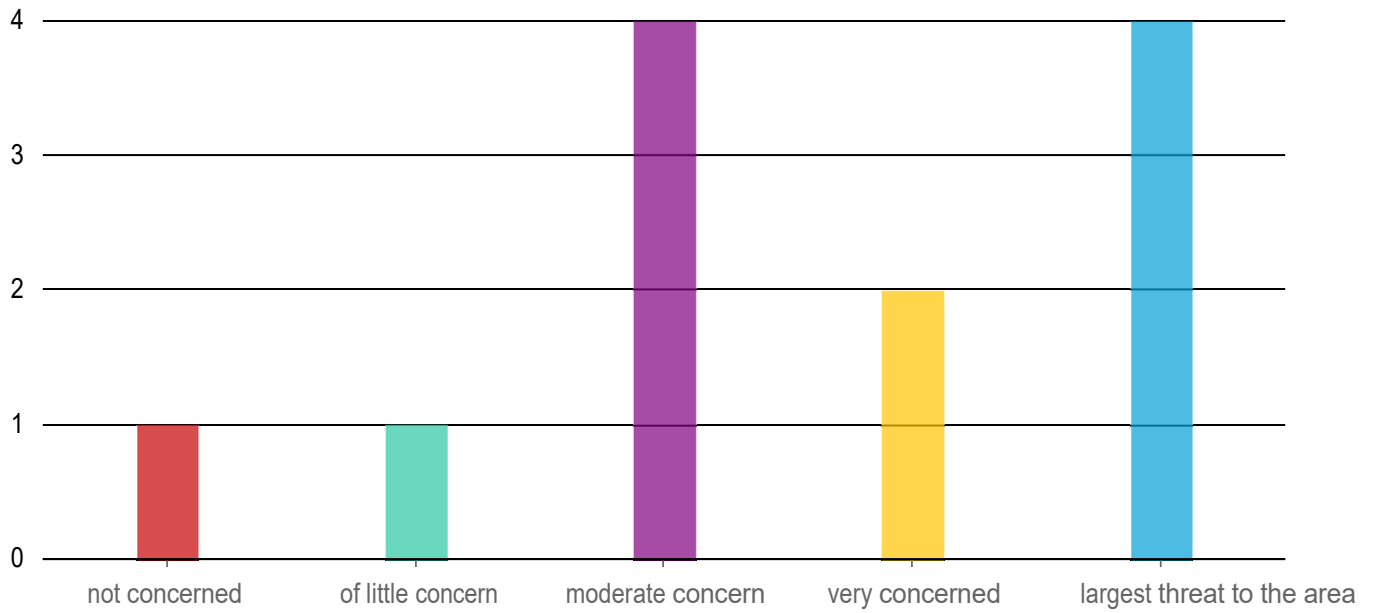


Answers **Count** **Percentage**

not concerned	0	0%
of little concern	0	0%
moderate concern	1	8.33%
very concerned	7	58.33%
largest threat to the area	4	33.33%

Answered: 12 Skipped: 0

Diseases and insects (koa wilt, rapid 'ōhi'a death, etc.) *

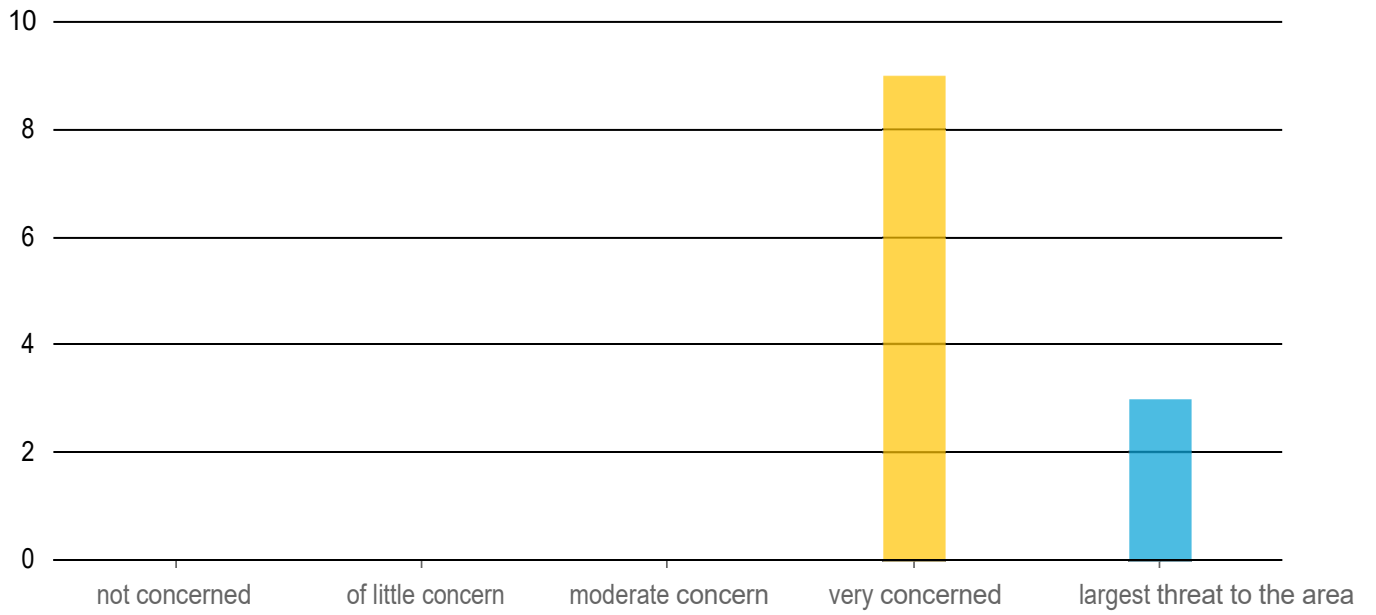


Answers **Count** **Percentage**

not concerned	1	8.33%
of little concern	1	8.33%
moderate concern	4	33.33%
very concerned	2	16.67%
largest threat to the area	4	33.33%

Answered: 12 Skipped: 0

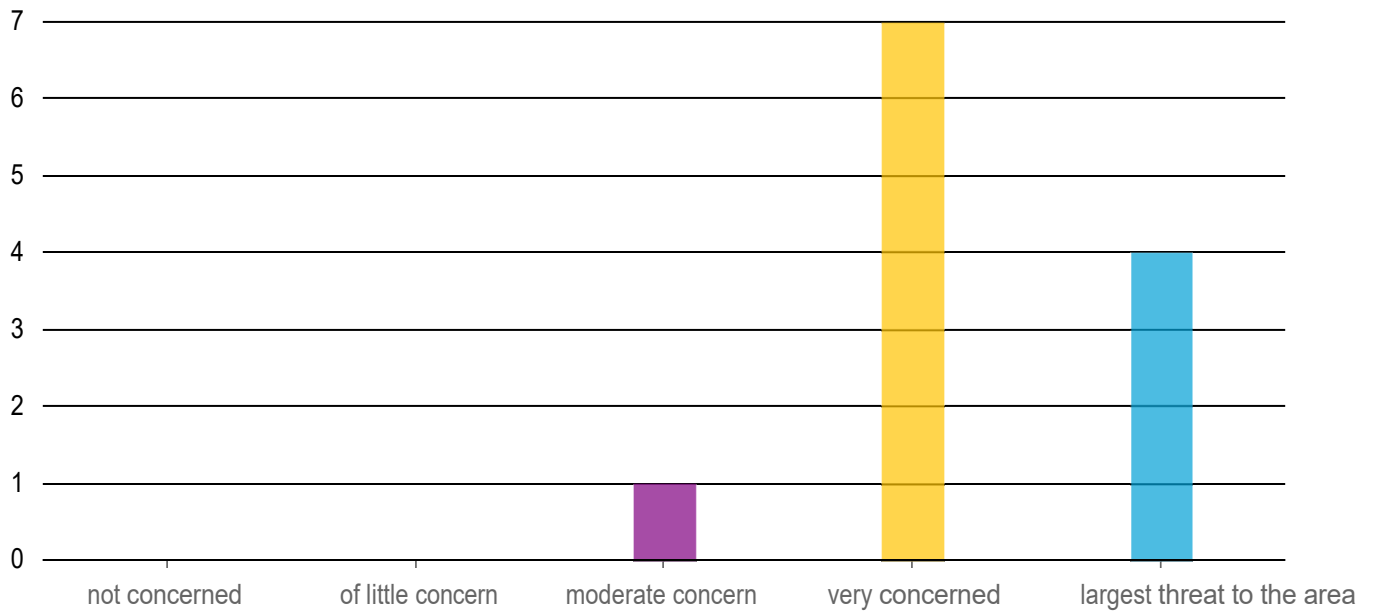
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Answers	Count	Percentage
not concerned	0	0%
of little concern	0	0%
moderate concern	0	0%
very concerned	9	75%
largest threat to the area	3	25%

Answered: 12 Skipped: 0

○ *



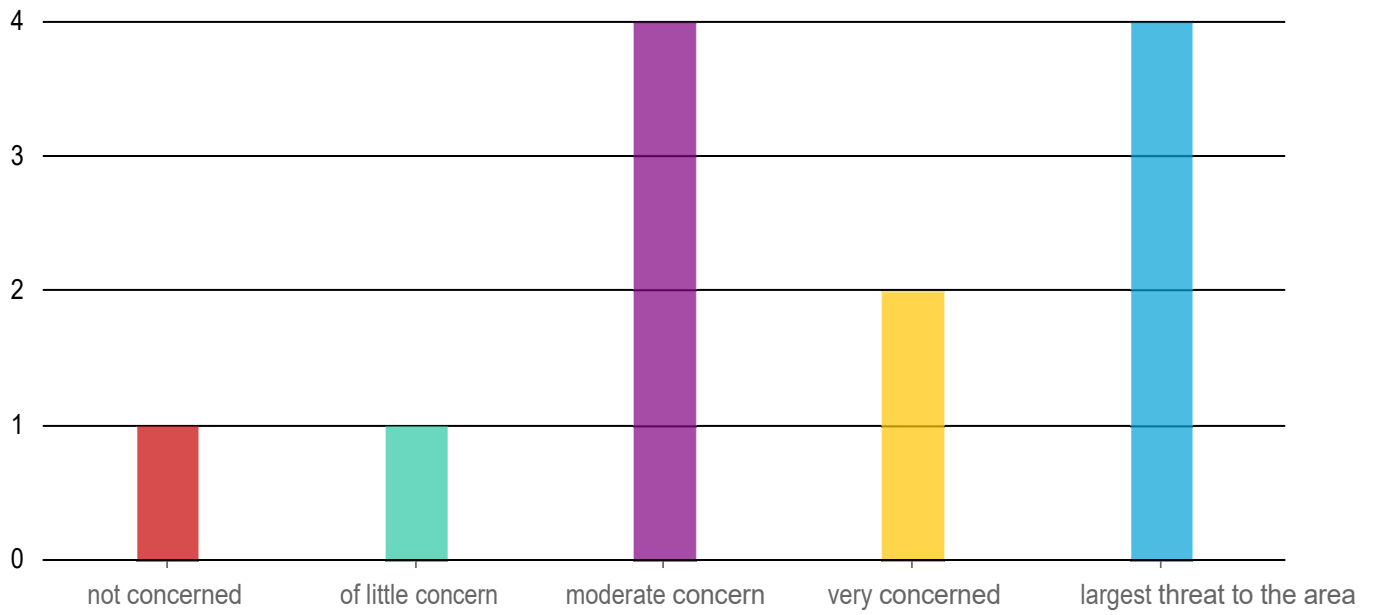
Answers **Count** **Percentage**

not concerned	0	0%
of little concern	0	0%
moderate concern	1	8.33%
very concerned	7	58.33%
largest threat to the area	4	33.33%

Answered: 12 Skipped: 0

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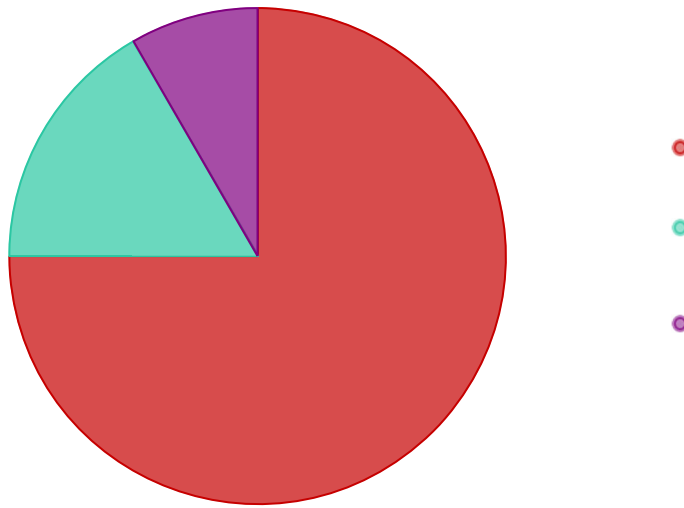


Answers **Count** **Percentage**

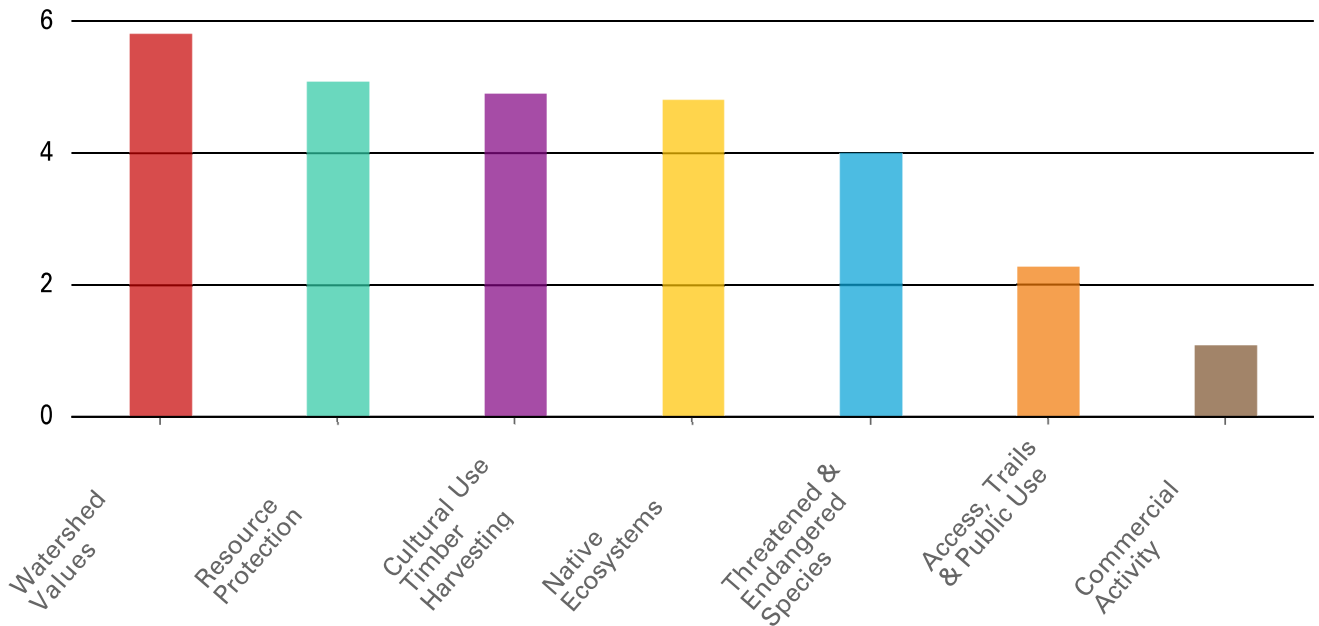
not concerned	1	8.33%
of little concern	1	8.33%
moderate concern	4	33.33%
very concerned	2	16.67%
largest threat to the area	4	33.33%

Answered: 12 Skipped: 0

*



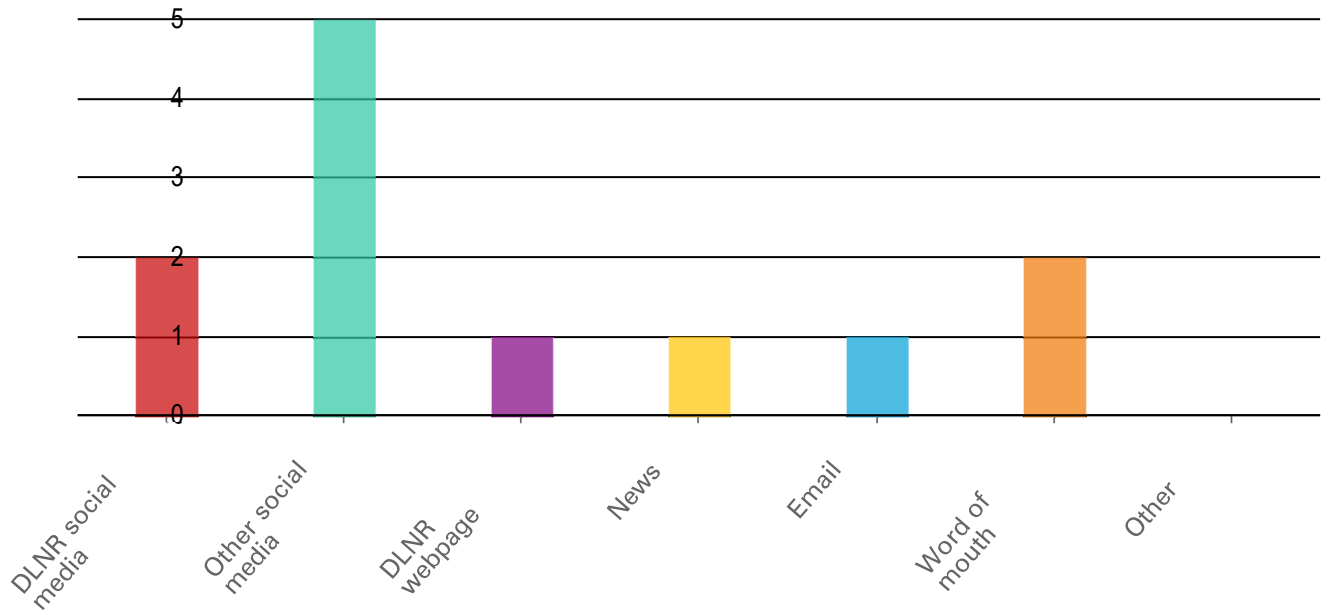
Fully support	9	75%
Do not support timber harvest in the area	2	16.67%
Support in concept, but have reservations on plans	1	8.33%



Rank	Answers	1	2	3	4	5	Average score	
1	Watershed Values (protect watershed values in the area)	18.18% 2	54.55% 6	18.18% 2	9.09% 1	0% 0	0% 0	5.82 0
2	Resource Protection (reduce damages from threats to the area)	18.18% 2	9.09% 1	36.36% 4	36.36% 4	0% 0		5.09
3	Cultural Use Timber Harvesting (small scale koa harvest for canoe construction)	27.27% 3	27.27% 3	18.18% 2	0% 0	0% 0	18.18% 2	4.91 1
4	Native Ecosystems (protect and enhance native ecosystems in the area)	18.18% 2	9.09% 1	18.18% 2	45.45% 5	9.09% 1		4.82

no		3
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Answers

**Count
Percentage**

DLNR social media	2	16.67%
Other social media	5	41.67%
DLNR webpage	1	8.33%
News	1	8.33%
Email	1	8.33%
Word of mouth	2	16.67%
Other	0	0%

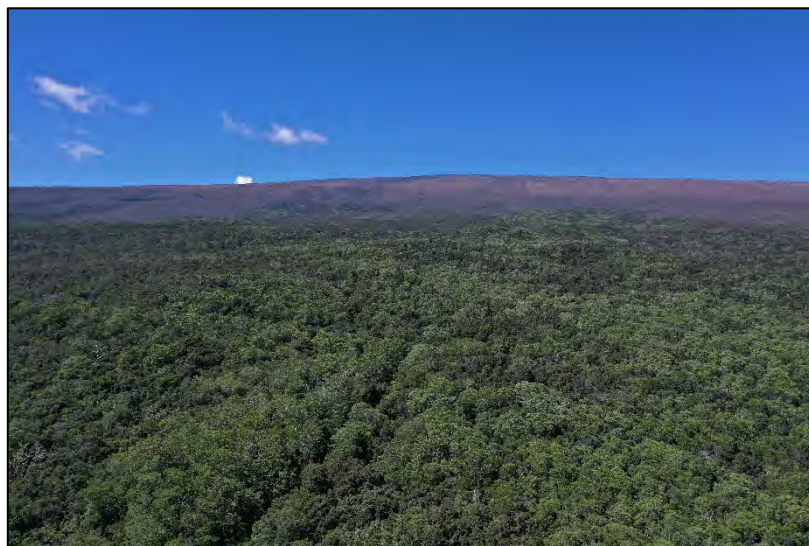
Exhibit D

Cultural Impact Assessment for the Kapāpala Koa Canoe Management Area

TMK (3) 9-8-001:014

Kapāpala Ahupua‘a
Ka‘ū District
Island of Hawai‘i

FINAL VERSION



Prepared By:
Lokelani Brandt, M.A. and
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Prepared For:
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ASM Project Number 39580.00

Cultural Impact Assessment for the Kapāpala Koa Canoe Management Area

TMK (3) 9-8-001:014

Kapāpala Ahupua‘a
Ka‘ū District
Island of Hawai‘i



CHAPTERS

	Page
1. INTRODUCTION	1
PROJECT AREA DESCRIPTION	5
Vegetation and Gulches.....	10
2. BACKGROUND	14
RESEARCH METHODS.....	14
CULTURE-HISTORICAL CONTEXT	14
PRACTICES AND CUSTOMS OF TRADITIONAL HAWAIIAN CANOE MAKING	17
Beginning Rituals of the Kahuna Kālaiwa‘a.....	20
The Ascent to the Koa Forest.....	21
Consulting The ‘Elepaio.....	22
The Cutting and Felling Rituals	22
The Final Hewing Process.....	24
Hauling the Roughly Hewn Log to the Coast	25
CULTURE-HISTORY OF KAPĀPALA AHUPUA‘A	27
The Environmental Setting and Resilient Kinship Networks	28
Ethnographic Accounts of Settlement of Ka‘ū and ‘ <i>Aumāku</i> a Worship.....	30
LEGENDARY ACCOUNTS FEATURING KAPĀPALA	31
Ke Koa Nui Weliweli Ma Waena o Pele a me Waka.....	32
Chief Kapāpala Taunts Pele and Meets Certain Death at Kīlauea.....	34
Battle Between Pele and Kamapua‘a	34
Story of Nānaele.....	35
KA‘Ū ALI‘I FROM THE PRECONTACT TO EARLY HISTORIC PERIOD.....	36
The Reign of ‘Umi a Līloa to Keawenuia‘umi.....	36
Keawenuia‘umi and the Rise of the ‘Ī Chiefs	37
The Reign of Lonoikamakahiki down to Kīwala‘ō and Kamehameha	38
The Era of Keōuakū‘ahu‘ula and Kamehameha I (1782-1819).....	39
Death of Kamehameha, the Overturning of the ‘ <i>Aikapu</i>	43
EARLY EUROPEAN VISITORS AND MISSIONARY ACCOUNTS	44
Archibald Menzies 1794 Trip to Mauna Loa via the ‘Ainapō Trail in Kapāpala	44
William Ellis’ 1823 Pass Through Kapāpala	46
E.W. Clark’s Brief Visit to Kapāpala.....	47
Chester H. Lyman, 1846 Observes Canoe Sheds in Kapāpala and Population Decline in Ka‘ū	47
KAPĀPALA DURING THE MID TO LATE 19 TH -CENTURY TO PRESENT DAY.....	49
<i>Māhele ‘Āina</i> of 1848.....	49
Boundary Commission Testimony.....	50
<i>Pulu</i> Trade and Other Mid-19 th -Century Agricultural Endeavors	53
History of Kapāpala Ranch, the 1868 Eruption, and the Establishment of the Ka‘ū Forest Reserve	54
PREVIOUS ARCHAEOLOGICAL AND CULTURAL STUDIES IN KAPĀPALA	67
3. CONSULTATION.....	68
OUTREACH EFFORTS	68

CONSULTATION METHODOLOGY	71
SUMMARY OF WORKING GROUP MEETING NOTES	71
DOUGLAS “DOUG” BUMATAY	74
LANI CRAN PETRIE AND DALE & JODY FERGESTROM.....	76
JOHN REPOGLE.....	78
KALĀHO‘OHIE MOSSMAN, EDITH KANAKA ‘OLE FOUNDATION	80
KATIE KAMELAMELA, PH.D.	81
4. IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS.....	83
SUMMARY OF CULTURAL-HISTORICAL BACKGROUND INFORMATION	84
IDENTIFICATION OF TRADITIONAL AND CUSTOMARY PRACTICES, VALUED CULTURAL RESOURCES	86
Forest Resources and Harvesting of Avian and Plant Resources.....	86
<i>Kālaiwa ‘a</i> and <i>Māmaki</i> Cultivation Settlement	87
Trails.....	87
Caves	87
Water Resources.....	87
Ranching.....	87
Hunting.....	87
RECOMMENDATIONS AND CONCLUSION.....	88
Dedicated KKCMA Staff.....	88
Archaeological Survey	88
Use of Traditional Place Name	88
Improve Fencing.....	89
Education and Stewardship Opportunities	89
Reciprocation.....	89
Formalize the Existing KKCMA Working Group or Establish Another Working Group.....	89
Repurposing Inadvertently Destroyed or Damaged Vegetation.....	89
Coordinate Harvesting Efforts.....	89
Conclusion.....	90
REFERENCES CITED.....	91
APPENDIX A. KA WAI OLA PUBLIC NOTICE	101
APPENDIX B. PIGS IN HAWAI‘I, FROM TRADITIONAL TO MODERN (MALY ET AL. N.D.).....	103

FIGURES

	Page
1. Project area location.....	2
2. Tax Map (3) 9-8-01 showing project area located within Parcels 014 (1-B).....	3
3. Google Earth™ satellite image showing project area location.....	4
4. Map showing various forest reserves around the project area.....	5
5. Entrance into the KKCMA, view to the west.....	6
6. Access road and cattle fencing along the eastern boundary of the KKCMA, view to the northeast.....	6

FIGURES

	Page
7. Northeastern corner of the KKCMA with Kapāpala Ranch in the background beyond the fence, view to the northeast.....	7
8. View of access road and forest along the northwestern corner of KKCMA, view to the southwest.....	7
9. View of access road and forest along the southwest corner of the KKCMA, view to the east.....	8
10. Access road extending north-south across the KKCMA, view to the north.....	8
11. Geology underlying the project area.....	9
12. Soils in the project area.....	10
13. Forest strata in the KKCMA.....	11
14. View of forest within the northern portion of K01, view to the southeast.....	12
15. View of forest within K02 along the central (north-south) access road, view to the south.....	12
16. View of forest along the northern portion of K03, view to the northwest.....	13
17. View of forest in K04, view to the southeast.....	13
18. Mr. A. Lister and Kaiopua with a <i>koa</i> canoe at Kealakekua, Kona, Hawai‘i. Photo courtesy of K. P. Emory, Bishop Museum Archives (SN 10480).....	18
19. Five men preparing to haul an unfinished canoe to Hōnaunau, South Kona, to be finished; Hawai‘i. Photo courtesy of K. P. Emory, Bishop Museum Archives.....	26
20. Hawai‘i Registered Map 2060 from J.M. Donn (1901) showing KKCMA project area in Kapāpala, Ka‘ū.....	27
21. Handy and Pukui’s (1998:19) cartographic sketch overlaid on a Google Earth aerial showing the <i>wao</i> in Ka‘ū.....	29
22. Hawai‘i Registered Map 510 from 1874 by Lydgate showing project area in the “koa woods” portion of Kapāpala Ranch and fissure extending from Kīlauea through Kapāpala.....	56
23. Kapāpala Ranch headquarters ca. late 19 th or early 20 th century (from Kapāpala Ranch website).....	58
24. A portion of Hawai‘i Registered Map No. 2361 prepared by Geo Wright in 1905-06 shows the project area adjacent to the northeastern boundary of the Ka‘ū Forest Reserve.....	60
25. Territorial survey map of Kapapala from 1907 by E.D. Baldwin (From the collection of Lani Petrie at Kapāpala Ranch).....	60
26. Portion of Hawai‘i Registered Map 2388 from 1907 prepared by E.D. Baldwin and Geo F. Wright showing project area adjacent to the Ka‘ū Forest Reserve.....	61
27. 1921 USGS Kilauea Quadrangle map showing the project area and water pipelines throughout the ranch.....	62
28. 1924 USGS Kilauea Quadrangle map showing the project area and water pipelines throughout the ranch.....	62
29. Hawai‘i Registered Map No. 2829 by C. Murray shows the project area in 1928.....	63
30. Hawai‘i Registered Map No. 2838 by C. Murray depicts the project area in 1930.....	64
31. Map titled “A Portion of Kapapala Ranch Kau-Hawaii” prepared by Peter E. Arioli in 1930 shows the project area within a portion of Yamaoka Paddock No. 2.....	65
32. 1967 USGS map showing the project area within the Yamaoka Paddock No. 1 and Ainapo Paddock.....	66
33. 1977 aerial photo showing the project area within the Yamaoka Paddock No. 1.....	67

TABLES

	Page
1. Hawaiian <i>koa</i> terminology from Holmes (1981:21).....	19

Table of Contents

2. <i>Akua</i> associated with canoe making (* <i>akua</i> mentioned by Malo and Kalokuokamaile).....	20
3. Hawaiian terminology associated with the different types of hauling duties.	25
4. Members of the Working Group.....	69
5. Dates of Working Group meetings.	70
6. Persons and organizations contacted for consultation.	70

1. INTRODUCTION

At the request of Forest Solutions Inc. on behalf of the State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW), ASM Affiliates (ASM) has prepared this Cultural Impact Assessment (CIA) to inform a Hawai‘i Revised Statutes Chapter 343 Environmental Assessment (EA) being prepared for the Kapāpala Koa Canoe Management Area (KCCMA). The KCCMA is synonymous with Tax Map Key (TMK) (3) 9-8-001:014 (1-B), a 1,257-acre agricultural-zoned parcel (referred to hereafter as the ‘project area’) that is a part of the Ka‘ū Forest Reserve, in Kapāpala Ahupua‘a, Ka‘ū District, Island of Hawai‘i (Figures 1, 2, and 3). The primary purpose of the KCCMA is to provide for sustainable production and supply of *koa* (*Acacia koa*) for the construction of *koa* canoes used customarily for fishing, outrigger canoe racing, and voyaging. Secondary management objectives include native forest protection, protection of watershed resources, protection of forest bird habitat, collaboration with educational and community groups, access for certain recreational activities, and integration of traditional Hawaiian stewardship models with Western conservation practices.

This CIA, which is intended to inform an EA conducted in compliance with HRS Chapter 343, is being prepared pursuant to Act 50 and in accordance with the Environmental Review Program (formerly known as the Office of Environmental Quality Control [OEQC]) *Guidelines for Assessing Cultural Impacts*, adopted by the Environmental Council, State of Hawai‘i, on November 19, 1997 (OEQC 1997). Act 50, which was proposed and passed as Hawai‘i State House of Representatives Bill No. 2895 and signed into law by the Governor on April 26, 2000, specifically acknowledges the State’s responsibility to protect native Hawaiian cultural practices. Act 50 further states that environmental studies “. . . should identify and address effects on Hawaii’s culture, and traditional and customary rights” and that “native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the ‘aloha spirit’ in Hawai‘i. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on governmental agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.”

The current report is divided into four main chapters. Chapter 1, the introduction, includes an overview of the proposed KCCMA project as well as a physical description of the project area. To provide a cultural context of the project area and traditional Hawaiian canoe carving practices, Chapter 2 begins with a historical review of traditional practices and beliefs associated with *koa* harvesting and canoe making. This chapter also includes cultural-historical background information specific to the project area and the broader geographical region of Kapāpala, and at times the greater Ka‘ū District. This chapter also includes a summary of prior archaeological and cultural studies that have been conducted within or near the project area. The methods and results of the consultation process are then presented in Chapter 3. Lastly, Chapter 4 includes a discussion of potential cultural impacts as well as actions and strategies that may help to mitigate any identified impacts.

1. Introduction

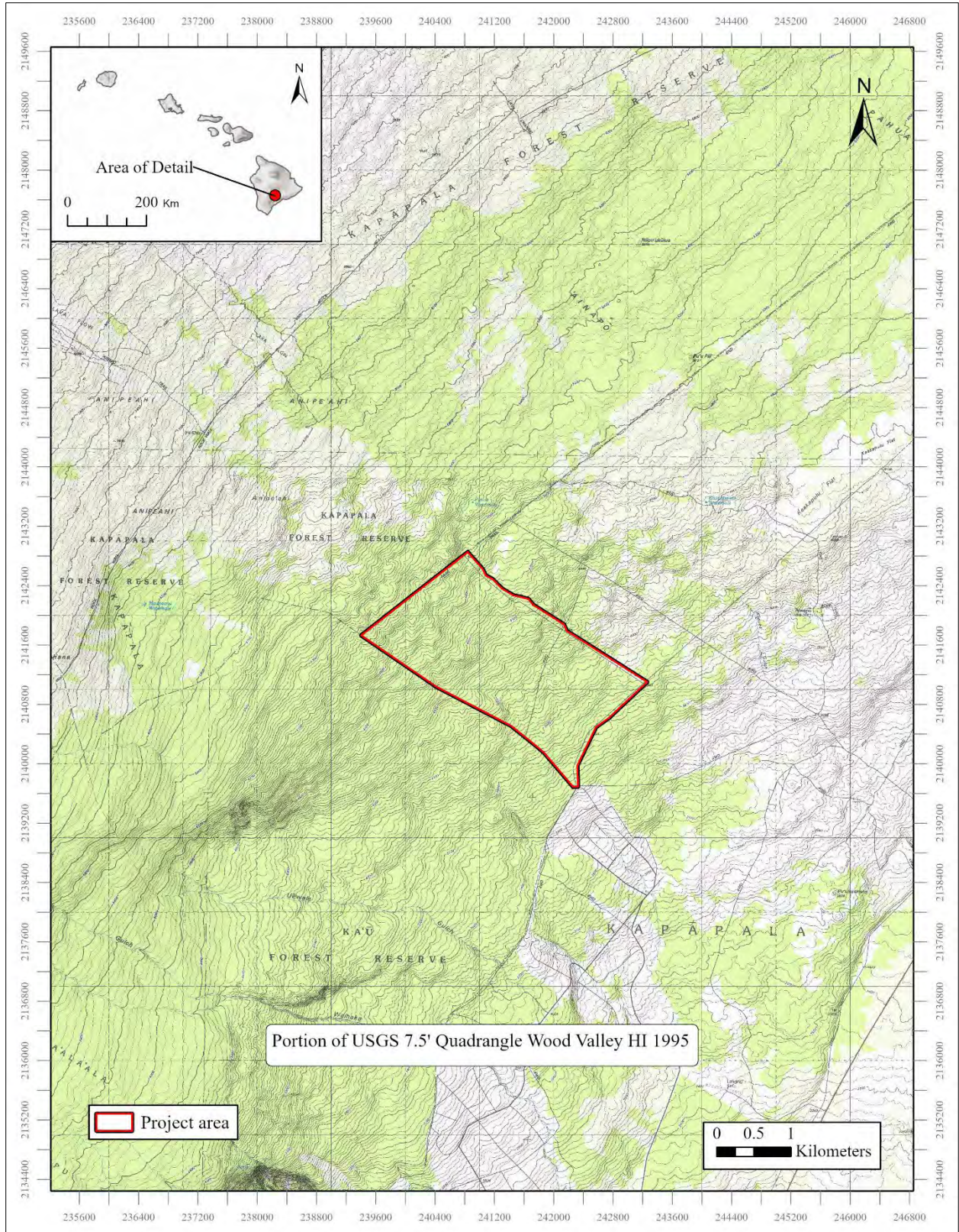


Figure 1. Project area location.



Figure 3. Google Earth™ satellite image showing project area location.

PROJECT AREA DESCRIPTION

The project area is situated along the eastern slopes of Mauna Loa between roughly the 1,132-meter (3,713 feet) and 1,552-meter (5,091 feet) elevation in Kapāpala Ahupua‘a, Ka‘ū District. The 1,257-acre KKCMA project area is within the Kapāpala Section of the Ka‘ū Forest Reserve, and it is surrounded by other State-owned lands including other sections of the Ka‘ū Forest Reserve to the southwest, the Kapāpala Forest Reserve to the northwest, and public lands under general lease and revocable permits to Kapāpala Ranch to the northeast and southeast (Figure 4). Portions of Kapāpala Ranch are also a cooperative game management area. The project area is located roughly 3.2-miles *mauka* (west) of Māmalahoa Highway (also known as Highway 11 or Hawai‘i Belt Road), 11 miles east of Moku‘āweoweo Crater, and 11 miles west of Halema‘uma‘u. Access to the KKCMA is through Kapāpala Ranch. At the southeastern boundary of the project area is a gate (Figure 5) that leads into the KKCMA. An unpaved road and cattle fencing extends along the entire perimeter of the project area (Figures 6, 7, 8, and 9). The central portion of the project area parcel is also bisected by an unpaved road (oriented roughly north-south) shown below in Figure 10.

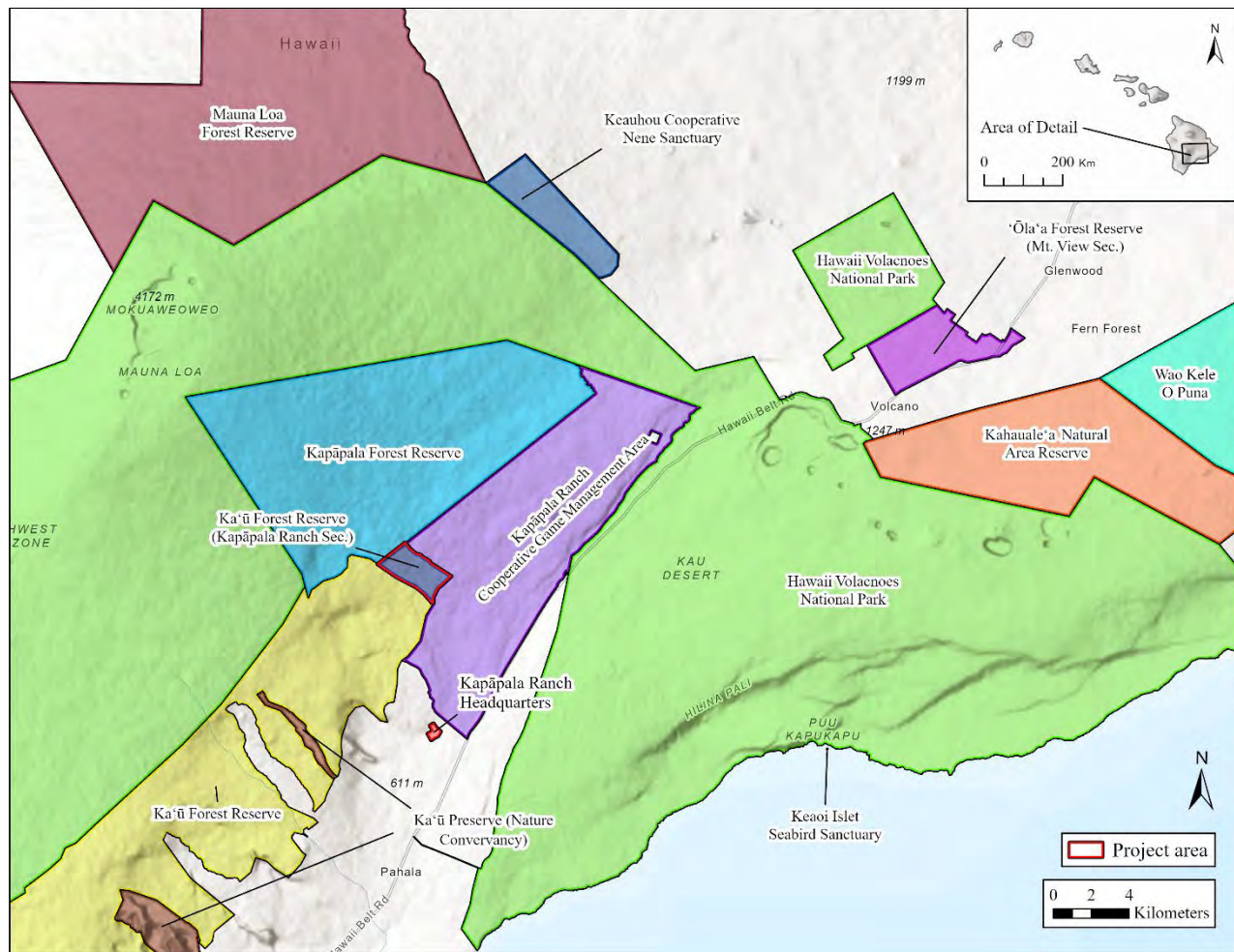


Figure 4. Map showing various forest reserves around the project area.



Figure 5. Entrance into the KKCMA, view to the west.



Figure 6. Access road and cattle fencing along the eastern boundary of the KKCMA, view to the northeast.



Figure 7. Northeastern corner of the KKCMA with Kapāpala Ranch in the background beyond the fence, view to the northeast.



Figure 8. View of access road and forest along the northwestern corner of KKCMA, view to the southwest.



Figure 9. View of access road and forest along the southwest corner of the KKCMA, view to the east.



Figure 10. Access road extending north-south across the KKCMA, view to the north.

At this elevation, the annual precipitation rate is about 83 inches and fluctuates seasonally. During *ho‘oilo* (the wet season) between October and March, the project area received anywhere between 5 to 9 inches monthly and can drop as low as 3 inches during *kau* (dry season) lasting between April through September (Giambelluca et al. 2013). The air temperature in the project area is relatively cool and dips as low as 56° Fahrenheit during *ho‘oilo* and increases slightly to about 62° Fahrenheit during *kau* (Giambelluca et al. 2014). The geology underlying the KKCMA is comprised entirely of *pāhoehoe* flows originating from Mauna Loa between 750-1,500 years ago and mapped in Figure 11 as “Qk3.” Three soil types have been mapped in the project area with the most dominant being Kaholimo medial silt loam with a 10 to 20 percent slope which is mapped in Figure 12 as “573.” Two less dominant soil types are also present including another Kaholimo medial silt loam with a 3 to 10 percent slope found along the northeastern boundary and labeled in Figure 12 as “617” and Alapai hydrous silty clay loam with a 10 to 20 percent slope mapped in Figure 12 as “517” and found along the southeast corner of the project area.

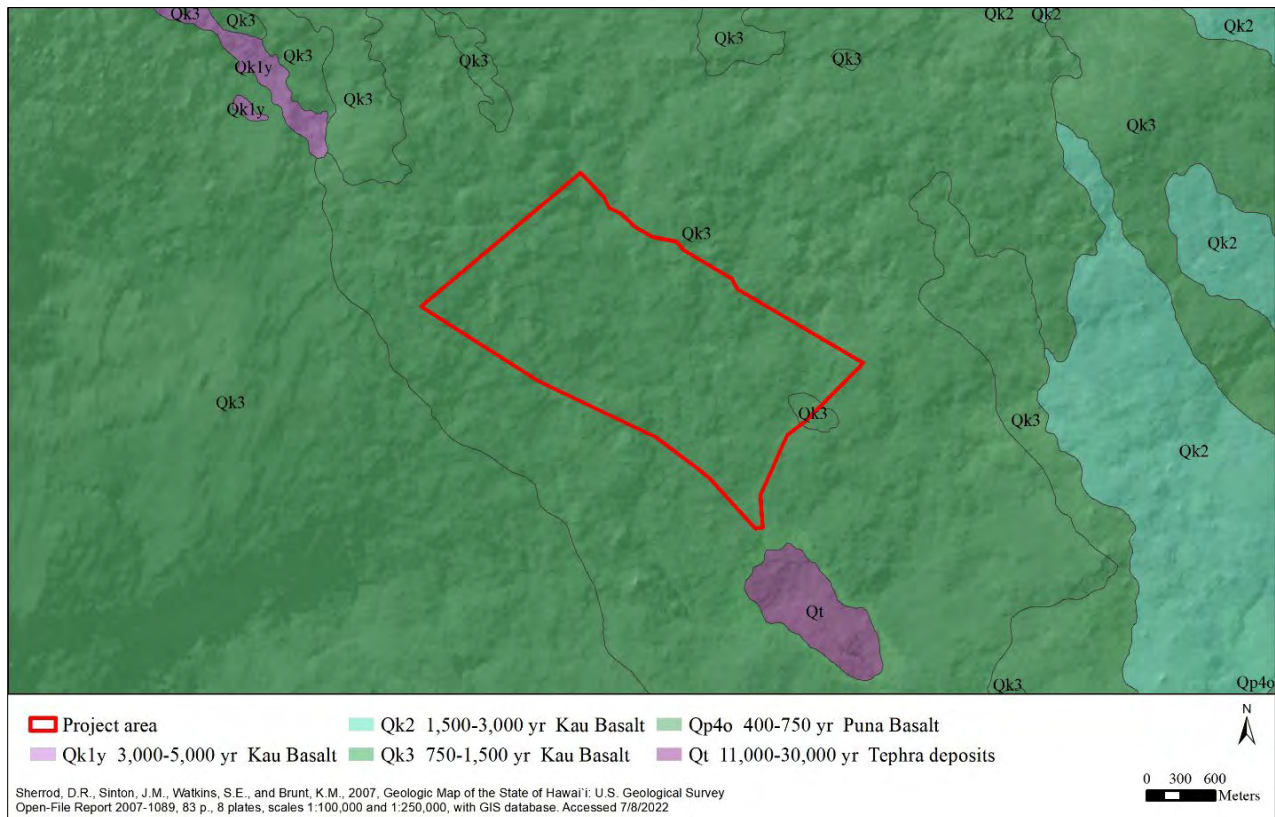


Figure 11. Geology underlying the project area.

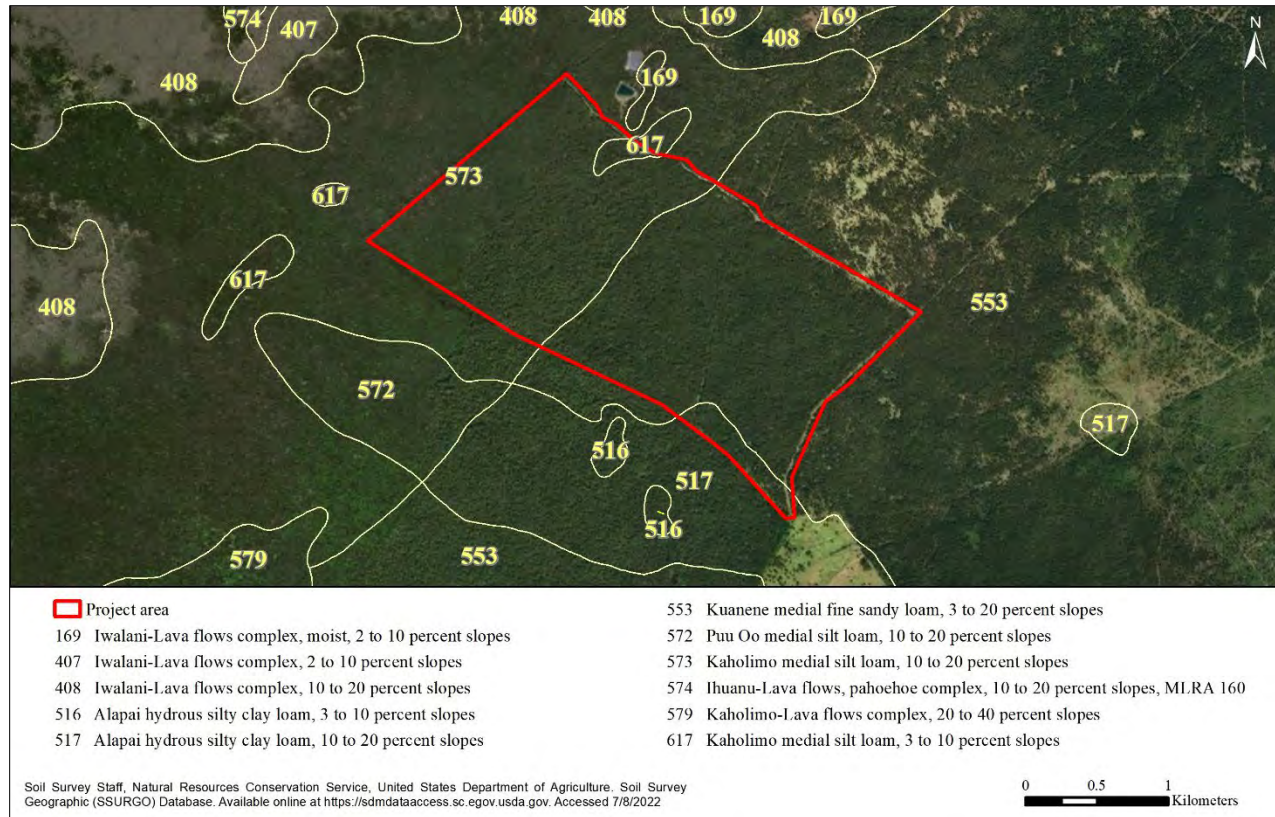


Figure 12. Soils in the project area.

Vegetation and Gulches

The vegetation within the KKCMA is dominated by mesic montane native *koa-‘ōhi‘a* forest. Recent field observations and data collected during forest inventories have divided the vegetation in the project area into four strata (Figure 13), which is largely based on vegetation cover. At the lowest elevation is K01 described as an open ‘Ōhi‘a Forest inclusive of 324 acres (Figure 14). Situated *mauka* of K01 is K02, an open Koa-‘Ōhi‘a Forest inclusive of 386 acres (Figure 15). *Mauka* of K02 is K03 described as a closed Koa-‘Ōhi‘a Forest comprising some 323 acres (Figure 16). At the *mauka*-most end of the project area is K04, described as a mature Koa Forest containing 207 acres (Figure 17). There are at least four gulches of various sizes that extend through the project area, two of which are named. Po‘opipi Gulch extends along the northeastern portion of the project area and Honanui Gulch along the southwestern portion of the project area.

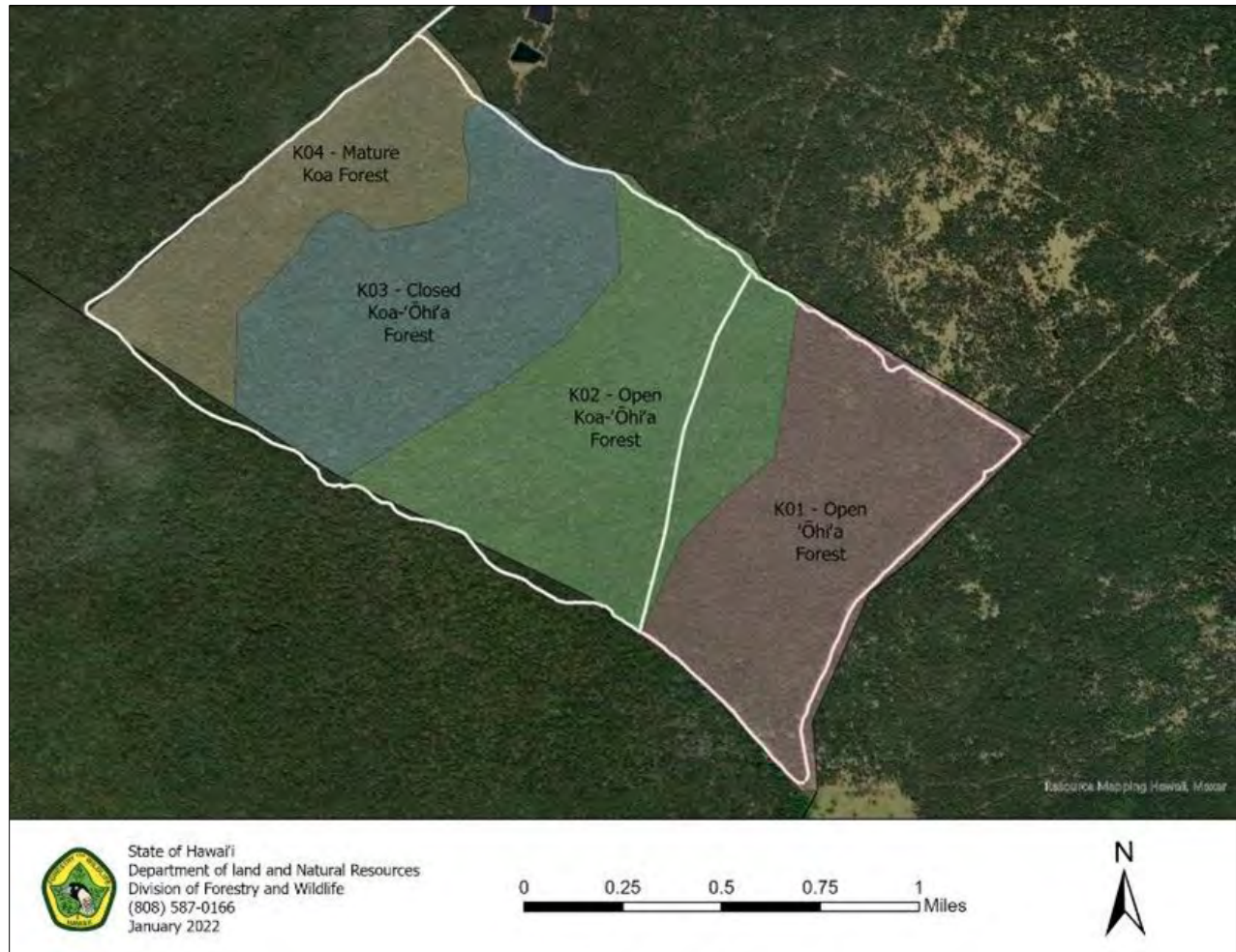


Figure 13. Forest strata in the KKCMA.



Figure 14. View of forest within the northern portion of KO1, view to the southeast.



Figure 15. View of forest within K02 along the central (north-south) access road, view to the south.



Figure 16. View of forest along the northern portion of K03, view to the northwest.



Figure 17. View of forest in K04, view to the southeast.

2. BACKGROUND

As specified in the OEQC *Guidelines for Assessing Cultural Impacts* (1997:1), “...the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment.” For this CIA, the *ahupua‘a* of Kapāpala is considered the ‘study area’, while the location of the KKCMA is referred to as the ‘project area.’ Limited background information for Ka‘ū, the broader regional designation in which Kapāpala is situated, also falls within the parameters of the OEQC guidelines and ensures that a broader set of cultural practices and histories are considered. Since the scope of this project focuses on the sustainable harvesting of *koa* that will be fashioned into canoes used customarily for fishing, outrigger canoe racing, and voyaging, the background section also includes a synthesis of historical accounts written by David Malo, Abraham Fornander, Tommy Holmes, Edgar Henriques, and Kalokuokamaile—all of whom wrote extensively about the customs and beliefs of traditional *koa* harvesting and canoe making.

To generate a set of expectations regarding the nature of cultural resources and customary practices that might be encountered within the project area and to establish a context within which to assess the significance of such resources, this background section begins with a general culture-historical context. This culture-historical context includes a discussion about the theories and beliefs associated with the settlement of the islands, an overview of traditional land management strategies, and a discussion on the intensification and development of Hawaiian land stewardship practices. This section is followed by a synthesis of historical accounts that speak directly to the customs and beliefs associated with traditional *koa* harvesting and canoe making. This background section includes a chronological summary of background information concerning the history of Kapāpala. Lastly, this section concludes with a summary of relevant prior archaeological and cultural studies that have been conducted within and in the immediate vicinity of the project area.

RESEARCH METHODS

The culture-historical context and summary of previously conducted archaeological and cultural research presented below are based on original research conducted by ASM Affiliates at various physical and digital repositories. Primary English language and Hawaiian language resources were found at multiple state agencies, including the Bishop Museum, State Historic Preservation Division, Hawai‘i State Archives, and the Department of Accounting and General Services Land Survey Division. Digital collections provided by the Office of Hawaiian Affairs Papakilo and Kīpuka databases, the Ulukau Hawaiian Electronic Library, and Newspapers.com. Lastly, secondary resources curated at ASM Affiliates’ Hilo office offer general information regarding the history of land use, politics, and culture change in Hawai‘i, enhancing the broad sampling of source materials cited throughout this CIA.

CULTURE-HISTORICAL CONTEXT

While the question of when Hawai‘i was first settled by Polynesians remains contested, scholars working in the fields of archaeology, folklore, Hawaiian studies, and linguistics have offered several theories. With advances in palynology and radiocarbon dating techniques, Kirch (2011), Athens et al. (2014), and Wilmshurst et al. (2011) have argued that Polynesians arrived in the Hawaiian Islands sometime between A.D. 1000 and A.D. 1200. This initial migration on intricately crafted *wa‘a kaulua* (double-hulled canoes) to Hawai‘i from Kahiki, the ancestral homelands of Hawaiian deities and peoples from southern Pacific islands, occurred at least from initial settlement to the 13th century. According to Fornander (1969), Hawaiians brought from their homeland certain Polynesian customs and beliefs: the major gods Kāne, Kū, Lono, and Kanaloa (who have cognates in other Pacific cultures); the *kapu* system of political and religious governance; and the concepts of *pu‘uhonua* (places of refuge), *‘aumakua* (ancestral deity), and *mana* (divine power). Archaeologist Kenneth Emory who worked in the early to mid-20th century reported that the sources of early Hawaiian populations originated from the southern Marquesas Islands (Emory in Tatar 1982). However, Emory’s theory is not universally accepted, as Hawaiian scholars in the past and present have argued for a pluralistic outlook on ancestral Hawaiian origins from Kahiki (Case 2015; Fornander 1916-1917; Kamakau 1866; Kikilo 2010; Nakaa 1893; Poepoe 1906).

While stories of episodic migrations were widely published in the Hawaiian language by knowledgeable and skilled *kū‘auhau* (individuals trained in the discipline of remembering genealogies and associated ancestral stories), the cultural belief that living organisms were *hānau ‘ia* (born) out of a time of eternal darkness (*pō*) and chaos (*kahuli*) were brought and adapted by ancestral Hawaiian populations to reflect their deep connection to their environment. As an example, the *Kumulipo*, Hawai‘i’s most famed *ko‘ihonua* (a cosmogonic genealogical chant), establishes a birth-rank genealogical order for all living beings (Beckwith 1951; Liliuokalani 1978). One such genealogical relationship that remains widely

accepted in Hawai‘i is the belief that *kalo* (taro) plants (in addition to all other plants, land animals, and sea creatures), are elder siblings to humans (Beckwith 1951). This concept of hierarchical creation enforces the belief that all life forms are intimately connected, evidencing the cultural transformations that occurred in the islands through intensive interaction with their local environment to form a uniquely Hawaiian culture.

In Hawai‘i’s ancient past, inhabitants were primarily engaged in subsistence-level agriculture and fishing (Handy et al. 1991). Following the initial settlement period, communities clustered in the *ko‘olau* (windward) shores of the Hawaiian Islands where freshwater was abundant. Sheltered bays allowed for nearshore fisheries (enriched by numerous estuaries) and deep-sea fisheries to be easily accessed (McEldowney 1979). Widespread environmental modification of the land also occurred as early Hawaiian *kanaka mahi‘ai* (farmers) developed new subsistence strategies, adapting their familiar patterns and traditional tools to work efficiently in their new home (Kirch 1985; Pogue 1978). Areas with the richest natural resources became heavily populated over time, resulting in the population’s expansion to the *kona* (leeward) side of the islands and to more remote areas (Cordy 2000).

Overview of Traditional Hawaiian Land Management Strategies

Adding to an already complex society was the development of traditional land stewardship systems, including the *ahupua‘a*. The *ahupua‘a* was the principal land division that functioned for taxation purposes and furnished its residents with nearly all subsistence and household necessities. *Ahupua‘a* are land divisions that typically include multiple ecozones from *mauka* (upland mountainous regions) to *makai* (shore and near-shore regions), assuring a diverse subsistence resource base (Hommon 1986). Although the *ahupua‘a* land division typically incorporated all of the ecozones, their size and shape varied greatly (Cannelora 1974). Noted Hawaiian historian and scholar Samuel Kamakau summarized the ecozones that could be found in a given *ahupua‘a*:

Here are some names for [the zones of] the mountains—the *mauna* or *kuahiwi*. A mountain is called a *kuahiwi*, but *mauna* is the overall term for the whole mountain, and there are many names applied to one, according to its delineations (*‘ano*). The part directly in back and in front of the summit proper is called the *kuamauna*, mountaintop; below the *kuamauna* is the *kuahea*, and makai of the *kuahea* is the *kuahiwi* proper. This is where small trees begin to grow; it is the *wao nahele*. Makai of this region the trees are tall, and this is the *wao lipo*. Makai of the *wao lipo* is the *wao ‘eiwa*, and makai of that the *wao ma‘ukele*. Makai of the *wao ma‘ukele* is the *wao akua*, and makai of there is the *wao kanaka*, the area that people cultivate. Makai of the *wao kanaka* is the *‘ama‘u*, fern belt, and makai of the *‘ama‘u* the *‘apa‘a*, grasslands.

A solitary group of trees is a *moku la‘au* (a “stand” of trees) or an *ulu la‘au*, grove. Thickets that extend to the *kuahiwi* are *ulunahale*, wild growth. An area where *koa* trees suitable for canoes (*koa wa‘a*) grow is a *wao koa* and mauka of there is a *wao la‘au*, timber land. These are dry forest growths from the *‘apa‘a* up to the *kuahiwi*. The places that are “spongy” (*naele*) are found in the *wao ma‘ukele*, the wet forest.

Makai of the *‘apa‘a* are the *pahe‘e* [*pili* grass] and *‘ilima* growths and makai of them the *kula*, open country, and the *‘apoho* hollows near to the habitations of men. Then comes the *kahakai*, coast, the *kahaone*, sandy beach, and the *kalawa*, the curve of the seashore—right down to the *‘ae kai*, the water’s edge.

That is the way *ka po‘e kahiko* [the ancient people] named the land from mountain peak to sea. (Kamakau 1976:8-9)

The *maka‘āinana* (commoners, literally the “people that attend the land”) who lived on the land had rights to gather resources for subsistence and tribute within their *ahupua‘a* (Jokiel et al. 2011). As part of these rights, residents were required to supply resources and labor to *ali‘i* (chiefs) of local, regional, and island chiefdoms. The *ahupua‘a* became the equivalent of a local community with its own social, economic, and political significance and served as the taxable land division during the annual *Makahiki* procession (Kelly 1956). During the time of *Makahiki*, the paramount *ali‘i* sent select members of his/her retinue to collect *ho‘okupu* (tribute and offerings) in the form of goods from each *ahupua‘a*. The *maka‘āinana* brought their share of *ho‘okupu* to an *ahu* (altar) that was marked with the image of a *pua‘a* (pig), serving as a physical marker of *ahupua‘a* boundaries. In most instances, these boundaries followed mountain ridges, hills, rivers, or ravines (Alexander 1890). However, Chinen (1958:1) reports that “oftentimes only a line of growth of a certain type of tree or grass marked a boundary; and sometimes only a stone determined the corner of a division.” These ephemeral markers, as well as their more permanent counterparts, were oftentimes named as evidenced in the thousands of boundary marker names that are listed in Soehren (Soehren 2005b).

Ahupua'a were ruled by *ali'i 'ai ahupua'a* or chiefs who controlled the *ahupua'a* resources. Generally speaking, *ali'i 'ai ahupua'a* had complete autonomy over the *ahupua'a* they oversaw (Malo 1951). *Ahupua'a* residents were not bound to the land nor were they considered property of the *ali'i*. If the living conditions under a particular *ahupua'a* chief were deemed unsuitable, the residents could move freely in pursuit of more favorable living conditions (Lam 1985). This structure safeguarded the well-being of the people and the overall productivity of the land, lest the chief loses the principal support and loyalty of his or her supporters. In turn, *ahupua'a* lands were managed by an appointed *konohiki*, oftentimes a chief of lower rank, who oversaw and coordinated stewardship of an area's natural resources (Lam 1985). In some places, the *po'o lawai'a* (head fisherman) held the same responsibilities as the *konohiki* (Jokiel et al. 2011). When necessary, the *konohiki* took the liberty of implementing *kapu* (restrictions and prohibitions) to protect the *mana* of an area's resources from environmental and spiritual depletion.

Many *ahupua'a* were divided into smaller land units termed '*ili* and '*ili kūpono* (often shortened to '*ili kū*). '*Ili* were created for the convenience of the *ahupua'a* chief and served as the basic land unit which *hoa'āina* (caretakers of particular lands) often retained for multiple generations (Jokiel et al. 2011; MacKenzie 2015). As '*ili* were typically passed down in families, so too were the *kuleana* (responsibilities, privileges) that were associated with it. The right to use and cultivate '*ili* was maintained within the '*ohana*, regardless of the succession of *ali'i 'ai ahupua'a* (Handy et al. 1991). Malo (1951) recorded several types of '*ili*, including the '*ili pa'a* (a single intact parcel) and '*ili lele* (a discontinuous parcel dispersed across an area). Whether dispersed or wholly intact, '*ili* required a cross-section of available resources, and for the *hoa'āina*, this generally included access to agriculturally fertile lands and coastal fisheries. '*Ili kūpono* differed from other '*ili* lands because they did not fall under the jurisdiction of the *ahupua'a* chief. Rather, they were specific areas containing resources that were highly valued by the ruling paramount chiefs, such as fishponds (Handy et al. 1991).

Ali'i 'ai ahupua'a, in turn, answered to an *ali'i 'ai moku* (chief who claimed the abundance of the entire *moku* or district) (Malo 1951). Hawai'i Island is comprised of six *moku* (districts) that include Kona, Ka'ū, Puna, Hilo, Hāmākua, and Kohala. Although a *moku* comprises multiple *ahupua'a*, *moku* were considered geographical subdivisions with no explicit reference to rights in the land (Cannelora 1974). While the *ahupua'a* was the most common and fundamental land division unit within the traditional Hawaiian land management structure, variances occurred, such as the existence of the *kalana*. By definition, a *kalana* is a division of land that is smaller than a *moku*. *Kalana* was sometimes used interchangeably with the term '*okana* (Lucas 1995; Pukui and Elbert 1986), but Kamakau (Kamakau 1976) equates a *kalana* to a *moku* and states that '*okana* is merely a subdistrict. Despite these contending and sometimes conflicting definitions, what is clear is that *kalana* consisted of several *ahupua'a* and '*ili 'āina*.

This form of district subdividing was integral to Hawaiian life and the product of advanced natural resource management systems. As populations resided in an area over centuries, direct teaching and extensive observations of an area's natural cycles and resources were retained, well-understood, and passed down orally over the generations. This knowledge informed management decisions that aimed to sustainably adapt subsistence practices to meet the needs of growing populations. The *ahupua'a* system and the highly complex land management system that developed in the islands are but one example of the unique Hawaiian culture that developed in these islands.

Intensification and Development of Hawaiian Land Stewardship Practices

Hawaiian philosophies of life in relation to the environment helped to maintain both natural, spiritual, and social order. In describing the intimate relationship that exists between Hawaiians and '*āina* (land), Kepā Maly writes:

In the Hawaiian context, these values—the “sense of place”—have developed over hundreds of generations of evolving “cultural attachment” to the natural, physical, and spiritual environments. In any culturally sensitive discussion on land use in Hawai'i, one must understand that Hawaiian culture evolved in close partnership with its' natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture and nature begins.

In a traditional Hawaiian context, nature and culture are one in the same, there is no division between the two. The wealth and limitations of the land and ocean resources gave birth to, and shaped the Hawaiian world view. The '*āina* (land), *wai* (water), *kai* (ocean), and *lewa* (sky) were the foundation of life and the source of the spiritual relationship between people and their environs. (Maly 2001)

The '*ōlelo no 'eau* (proverbial saying) “*hānau ka 'āina, hānau ke ali'i, hānau ke kanaka*” (born was the land, born were the chiefs, born were the commoners), conveys the belief that all things of the land, including *kanaka* (humans), are connected through kinship links that extend beyond the immediate family (Pukui 1983:57). '*Āina* or land, was perhaps most revered, as noted in the '*ōlelo no 'eau* “*he ali'i ka 'āina; he kauwā ke kanaka,*” which Pukui (Pukui 1983:62) translated as “[t]he land is a chief; man is its servant.” The lifeways of early Hawaiians, which were dependent

entirely from the finite natural resources of these islands, necessitated the development of sustainable resource management practices. Over time, what developed was an ecologically responsive management system that integrated the care of watersheds, natural freshwater systems, and nearshore fisheries (Jokiel et al. 2011).

Disciplined and astute observation of the natural world became one of the most fundamental stewardship tools used by the ancient Hawaiians. The vast knowledge acquired through direct observation enabled them to detect and record the subtlest of changes, distinctions, and correlations in the natural world. Examples of their keen observations are evident in the development of Hawaiian nomenclature to describe various rains, clouds, winds, stones, environments, flora, and fauna. Many of these names are geographically unique or island-specific, and have been recorded in *oli* (chants), *mele* (songs), *pule* (prayers), *inoa 'āina* (place names), and *'ōlelo no 'eau* (proverbial sayings). Other Hawaiian arts and practices such as *hula* (traditional dance), *lapa 'au* (traditional healing), *lawai 'a* (fishing), *mahi 'ai* (farming) further aided in the practice of knowing the rhythms and cycles of the natural world.

Comprehensive systems of observing and stewarding the land were coupled by the strict adherence to practices that maintained and enhanced the *kapu* and *mana* of all things in the Hawaiian world. In Hawaiian belief, all things natural, places, and even people, especially those of high rank, possessed *mana* or “divine power” (Pukui and Elbert 1986:235; Pukui et al. 1972). *Mana* was believed to be derived from the plethora of Hawaiian gods (*kini akua*) who were embodied in elemental forces, land, natural resources, and certain material objects and persons (Crabbe et al. 2017). Buck (1993) expanded on this concept noting that *mana* was associated with “the well-being of a community, in human knowledge and skills (canoe building, harvesting) and in nature (crop fertility, weather etc.)” (c.f. Else 2004:244).

To ensure the *mana* of certain resources, places, and people, *kapu* of various kinds were implemented and strictly enforced to limit over-exploitation and defilement. Elbert and Pukui (1986:132) defined *kapu* as “taboo, prohibitions; special privilege or exemption.” Kepelino noted that *kapu* associated with *akua* (deities) applied to all social classes, while *kapu* associated with *ali 'i* were applied to the people (in Beckwith 1932). As *kapu* dictated social relationships, they also provided “environmental rules and controls that were essential for a subsistence economy” (Else 2004:246). The companion to *kapu* was *noa*, translated as “freed of taboo, released from restrictions, profane, freedom” (Pukui and Elbert 1986:268). Some *kapu*, particularly those associated with maintaining social hierarchy and gender differentiation were unremitting, while those *kapu* placed on natural resources were applied and enforced according to seasonal changes. The application of *kapu* to natural resources ensured that such resources remained available for future use. When the *ali 'i* or the lesser chiefs (including *konohiki* and *po 'o lawai 'a*) determined that a particular resource was to be made available to the people, a decree was proclaimed indicating that *kapu* had been lifted, thereby making it *noa*. Although transitioning a resource from a state of *kapu* to *noa* allowed for its use, people were expected to practice sustainable harvesting methods and pay tribute to the paramount chief and the *akua* associated with that resource. *Kapu* were strictly enforced and violators faced serious consequences including death (Jokiel et al. 2011). Violators who escaped execution sought refuge at a *pu 'uhonua*, a designated place of refuge, or an individual who could pardon the accused (Kamakau 1992). After completing the proper rituals, the violator was absolved of his or her crime and allowed to reintegrate back into society.

In summary, the layering and interweaving of beliefs, land stewardship practices, and the socio-political system forms the basis of the relationship shared between the Hawaiian people and the land. It is through the analysis of these dynamic elements that we develop an understanding of the complexity of place.

PRACTICES AND CUSTOMS OF TRADITIONAL HAWAIIAN CANOE MAKING

The Hawaiian term *wa 'a* is a Proto-Polynesian cognate derived from the term *waka* or *vaka* and it has been posited by archaeologist and linguistic scholars that this term and few others have remained largely unchanged “because of their fundamental importance in each society” (Hommon 2013:142-143; Pukui and Elbert 1986). While the term *wa 'a* is most commonly used to refer to a canoe, other definitions include “trench, furrow, receptacle” and was sometimes used figuratively to refer to a woman and at times, “moving masses of liquid lava” because of its similarity to a moving canoe (Pukui and Elbert 1986:375). Canoes appear in many of Hawai'i's earliest migration stories (Fornander 1878, 1880, 1916-1917, 1918-1919). The canoes that were used by the early Polynesians to migrate across vast oceans from their ancestral homeland in Kahiki to Hawai'i were typically double-hulled plank-lashed canoes (Chun and Burningham 1995). As the main transporter of peoples and deities from one island to the next, the significance of the canoe is deeply rooted in the origins of the Hawaiian people and Hawaiian canoe traditions and customs persists today as a critical piece of a living culture.

Upon their arrival in Hawai'i, early Polynesian voyagers continued to construct and utilize canoes (Figure 18) for fishing, travel, warfare, and play (Chun and Burningham 1995; Fornander 1878). However, their new environment provided a host of endemic hardwood plant species from which they would soon adapt their canoe-making traditions.

2. Background

Koa (*Acacia koa*), the second most prolific tree in the Hawaiian forest—after ‘ōhi‘a (*Metrosideros polymorpha*)—became the choice species for canoes (Holmes 1981). Although *koa* was the principle wood used in canoe-making Malo (1898:168) notes that “from the earliest times the wood of the bread-fruit, *kukui*, *ohia-ha*, and *wiliwili* was used in canoe making...” Known for its range of characteristics and form, botanists generally agree that there are three subgroups of *koa* found throughout Hawai‘i, *Acacia koa*, *A. kauaiensis*, and *A. Koaia* (*koai‘e*) (Baker et al. 2009; Wagner et al. 1999). Of the three subgroups, *A. koa* (referred to hereafter as *koa*) known for its extraordinary height, circumference, and remarkable durability, was the species relied upon by the ancient Hawaiians for canoe building. The transition from plank-lashed canoes to hollowed out *koa* logs marked an important shift in Polynesian canoe building traditions (Holmes 1981).

Despite its wide spread distribution, not every *koa* tree was suitable for canoe making. According to South Kona Native, Z.P. K. Kawaikaumaiikamakaokaopua (1922) (also known as and referred to hereafter as Kalokuokamaile), the master canoe carvers, known as *kahuna kālaiwa‘a* or *kālaiwa‘a*, was considered the foremost of all traditional occupational trades. The master carver had to possess a wide range of highly specialized technical knowledge. The *kālaiwa‘a* paid close attention to the wood grain and developed a pragmatic classification system in which different wood grains were named based on their attributes. Low-density *koa* (roughly 30-40 pounds per cubic foot), which was most suitable for paddles but sometimes used for canoes, was known as *koa lā‘au mai‘a* (banana-colored *koa*) and was characterized by its soft, lightweight, and yellow color. This type of *koa* was also known as *koa ‘awapuhi* (ginger *koa*) but was considered female. The favored wood grain for canoes was the mid-range density *koa* (40-60 pounds per cubic foot), which was valued for both its durability and strength. High-density *koa* (60-80 pounds per cubic foot) known as *koa ‘i‘o ‘ōhi‘a* (‘ōhi‘a grain *koa*) was less ideal for canoe building as the wood was exceptionally dense which made carving very difficult (Holmes 1981).



Figure 18. Mr. A. Lister and Kaiopua with a *koa* canoe at Kealakekua, Kona, Hawai‘i. Photo courtesy of K. P. Emory, Bishop Museum Archives (SN 10480).

According to Holmes (1981), to identify the grain quality, the *kālaiwa‘a* scrutinized the tree’s observable traits including its bark, trunk shape and dimensions, and branching patterns. The whitish bark found on the *lau mai‘a* variety was named *kaekae*, which has been translated by (Pukui and Elbert 1986:109) as “smooth, polished, perfect, as a new canoe without knots or knobs.” In contrast, the tough dark red bark found on the ‘i‘o ‘ōhi‘a variety was known as *mauā* meaning “stiff” or “shoots from fallen trunks” (Pukui and Elbert 1986:241). Holmes (1981) provided the following terminology (Table 1) used in identifying *koa* suitable for canoes.

Table 1. Hawaiian *koa* terminology from Holmes (1981:21).

<i>Hawaiian Term</i>	<i>Definition</i>
<i>koa hi‘u wa‘a</i>	growing straight up before branching; also <i>koa hi‘u awa</i> .
<i>koa huhui</i>	growing straight up, with a cluster of branches at the top.
<i>koa huli pū</i>	having wood of such good quality throughout that it was thought best to avoid cracking the log by exposing and drying out the roots, letting the tree fall over, rather than cutting it down.
<i>koa iho ‘ole</i>	crooked but nicely bent in an arc; could be easily shaped to give the hull a “banana” curve; considered the most desirable type.
<i>koa kamahele</i>	having one branch larger and more serviceable than the trunk itself; also <i>koa lālā kamahele</i> .
<i>koa kolo</i>	leaning or sprawling, but still fit for use.
<i>koa kolopū</i>	growing straight up with no significant branching; of uniform diameter nearly the whole length of the trunk; waves will wash into a canoe made from this type.
<i>koa kū ke‘ele wa‘a</i>	straight but somewhat flattened on both sides.
<i>koa kūpalaha</i>	having a broad, straight trunk, but rather flat on one side.
<i>koa kūpalina</i>	generally usable but imperfect; bent, flattened, short, not well-proportioned.
<i>koa kupulā‘iki</i>	same as <i>koa kūpalaha</i> .
<i>koa lālā kamahele</i>	same as <i>koa kamahele</i> .
<i>koa lau kane</i>	(no data)
<i>koa lau kani</i>	strong; considered male; possibly same as <i>koa lau kane</i> .
<i>koa lau nui</i>	a large-leafed variety.
<i>koa no‘u</i>	straight, thick, unblemished, not very tall; suitable for a wide, short canoe such as an ‘ōpelu (heavy duty fishing canoe).
<i>koa poepoe</i>	of good size but short and thick.

Today, *koa* is found across all the main Hawaiian Islands except Ni‘ihau and Kaho‘olawe, with the largest populations found on Hawai‘i Island between the 3,000 to the 6,500-foot elevation where they dominate the native lower montane forest (Baker et al. 2009). Its present-day distribution has been, however, severely disrupted by historical industries such as ranching, logging, land clearing, and wild fire (Holmes 1981).

Several Hawai‘i based historians and scholars have written extensively on the various steps involved in transforming a *koa* tree into the hull of a canoe. Let it be known that while the ‘*ike* (information) provided may not be specific to the Kapāpala area, the ‘*ike* is specific to practices of Hawai‘i Island and of the South Kona region. It is presumed by the cohesiveness of these accounts and the geographical closeness of Ka‘ū to South Kona, that the processes utilized by the *kālaiwa‘a* of Kapāpala were likely very similar to the accounts recorded by David Malo, Abraham Fornander, Tommy Holmes, Edgar Henriques, and Kalokuokamaile.

Malo (1903) was a North Kona descendant, famed as a chiefly counselor, Hawaiian historian, scholar, and minister who was born around the time of Vancouver’s second voyage to Hawai‘i. He was integral in recording the history of old Hawai‘i and much of what we know today comes from his contributions. Fornander arrived in the islands around 1838 and married Moloka‘i Chiefess Pinao Alanakapu. He was a judge who, through his writings helped to preserve a lot of Hawai‘i’s traditions and culture (Advertiser 1887). Holmes was an accomplished writer, publisher, and founder of the Polynesian Voyaging Society who specialized in marine and maritime ethnohistory of Hawai‘i and the Pacific Islands (Froiseth and Froiseth 1993; Holmes 1981). Henriques was the recording secretary of the Hawaiian Historical Society in 1926. In 1912 he accompanied *kahuna kālaiwa‘a* Kealakahi and witnessed firsthand, the *wa‘a* ceremonies that took place in Ki‘ilae, South Kona (Henriques 1926) Kalokuokamaile was a South Kona descendent of canoe makers whose father was an expert in this work. He continued to build canoes traditionally during the early 1900s (Holmes 1981).

Beginning Rituals of the Kahuna Kālaiwa‘a

“The building of a canoe was an affair of religion” (Malo 1903:168) Much of Hawai‘i’s traditional practices were religious in nature as they dealt with *kanaka* entering spaces that required certain rituals and protocols to appease the myriad of Hawaiian gods. Due to the dangerous nature of constructing canoes, *kahuna kālaiwa‘a* adhered to a variety of canoe gods in every step of the *kālaiwa‘a* process. One of the first steps in becoming a *kahuna* is choosing your primary god. Kalokuokamaile (1922) names Lea, Mokuhāli‘i, and Kūpā‘aika‘e as the three primary canoe-carving gods. In addition to these three, countless other gods are called upon during different stages of the process. Table 2 is taken from Tommy Holmes’ (1981:31) and is supplemented with additional gods mentioned by Malo, Kalokuokamaile, and Elbert and Pukui (1971).

Table 2. *Akua* associated with canoe making (akua* mentioned by Malo and Kalokuokamaile)**

<i>Name</i>	<i>Description</i>
<i>Hina-ke-kā</i>	Goddess of canoe bailers.
<i>Hina-kū-wa‘a</i>	Another name for Lea.
<i>Hina-puku-‘ai</i>	Goddess of food plants; sister of Lea; took the form of an ‘ <i>elepaio</i> . Elbert and Pukui (1971:384) add that if she [in the form of an ‘ <i>elepaio</i>] “pecked a tree, canoe makers knew that it was insect ridden and not suitable for a canoe. The spot where she landed on a felled tree was to be the prow; she then ran toward the stern.”
<i>Ka-pū-‘ā-o-alaka‘i</i>	Another name for Ka-pū-o-alaka‘i.
<i>Ka-pū-o-alaka‘i</i>	Forest goddess; presided over the lines by which new canoes were guided as they were transported from mountains to sea; also Ka-pū-‘ā-o-alaka‘i.
<i>Kama-i-ka-huli-wa‘a-pū</i>	God who aided in floating, righting, and bailing out upset canoes.
<i>Kānealuka</i>	God of canoe builders.
<i>Kū-‘ālana-wao</i>	Kū of the upland offering. Elbert and Pukui (1971:389) add that he was “a god of the forest (<i>wao</i>) and of canoe makers.
<i>Kū-holoholo-pali</i>	Kū who steadies the canoe as it is carried down steep places.
<i>Kū-kalanawao</i>	Kū who guides throughout the mountain wilderness.
<i>Kū-kanaloa</i>	(no data)
<i>Kū-ka-‘ōhi‘a-laka</i>	Kū of the sacred ‘ <i>ōhi‘a</i> ; also Laka.
<i>Kū-maha-ali‘i</i>	Kū who journeys in the canoe.
<i>Kū-mauna</i>	Kū of the mountains.
<i>Kū-moku-hāli‘i</i>	Kū who bedecks the island; canoe builder’s chief god; husband of Lea; also Mokuhāli‘i.
<i>Kū-‘ōhi‘a-Laka</i>	Another name for Laka.
<i>Kū-olonawao</i>	Kū of the deep forest.
<i>Kū-pepeiao-loa</i>	Kū of the long comb-cleats; god of the seat braces by which the canoe is carried.
<i>Kū-pepeiao-poko</i>	Kū of the short comb-cleats; god of the seat braces by which the canoe is carried.
<i>Kū-pulapula</i>	Kū with many offspring.
<i>Kū-pulupulu</i>	Kū the chip-maker; god of the forest; also Kū-pulupulu-i-ka-nahele, Kulauka.
<i>Kulauka</i>	Another name for Kū-pulupulu.
<i>Laka</i>	God of canoe builders; also Kū-‘ōhi‘a-laka.
<i>Lea</i>	Goddess of canoe builders; wife of Kū-moku-hāli‘i; sister of Hina-puku-‘ai; took form of an ‘ <i>elepaio</i> ; also Hina-kū-wa‘a, Laea, Lea-ka-wahine.
<i>Lea-ka-wahine</i>	Another name for Lea.
<i>Moku-hāli‘i</i>	Another name for Kū-moku-hāli‘i
* <i>Kū-pā-‘ai-ke‘e</i>	God of canoe makers (Kawaikaumaiikamakaokaopua 1922; Pukui and Elbert 1986). Elbert and Pukui (1971:391) note that Kūpā‘aika‘e “was also worshipped as the inventor of the adze.”
* <i>Kū-ka-‘ie‘ie</i>	(Malo 1903)

The process of finding the right tree to create a canoe varies among historians. Malo (1903) suggests a man observing a tree he thinks would be good, to which he then consults a *kahuna kālaiwa‘a*. Meanwhile, Kalokuokamaile, Fornander, Holmes, and Henriques cohesively write that consultation with a *kahuna kālaiwa‘a* is done prior to finding or coming across a tree (Fornander 1918-1919; Henriques 1926; Holmes 1981; Kawaikaumaiikamakaokaopua 1922). Despite this slight difference, the *kahuna kālaiwa‘a* is always consulted when a canoe is requested to be made, and once it is agreed upon, the *kahuna* begins his rituals. First appeasing his primary god, the *kahuna* prepares *mōhai* (offerings) of a pig, a red *kūmū* fish, a black fish, and other items including coconuts and *‘awa* (*Piper methysticum*) (Malo 1903). Coupled with the *mōhai* are *pule* (prayer) and the commitment of sleeping next to the shrine in the *hale mua* (men’s eating house) until a sound tree is promised (Henriques 1926). The *kahuna* will then know when to make his ascent *mauka* once he dreams of a well-dressed male or female. In the case that the *kahuna* has a dream of a man without a *malo* (loincloth) or a woman without a *pā‘ū* (skirt), it indicates that a tree is rotten and not useful, thus requiring the *kahuna* to remain in ceremony until a good omen is received (Malo 1903). Henriques’ informant, Kealakahi, noted that this ritual would last roughly three days and on the fourth day is when the *kahuna* made his way up to the forest (Henriques 1926).

The Ascent to the Koa Forest

Once the *kahuna*’s dream revealed to him that his trip into the forest would be successful, preparations for the trip upland were made. The process of finding, felling, and hewing a *koa* often took months in the forest and required the party to prepare all the necessities. Kalokuokamaile records the importance of finding a water source next to the work area, which was considered lucky if a spring was found about a mile away. Kalokuokamaile also lists the other preparations that were needed to be carried into the forest “such as adzes, sleeping kapas, poi, fish, calabashes, water bottles, and ropes” (Pukui and Beckwith 1922). Malo, Kalokuokamaile, and Henriques share that once coming upon a suitable tree, the *kahuna* and his crew set up their temporary camp. Kalokuokamaile however, provides greater detail of how felling the first tree they came across was made into a shelter. Provided below is the Hawaiian from Kalokuokamaile’s original articles published in *Ka Nūpepa Kū‘oko‘a on Ke Kalaiwaa Ana Ame Kona Mau Ano* and English translations done by Mary Kawena Pukui and Martha Beckwith (Kawaikaumaiikamakaokaopua 1922; Pukui and Beckwith 1922):

I ka hina ana aku la o ka laau ilalo, o ia ka wa e ana ai oe i ka loloa o ka ili o ka laau koa, elike me kou makemake 8 kapuai paha a i ole 9 paha kapuai ka loa. Alaila, okioki paukuku apuni, alaila, mahele iho ma ke aloe like no me ka lole ana o ka ili bipi. A ina i hemo pono na ili elima a eono paha ua aneane no ia e lawa no na kanaka he umi. No ka mea, o ka laau waa e okiia ana he laau nunui a hookah kanaka anana puni, a kapa‘i ka lua o ka kanaka.

O ia hoi, he muku paha ke kapa‘i a he iwilei paha. A makaukau keia mau mea, ooki na laau pou hale elua, a kau iho ai ke kaupoku, a hoomoe mai no hoi na wahi laau o‘a ame na wahi laau kaola. Aole hoi o ke kaula, he nui ke kaula o ke ie; apau keia mau mea i ka paa hookau ka ili koa iluna o ka hale. Me ka hooponopono maikai ana i ka ili ko ai mea e palahalaha maikai ai ka ili koa apau na ili ko ai ka uhiia, hookau iho i mau laau kaola maluna iho i mea e mohala mau ai ka papaa ili, elike me ka piula hale. A hiki i kona maloo ana, aole ia e upiki hou.
(Kawaikaumaiikamakaokaopua 1922)

When the tree fell that was the time to measure out the length of the bark of the tree, any length that one desired, eight or nine feet in length. Cuts were made down the front like a cut made when skinning beef. If five or six pieces of bark peeled off nicely that was almost enough for ten men, because the tree that was being cut for a canoe could be embraced by a man with more to spare that is, about one and a half or perhaps a yard more. As soon as these were ready, posts were cut for the two side posts, the roof put on and the rafters and beams laid on. There was no worry about ropes as there were an abundance of ropes, the ieie vine. When this was completed, the koa barks were laid onto the house, care was taken to see that the koa bark laid nice and flat. After the koa barks were laid, poles were laid on them to flatten them like the shingles of a house. Then when they dried they did not curl up again. (Pukui and Beckwith:5)

Kalokuokamaile continues to emphasize the importance of completing the shelter before dark due to the drastic differences in the living conditions of the forests and the shores:

A ina aia no iluna ka la, pono e paina liilii; aka, ina ua ahiahi loa, pono e haalele ka ai ana, a paa ka hale i ke kukulu. No ka mea, o ka hale ka mea nui. E pono e paa ia mamua o ka poeleele ana. No ka mea, aole like ka noho ana o ke kuahiwi me ko kahakai nei, ka pumehana. O ka noho ana o ke kuahiwi he ua liilii, aia iloko o ka ohu, he ua liilii aia iloko, o ka noe, he ua liilii aia iloko o ka noe, he ua liilii aia iloko o kea o e po'ipu ana, ame ka ua u-he hana mao ole ana.

(Kawaikaumaiikamakaokaopua 1922)

Holmes (1981) adds that the temporary shelters were usually lean-to or tent-shaped with layers of ferns as flooring. Once the shelter was complete, the real work began. Locating the perfect tree not only required the *kahuna's* expert knowledge of the shape, color, density, and grain of a *koa*, but it also involved the expertise of a forest bird known as the '*elepaio* (*Chasiempis sp.*).

Consulting The 'Elepaio

The '*elepaio* were important consultants to follow and observe as this species was also a *kino lau* (many body forms) of Lea and depending on its behavior, indicated if the tree was rotten or suitable. While the rest of the historians (Fornander 1918-1919; Kawaikaumaiikamakaokaopua 1922; Malo 1903) recall the consultation of the '*elepaio* after the felling of a tree, Henriques' (1926) shares how the '*elepaio* is watched for two days, then for three more days, the *kahuna* followed the bird taking note of its behaviors before the felling. A detailed description of behaviors that a *kahuna* would encounter is provided by Fornander in his *Collection of Hawaiian Antiquities and Folk-lore* below:

If the bird darted down and perched on the trunk of the tree and then ran along the trunk to the other end, the canoe-hewing priest would remark: "The canoe is perfect." The conduct of the bird in running direct from the base to the end was the sign which enabled the priest to pronounce it perfect. Where the bird traversed was the top opening of the canoe. Supposing that the opening of the canoe which the bird apparently intended was underneath, the bird would fly to a certain height, then circle over the tree, the priest would understand that it was urging the turning of the tree. But if the opening that the *elepaio* intended to be was on the side, it would fly in that direction. On the other hand, if the bird came and stood on the trunk of the tree intended for a canoe, if it continued to remain there for some time, the canoe-hewing priest knew that a defect was at that point. If the bird again ran from the trunk and stood in another place, then another defect was at that locality, and thus the bird would indicate all the defects in the canoe, whether it be rottenness, hollow-cored, or knotted. In this way the canoe-hewing priest was made aware of the defects of the [tree for a] canoe. (Fornander 1919-1920:144)

The Cutting and Felling Rituals

Before the cutting and felling of a *koa*, the *kahuna kālaiwa'a* adhered to additional rituals to appease his god(s). Malo (1903), Kalokuokamaile (1922), and Henriques (1926) cohesively record the offering of a pig at or near the base of the *koa* to be felled followed by additional *mōhai* and *pule*. Both Malo (1903) and Kalokuokamaile (1922) offer examples of *pule* that address the canoe gods with a constant *mōhai* of red *kūmū* fish and a pig. Malo (1903) also adds coconuts and '*awa* being offered in addition to the fish and pig. In Kalokuokamaile's (1922) account of his first canoe-building experience, he was advised by his father to gather a red loin cloth in addition to the pig and fish. Continuing with Malo's process, the next day the *kahuna* cooked the pig next to the base of the *koa* tree to be felled, and only after eating the pig did the *kahuna* examine the tree, recited his prayer, and began the felling process. "*O Ku-pulupulu, Ku-ala-na-wao, Ku-moku-halii. Ku-ka-ieie, Ku-palake, Ku-ka-ohia-laka...O Lea and Ka-pua-o-alaka'i*, listen now to the ax. This is the ax that is to fell the tree for the canoe..." was a phrase recited by the *kahuna kālaiwa'a* before the *koa* was cut and toppled (Malo 1903). Malo provides additional details regarding the cutting and felling process:

The *koa* tree was then cut down, and they set about it in the following manner: Two scarfs were made about three feet apart, one above and one below, and when they had been deepened, the chips were split off in a direction lengthwise of the tree... When the tree began to crack to its fall, they lowered their voices and allowed no one to make a disturbance. When the tree had fallen, the head *kahuna*

mounted upon the trunk, ax in hand, facing the stump, his back being turned toward the top of the tree. Then in a loud tone he called out, "Smite with the ax and hollow the canoe! Give me the malo!" Thereupon the kahuna's wife handed him his ceremonial malo, which was white; and, having girded himself, he turned about and faced the head of the tree. Then having walked a few steps on the trunk of the tree, he stood and called out in a loud voice, "Strike with the ax and hollow it! Grant us a canoe!" Then he struck a blow with the ax on the tree, and repeated the same words again; and so he kept on doing until he had reached the point where the head of the tree was to be cut off. At the place where the head of the tree was to be severed from the trunk he wreathed the tree with ie-ie (*Freycinetia Scandens*). Then having repeated a prayer appropriate to cutting off the top of the tree, and having again commanded silence and secured it, he proceeded to cut off the top of the tree. This done, the kahuna declared the ceremony performed, the tabu removed; thereupon the people raised a shout at the successful performance of the ceremony, and the removal of all tabu and restraint in view of its completion. (Malo 1903:169)

Kalokuokamaile's *pule* is recited below with the translations done by Pukui and Beckwith (Kawaikaumaiikamakaokaopua 1922; Pukui and Beckwith 1922):

<i>E Lea ka wahine kua waa</i>	O Lea, woman who builds canoes,
<i>Akua kalaiwaa</i>	Goddess of canoe making.
<i>I pii mai nei au e kua</i>	I have come up to cut a tree for a canoe.
<i>E oki i kuu laau waa</i>	Here is my gift, a free will offering,
<i>Eia ka 'u uku, alana</i>	A sacrifice for you, o Lea
<i>Mohai ia oe e Lea,</i>	Here is a red fish, a red loin cloth
<i>Eia ka i 'a ula, malo ula</i>	Grant me much skill,
<i>E haawi mai i ka ike a nui</i>	Strength and wise thinking,
<i>Ka ikaika, ka noonoo,</i>	Grant me patience.
<i>Haawi mai ia 'u i ke aholoa</i>	All hindrances and obstacles,
<i>O na alalai o na ke 'ake 'a</i>	In front, behind
<i>Mamua, mahope</i>	And on all sides of the tree which I cut,
<i>A ma na aoao o kuu laau e oki ai</i>	Make them be trifles,
<i>E hoolilo ia lakou i opala</i>	Make the strokes of my adz strike well,
<i>E hoopili pono i ka maka o ke ko 'i</i>	Let the chips fly at each stroke
<i>Ma kuu wahi i makemake ai,</i>	Until the work is finished.
<i>Aole hoopakua i kuu ko 'i</i>	Amama, the prayer is freed
<i>Pa no lele ka mamala</i>	(Pukui and Beckwith 1922:10).
<i>Ahiki i ka pau ana</i>	
<i>Amama ua noa</i>	
(Kawaikaumaiikamakaokaopua 1922)	

In Kalokuokamaile's (in Pukui and Beckwith 1922) process of felling the tree, he recalls being instructed by the head *kahuna* to "Dig under the stump which you had cut" and at this point, Kalokuokamaile knew to bury the red fish and red loin cloth which signaled it was time to cook the pig. Kalokuokamaile details the work that needed to be done before the felling, one of which was preparing *hāpu'u* (*Cibotium menziesii*) fern stumps that acted as cushioning for the *koa*. This was to ensure the protection of the wood from the fall. After the *koa* was felled, the *kahuna* left the adz in the stump of the tree until more work was needed to be done. When it was time for Kalokuokamaile to consume the pig, the head *kahuna* recited the chant below and offered a piece of the nose, the tail, the ears, and internal organs to Kalokuokamaile to eat and free the *kapu*.

<i>E Lea ka wahine kua waa</i>	O Lea, woman who builds canoes,
<i>Akua kalaiwaa</i>	Goddess of canoe making,
<i>A me Mokuhalii, Kupaaiekee</i>	And Mokuhalii and Kupaaiekee
<i>Na akua kane kalaiwaa</i>	Male Gods of canoe making,
<i>Eia ka puua</i>	Here is pork,
<i>He puua uku, mohai, alana ia oukou</i>	A pork gift, a sacrifice, an offering
<i>Na Kalokuokamaile</i>	From Kalokuokamaile
	Grant him much skill,

*E haawi i ka ike a nui, ka ike mana, ka
mana palena ole
A nolaila, ke aie nei oukou i ka puua a
Kalokuokamaile
Amama ua noa
(Kawaikaumaiikamakaokaopua 1922)*

Skill and mana, unlimited mana,
So therefore you are obliged to
Kalokuokamaile for his pork.
Amama it is freed
(Pukui and Beckwith 1922:11)

Although the subtle difference between Kalokuokamaile's and Henriques' recollection of consuming the pig was either before or after the felling, their accounts are cohesive in that after the felling, the next part to tend to was the branches and the *ēulu* or the top of the tree (Henriques 1926; Kawaikaumaiikamakaokaopua 1922). Holmes (1981) further details that it wasn't until after this final severing of the *ēulu*, did the *kapu* surrounding the felling process become freed.

The Final Hewing Process

Before the rough hewing began, the *kahuna kālaiwa 'a* would take measurements and work out a blueprint of what the finished canoe would look like, taking note of any further rot, and determining which part of the trunk would become the top and bottom of the canoe. After this initial planning was complete, further restrictions were removed allowing other *kālaiwa 'a* to begin shaping the log (Holmes 1981; Malo 1903). Most of the accounts recording this process starts with tapering both ends giving the initial shape of the canoe. The exterior sides and *iwikuamo 'o* (keel) (Kawaikaumaiikamakaokaopua 1922) are next to be shaped and once done, the crew would utilize different techniques in turning the log over, which was dependent upon the number of people available to help, as well as the size of the log. One method required a stick with a rope attached to the top. Depending on the log, this method was considered easy as angling the stick under the log and pulling on the rope to turn the log over. In other cases, this stick and rope technique required a hole to be made where the opening is to be, then inserting the stick into the hole and pulling on the rope (Holmes 1981; Kawaikaumaiikamakaokaopua 1922; Malo 1903).

Kalokuokamaile's steps in the hewing process differ in that he notes turning the log over and starting on the side where the mouth will be up. He details how the trunk is cut into *paukū* (sections) from stern to prow or prow to stern, then hollowed out:

*I kou paukuku ana, e paukuku oe a loa a ka
i 'o ulaula, mai kahi niao a i kekahi niao me
kou malama loa i ke oki ana o moku loa
auanei kekahi niao, a na ia niao e hoouku i
ka waa i ka wa e pahola aku ai i ka waha o
ka waaa. A ua kapaia kela paukuku, he
momona, a he kea; a i ka pau ana i ka
paukuku, e wawahi i kela paukuku me ka
koilipi, mai mua a hope o ka waa.*

*Alaila, pahola oe i ka waha me ke ko 'iholu,
e hoiliwai ana a pololei. O ka maikai o keia
hana ana, o ka maikai no ia apau ka waa.
Ua pau ae ola i ka pahola ka waha, o ka
auwaha koe ialoko.*

*O ka hana ana iloko, e okioki huinakolu oe,
mai kahi niao, a i kekahi niao, mai hope mai
a mua. Aole okioki loloa i ka huinakolu,
mahope pipili a ulolohi ka uhau ana a ke
koilipi. (Kawaikaumaiikamakaokaopua
1922)*

In cutting the sections, they were cut down to the red wood from one rim to the other but care was taken not to cut into the rim and so making the canoe smaller when the opening was hollowed out. These sections were called *momona* or *ke'a*. After the cutting was done, the sections were broken up with a sharp adz from prow to stern of a canoe. Then the opening was begun with a bent adz (*ko'i holu*) to make the opening even and straight. When this was well done its work would be good until the canoe was completed. The opening was finished and so the next step was to hollow out the log. (Pukui and Beckwith 1922:6-7)

The interior shaping and hollowing out required further measurements for the different parts of the canoe. The *kahuna kālaiwa 'a* would determine where the *pepeiao* (comb cleats) and *wae* (U-shaped spreader) would be located by utilizing traditional anatomical measurements such as *anana* (distance from fingertips of outstretched arms), *muku* (distance of fingertips from one hand to the elbow of the other arm stretched at the sides), *iwilei* (distance from the collarbone to the tip of the middle finger of the other arm stretched at the sides), *kīko 'o* (span between the extended tips of the thumb and forefinger), and *poho* (half of a *kīko 'o*) (Holmes 1981).

The hollowing out of the canoe was the last step in this process. As described by Kalokuokamaile (1922), once the hollowing was finished, the canoe would be turned over, the *iwikuamo* 'o (lit. backbone; underside of canoe) would be shaped, and lastly, the log turned over again to finish hollowing the interior. Once completed, the hewed canoe would be roped up and hauled from the uplands to the coast for finishing.

Hauling the Roughly Hewn Log to the Coast

Hauling the roughly-hewn canoe from the forest to the coast was, perhaps, the most perilous part of the canoe carving process. Depending on the size of the log, an experienced leader and many skillful hands were required to work in unison to bring the canoe down safely and intact. Kalokuokamaile specifies that *kaula* (rope) which was both thick and long was one of the most important tools used in this process. Once the decision to bring the log down to the coast was made, the workers left the forest and made their way to the shore to initiate the preparation of the *kaula* and assemble helpers that would aid in hauling the semi-hewn log to the shore. Those who assisted in hauling the canoe to the shore were known as *po'e kanaka kauō* (haulers) and *pale wa'a* (canoe guides), the latter of whom, as reported by Kalokuokamaile, was charged with safeguarding the canoe during transportation and preventing injury (Kawaikaumaiikamakaokaopua 1922). Once enough *kaula* was prepared and on a clear sunny day, a great feast was prepared. Preceding the actual hauling, further rituals were held as the course of hauling could present obstacles and potential dangers. The process of hauling was overseen by the head carver, who was situated behind everyone (no other persons could walk beside or behind the head carver as that space was reserved for the *akua*), and the designated *paha* (chant to ease the work) chanter. When it came to the hauling, everyone enjoyed the process, men, women, and children, who sometimes rode on the canoe while it went down a slope, as if one was surfing (Holmes 1981; Kawaikaumaiikamakaokaopua 1922). Holmes (1981:39) provides additional terminology in Table 3 for the specific duties a hauler was responsible for.

Table 3. Hawaiian terminology associated with the different types of hauling duties.

<i>Hawaiian Terminology</i>	<i>Description</i>
<i>Kanaka Kailiili</i>	Men who held the <i>kaula kailiili</i> (check ropes, two on each side of the <i>kaula ko</i>) to keep the snout of the log on the right course.
<i>Kanaka Pu</i>	Men who kept the hauling rope taut and straight.
<i>Kanaka Ko Waa</i>	Multitude of men who did the hauling that were arranged to the left and to the right of the <i>kaula ko</i> (thick rope attached to <i>maku'u</i>).

(Malo 1903:246) states that the process of hauling the *koa* down “was a scene of riot and tumultuous joy.” To keep the work joyous and the workers focused, the *paha* called out in chant to maintain the group’s lively energy. As evidenced in the following *Mele Ho'okanikani-Pihe*, the hauling of the *koa* out of the forest was not a mundane act. Much vigor, focus, and energy were needed because in the Hawaiian worldview, moving the *koa* was the literal moving of the god. Malo (1903:247) related the following *Mele Ho'okanikani-Pihe*, which is still used today amongst the Hawaiian community to rally people together around a particular cause:

One—	<i>I ku mau mau!</i>	Stand up in couples! It moves, the god begins to run!
All—	<i>I ku wa!</i>	Stand at intervals!
One—	<i>I ku mau mau!</i>	Stand in couples
	<i>I ku huluhulu!</i>	Haul with all your might!
	<i>I ka lanawao!</i>	Under the mighty trees!
All—	<i>I ku wa!</i>	Stand at intervals!
One—	<i>I ku lanawao!</i>	Stand up among the tall forest trees!
All—	<i>I ku wa!</i>	Stand at intervals!
	<i>I ku wa! huki!</i>	Stand at intervals! and pull!
	<i>I ku wa! ko!</i>	Stand at intervals! and hau!
	<i>I ku wa a mau!</i>	Stand in place! And haul!
	<i>A mau ka eulu!</i>	Haul branches and all!
	<i>E huki, e!</i>	Haul now!
	<i>Kuli'a!</i>	Stand up my hearties!
	<i>Umi'a ka hanu!</i>	Hold your breath now!
	<i>A lana, ua holo ke akua!</i>	It moves, the god begins to run!

The success of the hauling relied heavily on working in tandem with everyone, being alert, and listening to the calls that were being made by the *pale wa'a* situated at the front and back of the canoe. Kalokuokamaile shared that “as the

2. Background

men called they said, ‘toward Kohala,’ or ‘toward Kau,’ but never to the north or south” to indicate the appropriate direction in which to steer the canoe (Pukui and Beckwith 1922:15). The path taken by the haulers were often pre-cleared and the shortest and most practical route, being only as wide enough for the canoe and haulers to fit. Kalokuokamaile (1922) further shares that it was a waste of time and labor to widen the path as perhaps only two canoes would ever pass through that same route, indicating that a new path was most likely cleared each time a log was hauled (Holmes 1981; Pukui and Beckwith 1922). Because hauling took a lot of time and energy, it was also customary for food to be left at designated resting places that the canoe would be hauled to. Often these resting places were near water sources.

The hauling would proceed and if ‘*a*’ flows were encountered, logs known as *ipuwai* (wood rollers) were laid over the rough ‘*a*’ to lessen the damage to the canoe. In the case that a canoe did become damaged beyond repair during any part of the hauling process, it was abandoned altogether and left to decay. The hauling ended at the *hālau wa ‘a* (canoe shed) located near the coast where the final shaping and assembling of the other parts took place (Holmes 1981).

Whereas during the Precontact and Early Historic periods, hauling the *koa* out from the forest was done entirely by hand, as new technologies emerged including carts and wagons, *kālaiwa ‘a* have and continue to adapt their traditions to ease the workload. As evidenced in the photo below (Figure 19), a partially hewn canoe is transported on a wagon frame in Hōnaunau, Kona.

As demonstrated above, the process of selecting, felling, shaping, and hauling a *koa* out of the forest to be made into a functioning *wa ‘a* was a deeply spiritual and arduous undertaking. Thus, the continuous use of *wa ‘a koa* today and into the future stands as a testament to the significance of this practice and the necessity of obtaining appropriate *koa* trees to ensure the continuation of this long-standing customary tradition.



Figure 19. Five men preparing to haul an unfinished canoe to Hōnaunau, South Kona, to be finished; Hawai‘i. Photo courtesy of K. P. Emory, Bishop Museum Archives.

CULTURE-HISTORY OF KAPĀPALA AHUPUA‘A

Situated along the eastern slopes of Mauna Loa, the expansive *ahupua‘a* of Kapāpala today covers approximately 172,780 acres of the northeastern section of the Ka‘ū District (Figure 20). Kapāpala is also one of just three *ahupua‘a* that encompasses the summit region of Mauna Loa (Handy et al. 1991). Historically, the land of Keauhou which included Kīlauea volcano and comprised of some 50,740 acres was an *‘ili kūpono* (independent subdivision) of Kapāpala (Maly and Maly 2004). However, Keauhou during the 1848 *Māhele ‘Āina* was given the status of an independent *ahupua‘a* and is today, the land that separates the districts of Ka‘ū from Puna. Thus, prior to 1848, Kapāpala contained well over 223,000 acres that included vast tracts of forest occupying the central region and flanked on either side by numerous lava flows originating from Mauna Loa and Kīlauea.

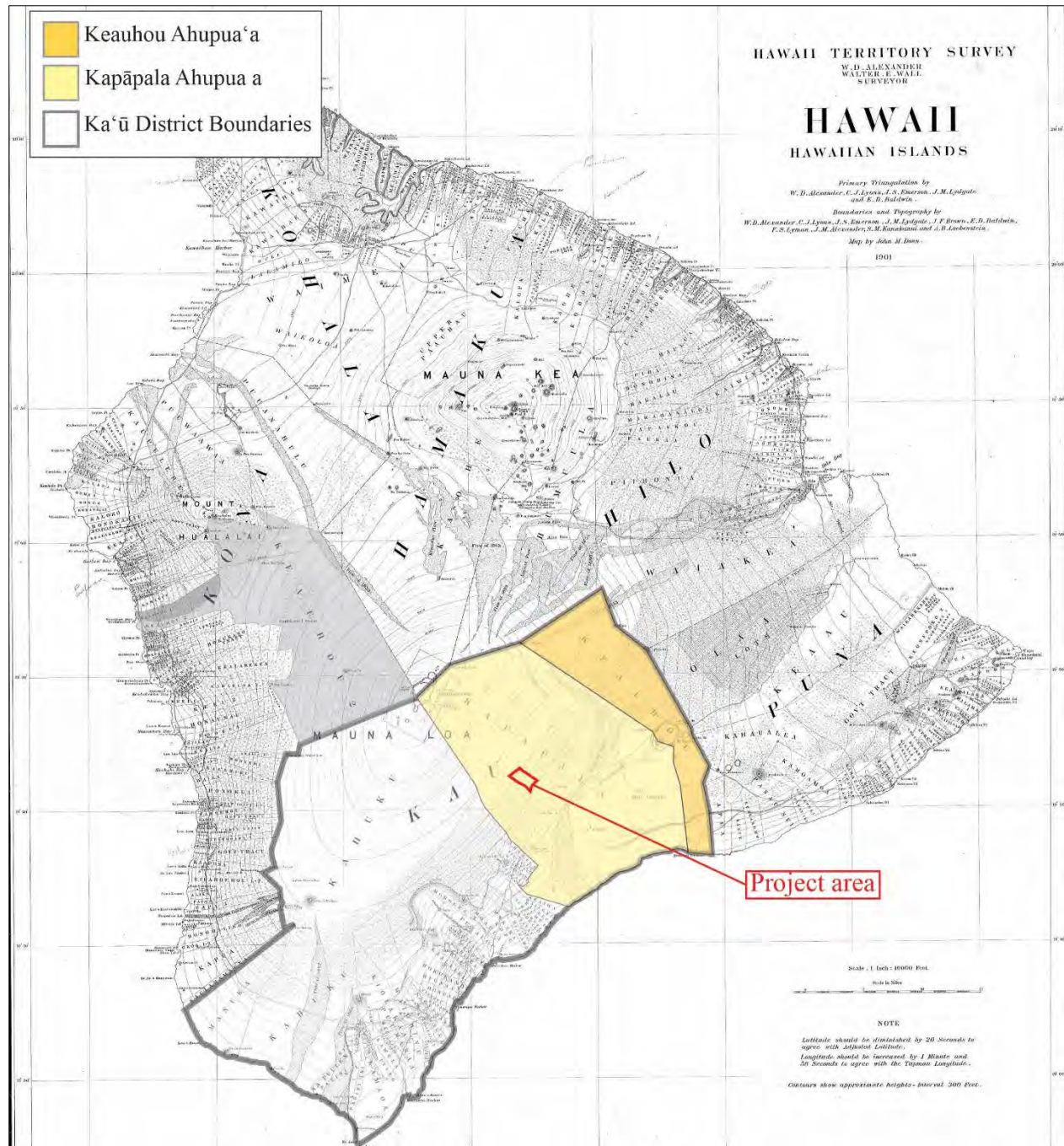


Figure 20. Hawai'i Registered Map 2060 from J.M. Donn (1901) showing KKCMA project area in Kapāpala, Ka'ū.

In their appraisal of native horticultural practices in the 1930s, Handy et al. provided the following geographical description of Kapāpala Ahupua‘a:

Between the northeasterly *ahupua‘a* of Kapapala and Kilauea, the upland area of active volcanic craters, there was never any cultivation, so far as we could learn. Below Kao-iki Pali the country is covered with lava, and in the forest above the *pali* from Kapapala to Ohiakea the bird snarers or feather hunters had their huts, but no taro was grown. On the land flanking the present Kapapala Ranch, which is now in sugar cane, dry taro used to be grown on the sloping *kula*, on the steep hillsides of gulches, and in the forest lying behind. Forest taro was here referred to as *ulu la‘au* (forest growth), and that on steep slopes as *pi‘ina* (climbing) (Handy et al. 1991:613).

The name Kapāpala refers to the endemic *pāpala* plant (*Charpentiera sp.*), which is found on all of the main Hawaiian Islands in both mesic and dry forests (Pukui et al. 1974; Rock 1913). Often used in the practice of ‘*ōahi* (firebrand tossing), the buoyant, soft fibrous wood of the *pāpala* was carried to selected coastal precipices on dark moonless nights, lit on fire, then tossed over the cliff where it was carried on the wind to create a fiery aerial display enjoyed by the people (Krauss 1993; Rock 1913). Krauss (1993:96) explains that “the central core of soft pith of the branches burned rapidly, causing streams of sparks to shoot out like fiery rockets.” Krauss (1993) further adds that “some of the embers dropped into the sea; others were intercepted by some of the spectators in canoes in the sea below the cliffs and used to brand themselves as a form of tattooing to commemorate the occasion...such a person was looked upon as a hero.”

Whereas Pukui et al. (1974) associated the place name Kapāpala with the endemic *pāpala* plant, some traditional *mo‘olelo* also identify Kapāpala as the name of a chief. In one such *mo‘olelo*, the chief Kapāpala was killed by the *akua* Pele, who is considered to be “the most important *kupuna* for all ‘*ohana* of Ka-‘ū” (Handy and Pukui 1998:29; Westervelt 1916). In another *mo‘olelo*, Kapāpala was “a champion warrior” who was defeated by two brothers Ka-Miki and Maka‘iole (Kin In and Pukui 2021). Another possible interpretation of this place name may be associated with its geographical placement amidst a volcanically active landscape—a region belonging to Pele—Hawai‘i’s goddess of lava. As Kapāpala is flanked on its western and eastern limits respectively by the volcanically active Mauna Loa and Kīlauea, this ‘*āina* (land) has experienced Pele’s numerous ‘*ōahi* (fiery displays). Thus, the name Kapāpala may be indicative of Pele’s fiery displays, the presence or abundance of the *pāpala* plant in this area, or may be a name derived from a local chief or warrior.

The Environmental Setting and Resilient Kinship Networks

Celebrated for its rugged lava-coated landscapes, windswept plains, expansive forests, and excellent fishing grounds, the unique physical environment of Ka‘ū “was a potent factor in conditioning, if not determining, the form and nature of the dispersed community (‘*ohana*) (Handy and Pukui 1998:18). Handy and Pukui further elaborated on this notion stating:

Ka-‘ū is the most rugged, the most forbidding, of all the areas of habitation in these islands, with its lava strewn coasts, vast windswept plains that are almost treeless, beyond which rise the majestic slopes of Mauna Loa, deeply forested just above the plains, but snow-covered towards the summit in winter months. The toughness of Ka-‘ū folk was the result of their rugged homeland and hardy life in wrestling a living from land and sea. It was affected certainly by the extremes of temperatures as between night, when the breeze and winds flow seaward from frosty altitudes, to midday when the black lava of plains and shore is furnace-hot from the sun. Handy and Pukui (1998:xvi)

Central to surviving in this forbidding landscape was the “dispersed community of ‘*ohana* [lit. family], of relatives by blood, marriage and adoption” who resided within different *wao* (environmental zones) and had access to a diversity of unique resources (Handy and Pukui 1998:2). Those ‘*ohana* residing at the coast were known as *ko kula kai* (of the seaward slopes) and those living in the uplands were dubbed *ko kula uka* (of the upland slopes). Understanding the nuances of each *wao* was vital to the people of Ka‘ū, who relied solely on their environment to furnish all their needs. Each *wao* extended horizontally across the district and marked vegetation and rainfall change. Handy and Pukui (1998:19) provide a cartographic sketch delineating the various *wao* in Ka‘ū (Figure 21).

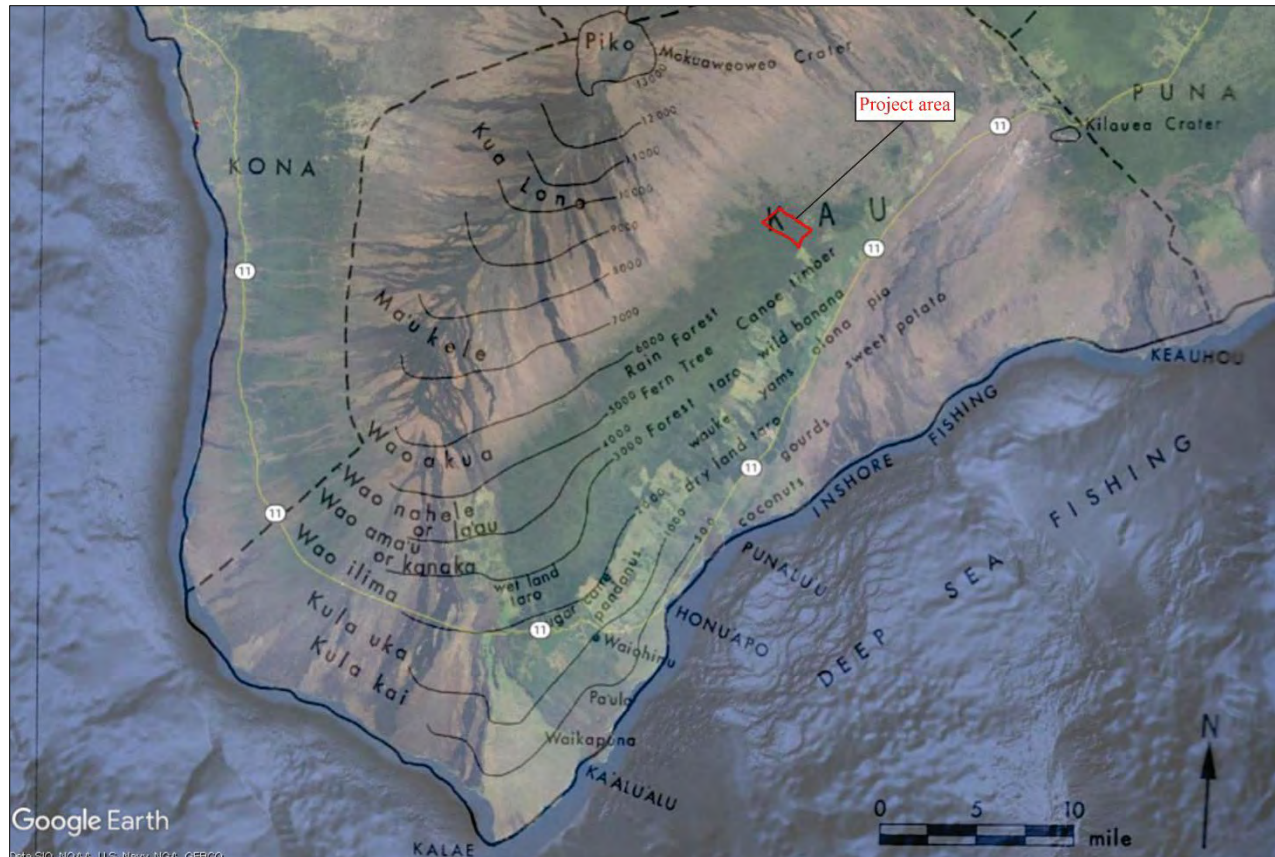


Figure 21. Handy and Pukui's (1998:19) cartographic sketch overlaid on a Google Earth aerial showing the *wao* in Ka'ū.

Based on the elevational location, the project area is situated at the upper fringes of the *wao ama'u/wao kanaka* and extends through the *wao nahele/wao lā'au* and into the *wao akua*. In characterizing these zones, Handy and Pukui wrote:

Beyond the open slopes (*kula*) become fern lands, then gradually merge with the lower forest (*wao*). In this zone where fern bushes and small trees prosper other varieties of upland taro requiring more water were cultivated, under mulch to keep in the moisture. This continued right back into the lower forest. Here were the wild bananas, wild yam (*Dioscorea*), arrowroot (*pia*); and tree fern (*Cobotium*), whose starchy core was eaten, extending down into this zone from the rain forest.

These zones were not fixed as to altitude. On the east, the wet uplands were wetter and extended lower than on the west, which was both beyond the range of heavy precipitation from trade winds and cut off somewhat by the shoulder of Mauna Loa running back to Kalae. (Handy and Pukui 1998:20-21)

Beyond the zone of habitation of this land of wide spaces on a clear day, the eyes of our deep sea fisherman will see the heavily forested zone (*wao akua*, jungle of gods), where his great *koa* (*Acacia koa*) trees cut for canoe hulls are growing. Beyond that the verdant rain forest, frequently swathed in cloud. (Handy and Pukui 1998:22)

The exchange of resources procured from the various *wao* via kinship networks and the movement of the *'ohana* across the *'āina* (land) for economic or social affairs were pivotal to surviving in this environment. Handy and Pukui (1998:18) express that “[t]he dispersal of the households comprising the extended family (*'ohana*), the types of structure constituting the domiciles, the means of livelihood and exchange of products of sea, land, and handcraft between individuals and households were all affected by topography, rainfall and vegetation, the nature of the shore and the sea offshore, by climate and weather and the cycle of seasons.” This exchange of resources via kinship networks detailed by Handy and Pukui (1998) offered increased access to geographically dispersed resources, while at the same time buffering against environmental and social perturbations (Allen and McAnany 1994). This network system functioned as a unit in external economic and social affairs, such as placing the burden of taxes levied by the *ali'i* during the annual collection of tribute (*Makahiki*), not on the individual or single households, but on the entire *'ohana* (Handy and Pukui 1998).

Ethnographic Accounts of Settlement of Ka‘ū and ‘Aumākua Worship

The extended kinship networks were not only crucial to thriving and expanding in this landscape but played a major role in the settlement of this district. The Hawaiian proverb, “*Hilina ‘i Puna, kālele ia Ka ‘ū*” describes how the districts of Ka‘ū and Puna were settled by an extended family (Pukui 1983:107). Pukui further elaborates:

The ancestors of these two districts were originally of one extended family. The time came when those of each district decided to have a name of their own, without breaking the link entirely. Those in Ka‘ū referred to themselves as the Mākaha [fiece] and those in Puna as the Kumākaha [in a state of fierceness]. (ibid.)

Pukui attributes the ancestor named ‘Ī as one of the progenitors of this extended family. The proverb, “*Ka hālau a ‘Ī*” literally translated as “the house of ‘Ī” describes the spreading of this family throughout Hāmākua, Hilo, Puna, and Ka‘ū (Pukui 1983:141). Another ancestor mentioned in traditional lore is the shark god Kūa. The proverb “*Na mamo i ka halo o Kūa*” relates that Kūa, a great shark god mated with his human sister and bore children (Pukui 1983:247). Kūa is said to be both an ancestor as well as a protector of the district (Pukui 1983). Emerson (1892:8) argued that the “shark was perhaps the most universally worshipped of all the aumakua, and, strange to say, was regarded as peculiarly the friend and protector of all his faithful worshippers.” Ancestral deity worship is considered a quintessential spiritual practice of the Native Hawaiians of old, and it stands today as a heritable custom, belief, and connection to the past preserved by rich oral traditions, many of which are associated with mythological tales. One such story concerns the famous shark war that occurred at ‘Ewa on the island of O‘ahu in which a power struggle ensued among a group of legendary and primal sharks that resulted in the banishment of the cannibalistic sharks. Five of the shark ‘aumākua involved in the battle were said to be from Ka‘ū, and are identified below (in addition to three other sharks also said to be of Ka‘ū):

Kealiikaua (k) is the hero of the great shark war. He is born at *Ninole, Kau*, on Hawaii. He acts as the friend of man, his great work being to travel about the islands and slay all those sharks who feed on human flesh. Four sharks accompany him.

Kalani (k) is “born on the coast of *Waiohinu (Kau district)* from the eye of his mother. His blood has been seen on the forehead of some who worshipped him. He guarded all the people of *Kau* from the other sharks who might harm them. He went to the great shark war at *Ewa, Oahu*, with his kinsman and friend *Kaholeakane*. They were swallowed up by *Kuheimoana* in this war. The little *Kalani* went first into the mouth of the monster, followed by his larger friend, whose size forced the monster to disgorge him. As he came out, the nimble *Kalani* darted out too. Then they swam into shoal water and thus led *Kuheimoana* to her fate. She got stranded on a shoal and was kept from the battle. *Kalani* went too near the shore and had a portion of flesh cut from his back by the people of *Ewa*, who ate it.” In another version, two pieces of his flesh form the spouting horn at *Kealae*. The natives say “If a man in a canoe wears anything red, *Kalani* will pursue the canoe and upset it.”

Kaholiakane [Kaholeakane] (k) is companion to *Kalani* in the great shark war.

Kua (k) a *Kau* shark who joins *Kalani* in the shark war.

Kane (k) companion to *Kalani*.

Haloa, a shark of *Mahana, Kau*, who comes in his spirit form and teaches his *kahu* the medicine to use to cure diseases.

Humeke, of *Kaalualu, Kau*.

Mikololo, of *Pokini, Molilele cliff, Kau*. (Emerson in Beckwith 1917:511-512)

In addition to ‘Ī and Kūa, Handy and Pukui (1998:27) also identify other progenitors who served as ‘aumākua (ancestral god/guardian spirit) to specific families and manifested as the *ipu ‘awa‘awa* (bitter gourd) and the ‘*enuhe* (caterpillar):

Believed to be local in origin were other forebears: that one from whose naval grew a gourd vine, originating in a certain cave, which spread over and peopled seven districts of Ka-‘u; another ancestor, identified with a particular hill, who appeared in the form of the caterpillars that feed upon the foliage of sweet potatoes, the staple of life in these districts.

For the Hawaiians of Ka‘ū—whose name has been translated by Handy and Pukui (1998) as “The [*ka*] Breast [*‘ū*]”—this beloved land upon which they built their lives shaped their worldview, beliefs, mannerisms, and customs. These people are celebrated in Hawaiian lore for their hardworking nature who labored willingly for their families and

chiefs but were most staunch in not tolerating mistreatment or abuse. Pukui (1983) provides several *‘ōlelo no‘eau* (poetical expressions) that cues us into the nature of this land and its people:

Uhiuhi lau māmane ka wai o Kapāpala.

Covered with *māmane* leaves is the water of Kapāpala.

The stream in Kapāpala, Ka‘ū often becomes very muddy. The people used to place *māmane* branches in the water to help the mud settle so that some drinking water could be obtained. This saying applies to a person who tries to cover up the wrongdoings of another. (Pukui 1983:313)

Ka ‘ū, ‘āina kipi.

Ka‘ū, land of rebels.

The people of Ka‘ū were known to rebel against oppression, even killing their own oppressive chiefs. (Pukui 1983:168)

Ka ‘ū, ‘āina kua makani.

Ka‘ū, a land over whose back the wind blows.

Ka‘ū is a windy land. (Pukui 1983:173)

Ka ‘ū nui kua makani.

Great Ka‘ū of the windblown back.

The wind always blows in Ka‘ū. (Pukui 1983:176)

Ka ‘ū mākaha.

Ka‘ū of the fierce fighters.

The district of Ka‘ū, Hawai‘i was known for its fierce and independent warriors. Kohāikalani, Koihala, and Hala‘ea, selfish and oppressive chiefs, were each destroyed by rebellious subjects. (Pukui 1983:176)

Ka ‘ū nui maka lepo.

Great Ka‘ū of dirty faces.

An expression of ridicule. Ka‘ū, Hawai‘i, is a dry, wind-swept district where clouds of dust rise into the air. (Pukui 1983:176)

The Hawaiian of Ka‘ū resiliently adapted to the environmental limitations of their *‘āina*, a land where some of the most legendary and dramatic natural phenomena have and continue to occur. Handy and Pukui (1998) emphasize that:

This legendary setting must likewise be understood in specific detail as a pillar and gourd, certain rock formations, trees, volcanic and meteorological phenomena are *kupuna* (forbears). Of particular families and persons: relationship, tabus, in fact every phase of personal and family life, are contingent upon affinity arising herefrom.

LEGENDARY ACCOUNTS FEATURING KAPĀPALA

Traditional Hawaiian *mo‘olelo* are key entry points to understanding the history and ideologies that have been attached to a specific place. The term *mo‘olelo*, which means “succession of talk,” has many meanings, including story, tale, myth, history, literature, tradition, and legend (Pukui and Elbert 1986:254). For this study, the term *mo‘olelo* is used to reference Hawaiian narratives that are mythological or legendary in nature. A review of *mo‘olelo* that feature Kapāpala is important because *mo‘olelo* aid in tracking important social and environmental change and are nuanced with *‘ike kūpuna* (ancestral knowledge) and perspectives that remain relevant to a living culture (Kikilo 2012). In some cases, *mo‘olelo* can be expansive, and detailed, and are sometimes interconnected to other *mo‘olelo* through certain characters or events. Furthermore, a review of *mo‘olelo* sheds light on aspects of Hawaiian culture including historical figures, beliefs, traditions, *wahi pana* (legendary places), and place names, all of which contribute to an in-depth understanding of the people, their culture, and their connection to a place.

Many of the *mo‘olelo* that feature the *‘āina* of Kapāpala are intimately tied to Pele-honua-mea (also known as Pele), the *akua wahine* (female deity) of lava who established her home in the depths of Halema‘uma‘u (Handy and Pukui 1998). Kalākaua (1888) indicates that active worship of Pele was ongoing since at least the 12th century and that the abolition of the *kapu* system in 1820 had little to no effect on this practice, which remains ongoing. In addition to being revered as a goddess, Pele was also worshipped as an *‘aumakua* by her descendants. According to Nimmo (1990:43), “most Hawaiians living in the volcano areas of Hawai‘i, the districts of Ka‘ū, Puna, and Kona, at the time of European contact traced their ancestry to Pele”. Pele is frequently and comprehensively referenced in historical and mythological

literature. Likewise, traditional tales of Pele's migration to Hawai'i from Kahiki are many and varied. Because Pele's story is so well-recorded in Hawaiian mythology, she is sometimes perceived, by some, as a sort of mythic cultural manifestation. However, for many Native Hawaiians and especially those from Ka'ū, Pele, in her most absolute form, is the lava. She is tangible and continues to exact her mighty powers. She commands respect, for she is the creator of land, and continues to instill that sense of wonder and awe in the people who get to experience her powerful earthly creations. Handy and Pukui (1998) emphasize that:

It is profoundly significant that the Hawaiians of Ka-'u did not fear or cringe before, or hate, the power and destructive violence of Mauna Loa. They took unto them this huge Mother mountain, measured their personal dignity and powers in terms of its majestic and drama... They loved Pele, whose home was their land: they endured her furies, and celebrated the drama of creation with which they lived so intimately in the songs and dances of the sacred *hula*, which dramatizes the myth of the "Woman of the Pit" (the crater, Kīlauea) and her "family." Embodied in cloud, thunder and lightning (Lono), in the forest and verdure (Wahine 'Oma'o, "Green Lady") in Hi'iaka "of living waters," the healer, and other cosmic terrestrial forces that encompassed them.

Historical literature tells us that with Pele's arrival and subsequent settlement, she transforms the islands. Kalākaua (1972:140) places the arrival of Pele and Hi'iaka during the reign of Kamiōle, or more specifically, in approximately A.D. 1175, and notes that "every tradition refers to them as deities at the time of their arrival at Hawai'i." When Pele arrived on the shores of Hawai'i, she learned that a fire god by the name of 'Ai Lā'au already had jurisdiction over the island. As Westervelt (1916) explained, after landing at Keahialaka in Puna, Pele embarked towards the mountains in her desire to go at once and see 'Ai Lā'au who lived in Kīlauea. By the time Pele arrived at Kīlauea, she found 'Ai Lā'au's home vacant. Having observed Pele making her way towards him, 'Ai Lā'au was overcome by fear and dread and sought to escape. Pele went to Kīlauea and dug vehemently day and night until she was satisfied, thus establishing Kīlauea as her home.

Given Kapāpala's geographic location, there are several recorded *mo'olelo* that tells of Pele's interaction with this area. Handy et al. (1991) mentioned that on the bare plains of Kapāpala stood a solitary *kukui* (*Aleurites mollucana*) tree, which is said to have been a place where Pele rested. This lone *kukui* tree was reportedly observed by Handy et al. (1991:231) in 1935 "but it looked very old and feeble." In addition to this obscure reference, the following paragraphs contain summaries of other *mo'olelo* that feature Pele as well other chiefs and chiefesses.

Ke Kaua Nui Weliweli Ma Waena o Pele a me Waka

Between May through December of 1899, Hawaiian literary author Moses Manu published *He Moolelo Kaaō Hawaii no ke Kaua Nui Weliweli ma Waena o Pelekeahiloa a me Wakakeakaikawai* (a Traditional Hawaiian Account Regarding The Ferocious Battle Between Pelekeahiloa And Wakakeakaikawai) in the Hawaiian language newspaper *Ka Loea Kalaiaina* (Manu 1899). As the title suggests, the *mo'olelo* recounts the battle between the fire deity Pele-ke-ahi-loa (Pele the long flame, an epithet for Pele) and the *mo'o wahine* (female reptilian-water deity) Waka-ke-aka-i-ka-wai (Waka the reflection in the water, an epithet for Waka). Although Manu named the *mo'olelo* after this battle, the *mo'olelo* also tells of Pele's *mo'okū'auhau* (genealogy) and migration to Hawai'i from Tahiti with various family members. Manu also recounts the story of Pele's sister, Kapō'ulakīna'u, who is noted as the first of Pele and her relatives to arrive in Hawai'i and traverse the archipelago in search of a new home. Broadly speaking, the *mo'olelo* records the physical transformation of the landscape and other places in the *moku* of Ka'ū, Puna, and Hilo from lush forests and white-sand beaches into the volcanic landscape that is seen today. Reference is also made to the lands of Kapāpala and the nearby Punalu'u as the place where the *mo'o wahine* Waka fled through, in her attempt to escape Pele's fires.

Before delving into this fascinating tale, it is worth providing some context about *mo'o*, their characteristics, and their significance in Hawaiian culture. According to Brown (2022:3) in her study titled *Ka Po'e Mo'o Akua Hawaiian Reptilian Water Deities*, *mo'o* "embody the life-giving and death dealing properties of water, the element with which they area associated." Brown adds that:

Mo'o are not ocean dwellers. Instead, they live primarily in or near bodies of fresh water. As a class of deities, they vary greatly in size—as huge as a mountain or as tiny as a house gecko. Many *mo'o* have alternate forms. Predominately female, those *mo'o* who masquerade as humans are often described as stunningly beautiful. Tradition holds that when you come across a body of fresh water in a secluded area and everything is eerily still, you should not longer for you have stumbled across the home of a *mo'o*. When the plants are yellowed and the water covered with a greenish-yellow froth, the *mo'o* is at home. If so, you should leave quickly lest the *mo'o* make itself known to you, to your detriment. (Brown 2022:3)

Below is a summary of the *mo'olelo*, derived from Manu's (1899) original Hawaiian language text, with a focus on the battle, the events that led up to it, and the aftermath. The segment of the *mo'olelo* summarized here begins at Halema'uma'u, one of the *hale lua* (pit homes) of Pele and her extended family. One day, Pele spotted a white bird encircling her home; it had long tailfeathers and black feathers along its head and wings. After seeing the bird on multiple occasions, she became annoyed and wanted to know more about it. Using her magical powers (*mana kupua nui*) Pele discovered that the bird, a *koa'e* (*Phaeton lepturus*), was half-man. She instructed her younger sister, Hulikapaauianua, to spy on the bird-man, follow him home, and confirm what she saw. Hulikapaauianua did as her sister commanded and followed the bird-man to his home near the sea in Pū'ula, Puna. It was here that Hulikapaauianua confirmed that the bird was indeed half-man—a handsome man named Puna'aikoa'e.

When Hulikapaauianua returned to Kīlauea and informed Pele of what she saw, Pele immediately departed her home without telling her family where she was headed. When she reached Pū'ula, she shapeshifted into a beautiful young woman and offered an arousing chant. Puna'aikoa'e, infatuated with this mysterious woman, invited her into his home and inquired about her identity. Pele revealed who she was and they became lovers. When Pele returned to Halema'uma'u, she told her family of Puna'aikoa'e and made it clear to her younger siblings that he was hers alone. Puna'aikoa'e went to live with Pele, who permitted him to roam freely around Kīlauea except for Pu'u'oni'oni, a place that was reserved for Hi'iakaikapoliopele—Pele's favorite younger sibling. On numerous occasions, and with Pele's permission, Puna'aikoa'e left Halema'uma'u for extended visits with his family in Puna, Hilo, and Ka'ū. Pele and Puna'aikoa'e lived happily with this arrangement for some time.

One day, when Puna'aikoa'e was in 'Ōla'a, he saw a beautiful woman like no other in the forest. The next day, he saw her again and introduced himself. The woman was the *mo'o* (reptilian water deity) Wakakeakawai (Waka) from O'ahu. It was as if Puna'aikoa'e forgot about Pele, and thus he spent a great deal of time with Waka. Pele knew who Puna'aikoa'e was with, and in respect of Waka, sent her younger sister, Kapuokokaulaokeahi, to retrieve Puna'aikoa'e. When Kapuokokaulaokeahi reached Puna'aikoa'e, she witnessed him and Waka relaxing together and told him to return to Kīlauea per the instructions of her sister. He was reluctant at first, but upon being reminded of Pele's power, he returned with Kapuokokaulaokeahi to Kīlauea. Waka, saddened by Puna'aikoa'e's departure, cried out to him, instructing him that when he saw a spiderweb in front of his face, it would be her. When Puna'aikoa'e reached Kīlauea, Pele told him that she would not be angered by his behavior on this occasion, but in the future, death would be his punishment.

Waka loved Puna'aikoa'e dearly and constantly thought about him. Eventually, she resolved to retrieve him and made her way to Ka'auea, where she released an eight-eyed, white-bellied spider. The spider reached the edge of the cliffs at Uēkahuna and peered into Halema'uma'u, where many men and women were resting. It descended into the crater, found Puna'aikoa'e, and crawled on one of his ears. Startled by the spider's movements, Puna'aikoa'e woke up and noticed a web in front of his nose. Remembering what his lover told him, he realized that the spider was from Waka. Careful not to awaken anyone, Puna'aikoa'e made his way out of Halema'uma'u and to Ka'auea where Waka was waiting. Once they were reunited, they made their way first to Kapulei, then to Kapāpala, then to a cave called Kaualehu in the uplands of Punalu'u, where one of Waka's *mo'o* relatives lived.

In the morning, Pele woke up to find Puna'aikoa'e was no longer with her. Infuriated by his departure, she instructed Kapuokokaulaokeahi to find him and confirm if he was with Waka. Kapuokokaulaokeahi did as she was instructed and eventually found the couple at Kaualehu. When she told Puna'aikoa'e to return with her to Halema'uma'u, Waka refused and sent Kapuokokaulaokeahi back to Pele. Kapunohu, the *mo'o* relative who lived at Kaualehu, warned Waka that her refusal would have terrible consequences. Before departing, Kapuokokaulaokeahi warned Waka and Puna'aikoa'e of the dangers they would soon face. Kapuokokaulaokeahi hastily made her way back to Halema'uma'u and told Pele of everything that transpired. Enraged, Pele met with her family who resolved to support her. This was the beginning of the battle that ensued.

Pele instructed many of her older relatives and younger siblings to stay at Kīlauea, while she took Hi'iakaika'alemoe and Hi'iakaika'ale'i with her. Hi'iakawāwahilani was left to assist their uncle, Lonomakua. The *pele* (lava) made its way underground from Kīlauea to Punalu'u. Three earthquakes occurred because of the movement of lava. Pele then instructed her younger sisters to make the sea rise upon the lands of Punalu'u. As the sea rose, it remained calm like water in a mountain stream and did not cause much destruction to the people living there. The sea rose all the way to the cave of Kaualehu, and as Waka and Puna'aikoa'e saw this, they did not know it was Pele in hot pursuit of them. As the sea quickly receded away from the entrance of her cave, Kapunohu looked out and saw smoke billowing from the sea and uplands. She told Waka and Puna'aikoa'e, "See! You two have brought me danger and conflict due to your behavior. Leave quickly. Pele surrounds us, there is nowhere for you to escape. Think quickly about how you can resolve this."

After responding to Kapunohu, Waka and Puna'aikoa'e exited the cave to fight Pele. Waka began calling to Mo'oinanea and Kihaniūlūmoku, respectively the head *mo'o* and guardian of Paliuli. In turn, Mo'oinanea called out

to the *mo'o* of Kaua'i to meet above Kalalea. They did as instructed and Mo'oinanea laid out a net made of spiderwebs that she used to transport the *mo'o* to Punalu'u. She then called out to the *mo'o* of O'ahu, Molokai, Maui, and Lāna'i to gather; she used her spiderweb net to transport them all to Punalu'u for the ensuing war. Once in Ka'ū, the land was filled with *mo'o*, and they knew that Pele was near and watching them. Mo'oinanea instructed the *mo'o* to wait before engaging with Pele.

Pele again made the sea rise two more times to the cave where Waka and Puna'aikoa'e were hiding. Once they began to flee, Pele's fires ignited, smoke billowed from the dirt, and burning rocks were hurled at the two lovers. As the other *mo'o* saw this, they knew that there was a reason why Pele was pursuing their *mo'o* relative. When they learned that it was because Waka took Pele's man, they decided that Waka would face the consequences of her actions without their assistance.

Waka and Puna'aikoa'e attempted to flee from Pele and sought aid from *mo'o* living in the mountains above Punalu'u. They rested for a bit when they arrived, only to be forced to flee once more when Pele found them and began to burn the forest. They ran back to Punalu'u, jumped into the sea, and swam to Honu'apo in hopes that Waka's *mo'o* relatives, Ka'ilioalono and Kawelohea, would assist them. Again, Pele thwarted their plans, killing any *mo'o* that dared to disobey Mo'oinanea's orders and assist Waka.

Waka and Puna'aikoa'e eventually made their way to Hīlea and later to Keāiwa. When Pele was near, they both transformed into birds (Waka became an owl and Puna'aikoa'e a *koa'e* bird) and flew away to Pākau. To no avail, Pele was still in hot pursuit, and with all their strength, Waka and Puna'aikoa'e fled to Pānau, then to Kaimū, Kamā'ili, 'Ōpihikao, and numerous other places until they reached Puna'aikoa'e's homeland of Pū'ula. Having no time to rest, they continued to flee to Paliuli, then to Māwae along the coast of Hilo. Finally, at Waiākea pond in the *ahupua'a* of Waiākea, Puna'aikoa'e was killed. Waka continued to flee but was soon forced into a large pond in Keaukaha and killed by Pele. Her body was turned to stone. The pond that Waka was killed in now bears her name. It is a place where *'ōwāowaka* (a type of Hawaiian mussel) was abundant in previous times.

It is said by the people of old that this battle is the reason why lava covered most of Puna, Ka'ū, as well as a long stretch of sand from Waiākea, Hilo to Pānau, Puna, known as Ke One Lau'ena a Kāne.

Chief Kapāpala Taunts Pele and Meets Certain Death at Kīlauea

W.D. Westervelt (1916:33-34) in his book *Legends of the Volcanoes* related several tense stories that tell of Pele's interactions with chiefs of Hawai'i Island who sought to compete with the fiery goddess in ancient pastimes such as *hōlua* and surfing. One such account recorded by Westervelt tells of Pele's encounter with a chief named Kapāpala. Having heard of the mystical fire woman, Kapāpala went to the edge of Halema'uma'u to investigate. There he found a group of beautiful women and was welcomed by Pele. They delighted in each other's company and challenged each other in many games and contests. Kapāpala was so victorious in their games and contests that he boasted greatly and told Pele that he could ride his surfboard on her fiery lake. Angered by the chief's daring remarks, Pele became furious at the thought of Kapāpala desecrating her sacred home. In an act of defiance, Kapāpala grabbed his surfboard and threw it down on a wave of molten fire as it encircled the crater wall. The audacious chief proceeded to surf the molten wave and to further show his contempt for Pele, stood on his head and rode the crest of the molten surf. In a fury, Pele called to her fire servants and *'aumākua* (family gods) to aid in Kapāpala's destruction. With the help of her fire servants and *'aumākua*, they hurled fiery waves across the lake causing the wave that Kapāpala was riding to become distorted. Unable to steady himself on the turbulent wave, at once, Kapāpala was tossed off his board and plugged into the heart of Pele's flaming crater where he perished.

Battle Between Pele and Kamapua'a

Fornander (1918-1919:332-342) in the fifth volume of his series titled *Hawaiian Antiquities and Folk-lore*, recounted one of many battles between Kamapua'a and Pele. In one such battle, Kamapua'a, a half-man, half-hog chief of O'ahu and adversarial lover of Pele, sailed for Hawai'i, landed in Puna, and proceeded to Kīlauea where Pele and her siblings were living. Once at Kīlauea, Kamapua'a stood at 'Akanikōlea, a point of land overlooking the crater that was *kapu* to Pele. While overlooking the crater, Kamapua'a saw Pele's sisters, Hi'iakaikapua'ane'ane and Hi'iakaikapoliopole at the pit of the crater floor stringing *lei*. As Kamapua'a called out in chant to the sisters, Pele overheard his voice but paid him no attention. Kamapua'a again called out, but this time his chant was provocative and nuanced with *kaona* (hidden meanings), in an attempt to entice Pele. Pele responded from the bottom of Halema'uma'u, "*Hele ala aku hoi ke kanaka, o ka puua ka la, oia ka mea e ala aku ai.*" (I would get up if you were a man; but being a hog I will not get up) (Fornander 1918-1919:334-335). Pele's retort prompted Kamapua'a to ask his gods why Pele slighted him and his gods instructed him to chant once more to Pele. Here Kamapua'a uttered the following chant to Pele in which mention is made to the waters of Kapāpala:

*Ia Makalii lau awaawa o Puna,
Hala ka wai mauka o Kapapala,
Lani pili o Hilo—e,
I Hilo, i Puna Kaua e!
E Pele e! ilaila kaua e noho ai,
Kui ana i ka lehua i Hopoe nei la,
(Fornander 1918-1919:335)*

By Makalii the leave of Puna were made bitter,
The waters went above Kapapala,
The heavy rains fell at Hilo,
In Hilo and Puna the rains fell.
O Pele, let us make our abode there,
And string the lehua at Hope.
(Fornander 1918-1919:334)

Pele's sisters urged her to respond to Kamapua'a, who had taken the form of a handsome man. Pele countered her sisters stating that they were indeed mistaken as the man standing at 'Akanikōlea was a pig disguised as a man who was the grandson of Kamaunuanoho and the son of Kahikiula and Hina. The sisters insisted that what they were seeing was a striking man and not a pig. Pele stood fast in her argument and maintained that the man was nothing more than a pig. Kamapua'a called out in chant to Pele several times more but this only incensed the unpredictable fire goddess.

Pele immediately ordered her siblings to stoke the fires and commanded that her two brothers Hi'iakalalo and Hi'iakaluna climb above Kamapua'a. As Pele's brothers approached Kamapua'a, he again asked his gods who these beings were. His gods informed him that if the brothers ever came together, the pig-man would meet certain death. To distract the brothers and avoid his impending doom, Kamapua'a sent his love god, Lonoikeaweawealoha who cunningly made love to the brothers. Kamapua'a's ploy worked and the brothers completely forgot the commands of their sister Pele. Keenly aware of Kamapua'a deceitful ruse to bring about trouble, Pele proceeded to take Kamapua'a to the lowlands of Puna in Mālamaniui and order Lonomakua and her siblings to again stoke the fires. After Pele and Kamapua'a exchange words, at the command of Pele, Lonomakua and Pele's siblings hurled molten rocks through the sky toward Kamapua'a. The liquid hot rocks reached the breast of Kamapua'a. Pele mistakenly thought he had been consumed by her fires, so she left and returned to her home at Kīlauea where she began to put out her fires. Kamapua'a was, however, surrounded by the powers of his gods Kuiliiakaua and others which protected him from succumbing to Pele's wrath.

Kamapua'a again appeared at 'Akanikōlea, very much alive. Vexed at the sight of Kamapua'a, Pele ordered that the fires be reignited once more. When Kamapua'a saw the fires, he called to his sister, Keli'iomakahanaaloa who appeared in the form of a small cloud. The moisture-laden cloud hovered directly over the pit of Kīlauea and Keli'iomakahanaaloa sent torrential rains that extinguished Pele's fires and caused the pit to overflow with water. All that was saved from this rainstorm was Pele's fire-making sticks. Kamapua'a in his hog form descended into the pit of Kīlauea until the whole place became overrun with hogs. Kamapua'a then opened his jaws, wielded his tusk, and swallowed all of Halema'uma'u including Pele and her family where they descended into the depths of the pig's belly until they were nearly dead. Kamapua'a's fickle love god, Lonoikeaweawealoha saw this scene and decided to end this horrific event so he put compassion in Kamapua'a's heart which saved Pele and her family from their deaths.

Kamapua'a, at once, ascended the crater cliff to 'Akanikōlea but Pele not willing to back down to the pig deity, ordered Lonomakua to stoke the fires once more. Using the fire-making sticks that were spared from the flood, Lonomakua rubbed them together until the fire in Kīlauea was rekindled and it overflowed the crater rim. At last, the fires reached the haughty Kamapua'a at which point he called for his various supernatural body forms including the *olomea*, *hala*, *'uhaloa*, and *'ama'uma'u* to grow with great vigor which shut off Pele's fires. The battle lasted many days until finally, the two adversarial lovers came together and agreed to divide the island of Hawai'i into Pele and Kamapua'a respective territories. Pele took the districts of Puna, Ka'ū, and Kona—lands known for their volcanic and rocky nature—and Kamapua'a took for himself, the districts of Kohala, Hāmākua, and Hilo—lands celebrated for their lush greenery. Thus the complex love saga between Kamapua'a and Pele ended.

Story of Nānaele

In their collaborative book, *Folktales of Hawai'i*, (Pukui and Green 1995:77-79) related the account of Nānaele, a comely high chiefess of Ka'alāiki, Ka'ū who escaped from her negligent husband Nāliko, a young chief of Kohala. One day, a company of travelers from Kohala visited Ka'ū and saw the kind and fair Nānaele. The travelers coveted the chiefess as a wife for their chief, Nāliko. A proposition was made to Nānaele and she consented after hearing that Nāliko was "a pleasant man, handsome, modest, and industrious, with other good qualities" (Pukui and Green 1995:77). Nāliko agreed to take Nānaele as his wife and a short time later the two were married at Ka'alāiki, and the pair returned to Kohala to live out their life as husband and wife.

Nānaele soon learned that her husband was not faithful and he often neglected her as he amused himself in *hula* and in the company of Kohala's young women. Unable to leave, Nānaele hoped that she could win his affection but Nāliko paid her no attention and left her without food. The body of the Ka'ū chiefess began to waste "away until she was nothing but bone" (Pukui and Green 1995:77). One day Nānaele approached her husband and pleaded with him to return home

and attend to her, however, Nāliko disregarded her concerns and returned to his pleasurable and neglectful ways. After her husband left, Nānaele crept out of the house in search of food. In a weakened state, the chiefess crawled along until she collapsed at the home of some farmers who were raising pigs. A passerby hearing the commotion from the pigs walked over to investigate and found the exhausted Nānaele laid out on the ground. The passerby picked up Nānaele and carried her back to his home where she was cared for by his wife.

By the time Nānaele began to recover from her feeble state, word had reached Ka'ū about the chiefess's poor condition. The people of Ka'ū, with heavy hearts, decided to fetch their chiefess and bring her back home. People from Ka'alāiki, Kawā, Kahuku, and as far as Kona and Kohala lent their assistance to retrieve the stricken chiefess. Two people carrying a *mānale* (palanquin) marched to the home where Nānaele was staying. Placing her on the *mānele*, the two individuals carried her some distance to a place where other men were stationed to relieve the weary bearers. She was taken by relay until Nānaele reached her home of Ka'ālaiki. Here, with the help of her people, Nānaele made a full recovery and she once again became sought after by many suitors.

Having heard of the improved condition of Nānaele, Nāliko planned to return to Ka'alāiki to get his wife back. News of Nāliko's plan had reached Ka'ū and the people prepared to protect Nānaele from returning to Kohala. Perceiving Nāliko's plan, the people of Ka'ālaiki reported to Nānaele's parents their scheme to hide the chiefess from the careless Nāliko. The people took Nānaele and concealed her at Kawā. Meanwhile, a carefully planned feast was prepared at Ka'alāiki in anticipation of Nāliko's arrival. As expected, Nāliko arrived at Ka'ālaiki and was greeted by his in-laws who informed him that Nānaele and her attendants had gone bathing in the sea but would return later in the evening. In the meantime, Nāliko was entertained with chant, dance, and drinks that put the unpleasant chief into a tranquil state. The men of Ka'ālaiki had planned, under the cover of darkness, to slay the awful chief but an old man pitied the chief and whispered to Nāliko:

They mean to kill you! Here! Delay is perilous! I will guide you to a place where you can hide. Come with me! (Pukui and Green 1995:79)

When the people of Ka'ālaiki were preoccupied, Nāliko and the old man fled through an underground cave until they "reached a spot back of the Kapāpala stock ranch where they ran along between the mountains Hualālai and Maunaloa" until Nāliko escaped back to his home district of Kohala. To avoid suspicion, the old man returned to Ka'ū and found the people searching the countryside between Kahuku to the crater at Kīlauea. The old man discreetly joined the search party and watched as the people futilely searched for Nāliko.

Having returned to Kohala, Nāliko knew he would never again see Nānaele, and had it not been for the old man, he would have been killed. The chiefess of Ka'ālaiki lived out the rest of her life in peace with her parents and her people.

KA'Ū ALI'I FROM THE PRECONTACT TO EARLY HISTORIC PERIOD

Aside from the *mo'olelo* (presented above) regarding the chief Kapāpala and his ill-fated encounter with Pele, the historical records associating Ka'ū's chiefly lineage to the lands of Kapāpala are relatively silent. However, from the writings of Kamakau and others, we can construct a generalized chronology of those *ali'i* (chiefs) that ruled the Ka'ū District. Kamakau (1991:101-102) asserts that "the chiefs of Hawai'i island were from Maui and from O'ahu and Moloka'i between the times of 'Aikanaka and Hanala'a-nui" and that "[t]here were seventeen generations during which Hawai'i island was without chiefs—some eight hundred years." Kamakau (1991) adds that the *po'e ali'i* or chiefly people residing on Hawai'i Island during this time were Punalu'u, Hīlea, Honomalino, Hikapoloa, and several other unnamed individuals. Kamakau suggests that the lack of chiefs on Hawai'i Island is the reason Pili (also known as Pilika'aiea), a chief from Kahiki was brought by the high priest Pā'ao to Hawai'i. Although Kamakau associated these names with ruling chiefs, the names of some of these chiefs have been preserved and remembered as *ahupua'a* names, two of which (Punalu'u and Hīlea Ahupua'a) are within eastern Ka'ū.

The Reign of 'Umi a Līloa to Keawenuia'umi

'Umi a Līloa, a renowned *ali'i* of the Pili line, is often credited with uniting the Island of Hawai'i under one rule sometime during the 1600s (Cordy 2000; Kamakau 1992). 'Īmaikalani, who was a powerful warrior and chief from Ka'ū, resisted 'Umi, but failed to defeat him in his younger days. Combat between the two *ali'i* occurred over an extended period, however, when 'Īmaikalani became blind in his old age, he maintained his reputation for strength and skill in battle. Of 'Īmaikalani, Kamakau (1992:18) related the following:

Many chiefs who had fought against him were destroyed. He was skilled in striking left or striking right, and when he thrust his spear (*pololu*) to the right or to the left it roared like thunder, flashed like lightning, and rumbled like an earthquake. When he struck behind him, a cloud of dust rose skyward as though in a whirlwind. 'Umi-a-Līloa feared I-mai-ka-lani. Although he was blind and unable to see,

his hearing was keen. He had pet ducks that told him in which direction a person approached, whether from in front, at the back, or on either side. All depended on the cries of the birds.

It was only through the skill and cunning prowess of ‘Umi’s lifelong friend, Pi‘imaiwa‘a, that ‘Īmaikalani was finally defeated. Pi‘imaiwa‘a studied ‘Īmaikalani until he became knowledgeable of the Ka‘ū chief’s strength and marvelous skill, and then he killed the two men who led ‘Īmaikalani on either side, the forty men who carried his spears, and all of his pet ducks. When ‘Īmaikalani was alone and helpless, Pi‘imaiwa‘a killed him and Ka‘ū became ‘Umi a Līloa’s (Kamakau 1992). ‘Umi a Līloa with the aid of his generals, Pi‘imaiwa‘a, ‘Ōma‘okāmau, and Kōi went on to conquer all of the district chiefs of Hawai‘i Island, where ‘Umi then divided the land amongst his chiefs and gave Ka‘ū to ‘Ōma‘okāmau (Fornander 1916-1917).

Succeeding ‘Umi a Līloa was his eldest son Keli‘iokāloa. Little is known of Keli‘iokāloa’s reign, however, Fornander (1880:111) writes that after his death “there supervened a season of internal war, anarchy, and confusion” which was likely the result of the district chiefs’ refusal to acknowledge Keli‘iokāloa’s brother, Keawenuia‘umi as the sovereign. There appear to be conflicting ideas of who the rightful sovereign was which led to two potential heirs competing for the kingdom, Keawenuia‘umi and Kūka‘ilani, Keli‘iokāloa’s son (Cordy 2000; Fornander 1880). At the time of this conflict, the ruling chief of Ka‘ū was Kahalemilo, the son of ‘Īmaikalani (Fornander 1916-1917). Kahalemilo and the other district chiefs of Hawai‘i Island were eventually slayed by Keawenuia‘umi.

Keawenuia‘umi and the Rise of the ‘Ī Chiefs

After slaying all of the chiefs of Hawai‘i Island, Keawenuia‘umi turned his attention to consolidating his power by appointing a new line of district chiefs. He named his half-brother, Kumalaenui a ‘Umi (Kumalae) as the new chief of Hilo, which eventually resulted in the outward expansion of the ‘Ī line of Ka‘ū chiefs into Hilo. Keawenuia‘umi later married off one of his daughters from Kamolanui-a-‘umi to Makua, the son of Kumalae. Born from this union was a daughter who became the mother of the ruling chief ‘Ī. The descendants of ‘Ī went on to rule over Hilo for many generations and subsequently expanded their territory to include portions of Hāmākua, Puna, and Ka‘ū districts (Cordy 2000). Pukui (1983:141) recorded the following ‘*ōlelo no ‘eau* “*Ka hālau a ‘Ī*” (the house of ‘Ī) which commemorates the political expansion of the ‘Ī line throughout the east Hawai‘i districts.

From the ‘Ī genealogy descended a long line of powerful rulers, many of whom ruled from Ka‘ū including the high chiefess, Lonoma‘āikanaka, her son Kalaninui‘ātamamao and his son Kalani‘ōpu‘u, and his son, Keōuakū‘ahu‘ula (McKinzie 1983). Edith Kawelohea McKinzie in her book *Hawaiian Genealogies Volume I* cites a chiefly genealogy chant that was published in the July 20, 1896 edition of the Hawaiian language newspaper, *Ka Maka‘āinana*. This chant detailed the genealogy from Lonoma‘āikanaka down to her great-grandson, Keōuakū‘ahu‘ula who would be the last standing district chief to battle against Kamehameha. That portion of the chant is recited below along with a translation provided by the lead author of this study:

- | | |
|---|--|
| 1. Keaweikekahialiokamoku k noho ia
Lonomaaikanaka w, loa o
Kalaninuiamamao k. | 1. Keaweikekahialiokamoku (male) dwelled
with Lonomaaikanaka (female), born was
Kalaninuiamamao (male). |
| 2. Kalaninuiamamao k noho ia
Kamakaimoku w, loa Kalaniopuu
k. | 2. Kalaninuiamamao (male) dwelled with
Kamakaimoku (female), born was
Kalaniopuu (male). |
| 3. Kalaniopuu k noho ia Kanekapolei
w, loa o Keoua Kuahuula k a me
Pauli Kaoleioku k. (McKinzie
1983:40) | 3. Kalaniopuu (male) dwelled with
Kanekapolei (female), born were Keoua
Kuahuula (male) and Pauli Kaoleioku
(male). |

Another of ‘Umi’s descendants to have ruled Ka‘ū was the *ali‘i wahine* (chiefess) Keakealaniwahine, who amongst other things, is remembered for conducting religious ceremonies at various *heiau* (temples) around Hawai‘i Island including Punalu‘u, southeast of the project area. As the story is told, during one of her circuits, she was accompanied by the chief ‘Ī and his son, Kua‘ana-a-‘Ī, both of whom were descendants of ‘Umi a Līloa. During this circuit, ‘Ī died, and to prevent defilement and as custom dictated, Kua‘ana-a-‘Ī departed and left Keakealaniwahine alone to complete the ceremonies. Keakealaniwahine construed this as an act of revolt and attempted to kill Kua‘ana-a-‘Ī. Kua‘ana-a-‘Ī and his followers captured Keakealaniwahine and banished her to Moloka‘i for two years, during which time he and his son, Kuahu‘ia, ruled the island. After her time on Moloka‘i, Keakealaniwahine returned to Hawai‘i Island and Kua‘ana-a-‘Ī placed Ka‘ū, Kona, and Kohala under her control (Cordy 2000).

The Reign of Lonoikamakahiki down to Kīwala‘ō and Kamehameha

In a portion of the *Legend of Pūpūkea* recorded by Fornander (1918-1919:436-451), he recounts the events that led up to a war between the chiefs of Maui and Hawai‘i Island. Although this war was centered primarily in the Waimea-South Kohala region of Hawai‘i Island, a portion of this story tells of the rallying of the troops from the various districts of Hawai‘i. At the center of this epic war were two brothers, Lonoikamakahiki and his junior, Pūpūkea, who were from Hawai‘i Island. Leading the Maui forces in this battle were Kamalālāwalu and his distinguished warrior, Makakūikalani. Lonoikamakahiki was a celebrated ruling chief of Hawai‘i Island with lineal ties to the ancient Pili dynasty (a Hawai‘i Island lineage with ties to Waipi‘o Valley) since roughly A.D. 1300. He was the son of Keawenui a ‘Umi, the grandson of ‘Umi a Līloa, and recognized as an accomplished and dexterous warrior.

Upon the advice of two of Lonoikamakahiki’s allies who had infiltrated the Maui army, Kūmaikeau and Kūmaikaia, Kamalālāwalu arrived at Pu‘u Hōkū‘ula in Waimea only to find the *pu‘u* (hill) bare of any vegetation or rocks—resources that he was told would help in his victory over the Hawai‘i Island chief. As Kamalālāwalu conversed with Kūmaikeau and Kūmaikaia in Waimea, messengers were sent to summon Lonoikamakahiki who was residing at Kealakekua, Kona and Pūpūkea who was living at Kapāpala, Ka‘ū:

When the messenger appeared before him [Lonoikamakahiki], he said to Lonoikamakahiki: “Kamalalawalu and Makakuikalani have come to give battle to you both; and have contended with Kanaloaua, who is a captive of Kamalalawalu.”

When Lonoikamakahiki heard these things, he questioned the messenger: “Where is the battle to take place?” The messenger replied: “There at Waimea, on top of that hill, Hokuula, where Kamalalawalu and all Maui are stationed.” Upon Lonoikamakahiki hearing this, instantly the overseers went forth to muster all the men of Kona. It is said that there were 32,000 men of Kona at that time. From thence the messenger traveled till he arrived at Kapapala, in Kau, where Pūpūkea was residing. When he heard [the tidings], he gathered together Kau, and marched forth between Maunakea and Hualalai. The herald journeyed on and touch Puna, at Hilo, and Hamakua, to gather the people together at Kohala, and hearing, they came. At this sallying forth, there were very many men, the paths being overcrowded and the dust rising on account of the tread of the soldiers. (Fornander 1918-1919:446)

According to this *mo‘olelo*, the soldiers from the districts of Hawai‘i Island marched to Waimea using four main routes. Thirty-two thousand soldiers from Kona traveled from Kanikū; 112,000 contingents from Ka‘ū traveled from ‘Ōhaieka, a land area in Kapāpala, through the saddle of Mauna Kea and Hualālai; 160,000 men from Puna, Hilo, and Hāmakua traveled from Mahiki (a forested section of Waimea); and another 96,000 combatants marched from Kaholeiwai to Moumoualao. As the battle ensued, Kamalālāwalu quickly realized that his army was vastly outnumbered. Instead of a full-fledged battle, Lonoikamakahiki and Kamalālāwalu quickly resolved that Pūpūkea and Makakūikalani would stand first to fight to determine the outcome of the war. Pūpūkea delivered two swift blows with his spear and Makakūikalani fell to his death. Upon the death of Makakūikalani, the Maui forces retreated to the coast in an attempted escape but they were quickly overwhelmed and slaughtered.

The lands of Ka‘ū and Kapāpala figure more prominently in the decades preceding and throughout the reign of Keōuakū‘ahu‘ula and Kamehameha. It was also during this period that the first Westerners set their sights on Hawai‘i in the year 1778, thus marking the end of Hawai‘i’s Precontact Period and the beginning of the early Historic Period. British explorer, Captain James Cook, in command of the ships *H.M.S. Resolution* and *H.M.S. Discovery*, first landed in the Hawaiian Islands on January 18, 1778 (Beaglehole 1967). The following January (1779), during a return trip to the islands, Cook and his men visited the southern tip of Hawai‘i Island where they described a large village on the point (Ka Lae) and met with the inhabitants who brought supplies to their ship. No detailed observations were made by Cook or his men of the Kapāpala area, however, Captain James King, who accompanied Cook on the voyage noted the Ka‘ū District, despite its desolate appearance, seemed more populous than the neighboring district of Puna. Kelly (1969) estimated the population of Ka‘ū to be anywhere between 10,000 and 13,500 at the time of European contact. King provided the following description of Ka‘ū:

It is not only by far the worst part of the Island but as barren waste looking a country as can be conceived to exist...we could discern black Streaks coming from the Mountain even down to the Seaside. But the [southern] neck seems to have undergone a total change from the Effect of Volcanoes, Earthquakes, etc...By the SE side were black honey combed rocks, near the [southern] extremity, which projects out, has upon it rocks of the most Craggy appearance, lying very irregularly, & of most curious shapes, terminating in Sharp points; horrid & dismal as this part of the Island appears, yet there are many Villages interspersed, & it struck as being more populous than the part of Opoona [Puna] which joins Koa [Ka‘ū]. There are houses built even on the ruins [lava flows] we have

describ'd. Fishing is a principal occupation with the Inhabitants, which they sold to us, & we also had a very plentiful supply of other food when off this end. (Beaglehole 1967:606-607)

After leaving South Point, Cook anchored near Ka'awaloa at Kealakekua Bay in the South Kona District on January 17th to resupply his ships. This trip occurred at the time of the annual *Makahiki* festival, where many chiefs and commoners were gathered around the bay. According to John Ledyard, a British marine on board Cook's ship, upward of 15,000 inhabitants were present at the bay, and as many as 3,000 canoes came out to greet the ships (Jarves 1847:59). On January 26th Kalani'ōpu'u, the reigning chief of Hawai'i Island, and former district chief of Ka'ū visited Cook on board the *H.M.S. Resolution*, where they exchanged gifts. Kamehameha was also present at this meeting (Jarves 1847).

On February 4th, Cook set sail from Kealakekua Bay, but a storm off the Kohala coast damaged the mast of the *H.M.S. Resolution*, and both ships were forced to return to Kealakekua to make repairs. On February 13th, several natives were discovered stealing nails from the British ships. They were fired upon by the crew, and a chief close to Kalani'ōpu'u named Palea was knocked down, and his canoe taken. That night one of Cook's boats was stolen, and the following morning Cook set ashore at Ka'awaloa with six marines to ask Kalani'ōpu'u for its return. Kalani'ōpu'u, however, denied any knowledge of the theft and Cook decided to hold the chief captive until the boat was returned (Kamakau 1992). When Cook tried to seize Kalani'ōpu'u, a scuffle ensued and Cook was killed (along with four of his men and several natives) there on the shores of Ka'awaloa. When Captain Cook fell, the British ships fired cannons into the crowd at the shore and several more natives were killed. Kalani'ōpu'u and his retinue retreated inland, bringing the body of Cook with them.

After the departure of the *H.M.S. Resolution* and *Discovery* around 1880, Kalani'ōpu'u proclaimed his son Kīwala'ō successor of his kingdom and gave custody of the war god Kūka'ilimoku to his nephew Kamehameha (Fornander 1996; Kamakau 1992). Kamehameha had been raised with Kīwala'ō in Ka'ū for a period of time during his childhood (Ii 1993). In accordance with the wishes of his father, Keōua (the younger brother of Kalani'ōpu'u), following the death of his mother, Kamehameha was brought to Ka'ū by Kalani'ōpu'u. According to 'Ī'ī:

...Upon their arrival in Kau, Kalaniopuu placed Kamehameha with his wife, the chiefess Kancikapolei, who put Kamehameha in the hands of her *kaikunane* relatives, Inaina *ma*. He was there for some time and was familiar with the life of the court by the time he became associated with his older cousin, Kiwalao, the son of Kalaniopuu and Kalola. (Ii 1993:6)

In 1781, a rebel Puna chief named 'Īmakakoloa led an uprising against Kalani'ōpu'u. It is said that this rebellion was sparked because 'Īmakakoloa grew tired of the incessant and exorbitant demands of Kalani'ōpu'u. 'Īmakakoloa, though a worthy opponent, was no match for Kalani'ōpu'u's superior forces, and was soon defeated. Following the defeat, 'Īmakakoloa managed to avoid capture and hid from detection for the better part of a year. While the rebel chief was sought, Kalani'ōpu'u "went to Ka-'u and stayed first at Punalu'u, then at Wai'ōhinu, then at Kama'oa in the southern part of Ka-'u, and erected a heiau called Pakini, or Halauwailua, near Kama'oa" (Kamakau 1992:108). 'Īmakakoloa was eventually captured and brought to Pakini Heiau, where Kīwala'ō was to sacrifice him as an offering. "The routine of the sacrifice required that the presiding chief should first offer up the pigs prepared for the occasion, then bananas, fruit, and lastly the captive chief" (Fornander 1969:202). However, before Kīwala'ō could finish the first offerings, Kamehameha, "grasped the body of 'Īmakakoloa and offered it up to the god, and the freeing of the tabu for the *heiau* was completed" (Kamakau 1992:109). Upon observing this single act of insubordination, many of the chiefs believed that Kamehameha would eventually rule over all of Hawai'i. After usurping Kīwala'ō's authority with a sacrificial ritual in Ka'ū, Kamehameha retreated to his home district of Kohala.

The Era of Keōuakū'ahu'ula and Kamehameha I (1782-1819)

After Kalani'ōpu'u's death in April of 1782, several chiefs were unhappy with Kīwala'ō's division of the island, and civil war broke out. Kīwala'ō—Kalani'ōpu'u's son and appointed heir—was killed in the battle of Moku'ōhai, South Kona in July of 1782. Supporters of Kīwala'ō, including his half-brother Keōuakū'ahu'ula (Keōua) and his uncle Keawemauhili, escaped the battle of Moku'ōhai with their lives and laid claim to the Hilo, Puna, and Ka'ū districts. According to 'Ī'ī (Ii 1993) nearly ten years of almost continuous warfare followed the death of Kīwala'ō, as Kamehameha endeavored to unite the island of Hawai'i under one rule and conquer the islands of Maui and O'ahu. Keōua, the chief of Ka'ū became Kamehameha's main rival on the island of Hawai'i, and he proved difficult to defeat (Kamakau 1992). Keawemauhili, after a battle with Kamehameha's forces, eventually gave his support to Kamehameha, but Keōua and the people of Ka'ū never stopped resisting.

Stephen Desha in his book *Kamehameha and his Warrior Kekūhaupi'o* tells of the historic battle named Kaua Kaua'awa (Battle of the Bitter Rain) that started in Hilo but was eventually routed to several places within Kapāpala. This battle which was fought between the forces of Kamehameha, Keawemauhili, and Keōua began with Kamehameha's

invasion of Keawemauhili's army in Hilo. While Kamehameha's forces were engaged in battle on the shores of Hilo, Keōua assembled his Pōniu army to follow rapidly after Kamehameha's warriors in Hilo. Kamehameha had, however, stationed a secondary army led by Ka'iana above Kainaliu to bar Keōua's warriors from attacking Kamehameha's Hilo army from the rear. When Keōua's Pōniu army met Kamehameha's forces in the uplands of Kainaliu, a hot battle ensued and Keōua's men were forced back. When Keōua heard of this retreat, he ordered another band of warriors known as the Pūkeawe to charge the men led by Ka'iana. Together Keōua's Pūkeawe and Pōniu armies outnumbered Ka'iana's men. To escape grave danger, Ka'iana's forces retreated to 'Ainapō to reassemble and call for additional reinforcement from South Kona. With the extra forces that numbered about 2,000, Ka'iana pursued Keōua's men and the battle moved from 'Ainapō to 'Ōhaikea, a high point of land with view planes to the ocean, and then to Kahauloa, and from that place to Keōmuku and Kapāpala (Desha 2000). In detailing the remainder of this battle, Desha added:

Bitter rain and biting cold fell on both sides, causing obscurity and aiding Keōua's warriors in their escape from being slaughtered by the forces led by Ka'iana. The people of Ka'ū were familiar with their land and the pits and hidden caves, so that they saved themselves by flight from Kamehameha's fearless men, led by that accomplished *ali'i* of Kaua'i [Ka'iana]. The people of old, in speaking of this battle, said that Keōua's side only escaped by being covered by that bitter rain so that they disappeared from the sight of their opponents. The reason, also, for this kind of rain being called 'awa was, that in a state of intoxication with 'awa, a similar mist would descend and obscure a man's mind, and he would topple over. Thus this rain of the mountain became an 'awa rain. (Desha 2000:182)

Although neither side was victorious, both armies eventually retreated but they continued to periodically wage war on each other. The near-constant warring on the island of Hawai'i following the death of Kīwala'ō undoubtedly affected the people in Keōua's home district of Ka'ū. Westervelt (1916) related the story of Keōua, Keawemauhili, and Kamehameha that began after the battle of Moku'ōhai, but tells of another battle in ca. 1790 when Kamehameha routed Keōua at Waimea and Hāmākua and then sent men to attack Ka'ū. As Keōua attempted to return to his home district via Kapāpala a portion of his army and accompanying family members were killed by the historic eruption remembered by Hawaiians as Keonehelelei (the falling sands) emanating from Kīlauea (Moniz Nakamura 2003). Westervelt writes:

... Kiwalao's half-brother Keoua escaped to his district Ka-u, on the southwestern side of the island. His uncle Keawe-mau-hili escaped to his district Hilo on the southeastern side.

For some years the three factions practically let each other alone, although there was desultory fighting. Then the high chief of Hilo accepted Kamehameha as his king and sent his sons to aid Kamehameha in conquering the island Maui.

Keoua was angry with his uncle Keawe-mau-hili. He attacked Hilo, killed his uncle and ravaged Kamehameha's lands along the northeastern side of the island.

Kamehameha quickly returned from Maui and made an immediate attack on his enemy, who had taken possession of a fertile highland plain called Waimea. From this method of forcing unexpected battle came the Hawaiian saying, "The spear seeks Waimea like the wind."

Keoua was defeated and driven through forests along the eastern side of Mauna Kea (The white mountain) to Hilo. Then Kamehameha sent warriors around the western side of the island to attack Keoua's home district. Meanwhile, after a sea fight in which he defeated the chiefs of the islands Maui and Oahu, he set his people to building a great temple chiefly for his war-god Ka-ili [Kūkā'ilimoku]. This was the last noted temple built on all the islands.

Keoua heard of the attack on his home, therefore he gave the fish-ponds and fertile lands of Hilo to some of his chiefs and hastened to cross the island with his army by way of a path near the volcano Kīlauea. He divided his warriors into three parties, taking charge of the first in person. They passed the crater at a time of great volcanic activity. A native writer, probably Kamakau, in the native newspaper *Kuokoa*, 1867, describes the destruction of the central part of this army by an awful explosion from Kīlauea. (Westervelt 1916:139-140)

He said: "Thus was it done. Sand, ashes, and stones threw up from the pit into a very high column of fire, standing straight up...When this column became great it blew all to pieces into sand and ashes and great stones, which for some days continued to fall around the sides of Kīlauea. Men, women, and children were killed. (Westervelt 1916:141)

Dibble, the first among the missionaries to prepare a history of the islands, gave the following description of the event:

“Keoua’s path led by the great volcano of Kilauea. There encamped. In the night a terrific eruption took place, throwing out flame, cinders, and even heavy stones to a great distance and accompanied from above with intense lightning and heavy thunder. In the morning Keoua and his companions were afraid to proceed and spent the day in trying to appease the goddess of the volcano, whom they supposed they had offended the day before by rolling stones into the crater. But on the second night and on the third night also there were similar eruptions. On the third day they ventured to proceed on their way, but had not advanced far before a terrible and destructive eruption than any before took place; an account of which, taken from the lips of those who were part of the company and present in the scent, may not be an unwelcomed digression.

‘The army of Keoua set out on their way in three different companies. The company in advance had not proceeded far before the ground began to shake and rock beneath their feet and it became quite impossible to stand. Soon a dense cloud of darkness was seen to rise out of the crater, and almost at the same instant the electrical effect upon the air was so great that the thunder began to roar in the heavens and the lightning to flash. It continued to ascend and spread abroad until the whole region was enveloped and the light of day was entirely excluded. The darkness was the more terrific, being made visible by an awful glare from streams of red and blue light variously combined that issued from the pit below, and being lit up at intervals by the intense flashes of lightning from above. Soon followed an immense volume of sand and cinders which were thrown in high heaven and came down in a destructive shower for many miles around. Some few persons of the forward company were burned to death by the sand and cinders and others were seriously injured. All experienced a suffocating sensation upon the lungs and hastened on with all possible speed.

‘The rear body, which was nearest the volcano at the time of the eruption, seemed to suffer the least injury, and after the earthquake and shower of sand had passed over, hastened forward to escape the dangers which threatened them, and rejoicing in mutual congratulations that they had been preserved in the midst of such imminent peril.

‘But what was their surprise and consternation when, on coming up with their comrades of the centre party, they discovered them all to have become corpses. Some were lying down, and others sitting upright clasping with dying grasp their wives and children and joining noses (their form of expressing affection) as in the act of taking a final leave. So much like life they looked that they at first supposed them merely at rest, and it was not until they had come up to them and handled them that they could detect their mistake. Of the whole party, including women and children, not one of them survived to relate the catastrophe that had befallen their comrades. The only living being they found was a solitary hog, in company with one of the families which had been so suddenly bereft of life. In those perilous circumstances, the surviving party did not even stay to bewail their fate, but, leaving their deceased companions as they found them, hurried on and overtook the company in advance at the place of their encampment.’

“Keoua and his followers, of whom the narrator of this scene were a part, retreated in the direction they had come. On their return, they found their deceased friends as they had left them, entire and exhibiting no other marks of decay than a sunken hollowness in their eyes; the rest of their bodies was in a state of nature preservation. They were never buried, and their bones lay bleaching in the sun and rain for many years.”

A blast of sulphurous gas, a shower of heated embers, or a volume of heated steam would sufficiently account for this sudden death. Some of the narrators who saw the corpses affirm that, though in no place deeply burnt, yet they were thoroughly scorched.”

Keoua’s prophets ascribed this blow from the gods to their high chief’s dislike of Hilo and gift to sub-chiefs of the fish-ponds, which were considered the favorite food-producers for offerings to Hiiaka, the youngest member of the Pele family.

Kamehameha’s prophets said that this eruption was the favor of the gods on his temple building.

The people said it was proof that Pele had taken Kamehameha under her special protection and would always watch over his interest and make him the chief ruler. (Westervelt 1916: 141-145)

The untimely eruption of Kilauea, as Keōua’s army attempted to return to Ka‘ū to stop Kamehameha’s warriors from ravaging their home district cost him about four hundred fighting men along with an untold number of women and children. Kamehameha’s prophets said that this eruption was the favor of the gods who rejoiced at his building of Pu‘ukohola Heiau in Kawaihae, which was constructed around 1790 as part of Kamehameha’s efforts to secure his rule

over Hawai'i Island (Fornander 1969). Although a portion of Keōua's forces was killed during this eruption, Keōua made it safely to his royal center which was at Punalu'u (Kamakau 1992). Despite the loss of men, Keōua continued to resist Kamehameha. In 1791 Kamehameha's forces, under the leadership of Ka'iana attacked Keōua's forces in Ka'ū. Fornander (1996:326–327) recounted the battle thusly:

The war with *Keoua* was vigorously continued by *Kamehameha* during the year 1791. One army corps under command of *Keeaumoku*, to which John Young and Isaac Davis were attached, operated against Hilo, while another corps under *Kaiana-a-Ahaua* was sent against Kau. Though sorely pressed on both sides, yet *Keoua* bravely kept his ground during the spring and summer of that year, and no decisive advantages were gained by *Kamehameha* in any of the battles fought. The prolonged contest, however, began to tell upon the resources of *Keoua*, yet with consummate tact and bravery he showed a bold and ready front to every attack, from whatsoever quarter aimed.

No reminiscences of the operations against Hilo have survived, but of the campaign in Kau some notices have been collected by the native historians. Supported by a fleet of war canoes hovering about the South Cape ("Lae a Kalaeloa") of Hawaii, *Kaiana* fought several engagements with *Keoua* at Paiahaa, at Kamaoa, and at Naohulelua, but they were what may be called drawn battles, *Kaiana* sometimes remaining master of the field, and sometimes being obliged to fall back on his flotilla for support. During one of the intermissions in this martial game *Keoua*, suddenly changed his ground from Kau to Puna. *Kaiana* looked upon this move as a confession of weakness, followed *Keoua*, into Puna, and with jubilant exultation anticipated an easy victory. At a place called Puuakoki the two forces met, and *Kaiana* was so severely handled by *Keoua*, and by his generals, *Kaieiea* and *Uhai*, that he made a precipitate retreat out of Puna and returned with his men to Kona, reporting his ill success to *Kamehameha*.

Unable to defeat Keōua in battle, Kamehameha resorted to trickery. Following the skirmishes with Ka'iana, Keōua stayed in Ka'ū, living "mauka in Kahuku with his chiefs and warriors of his guard" (Kamakau 1992:155). When Pu'ukohola Heiau was completed in the summer of 1791, Kamehameha sent his two counselors, Keaweheulu and Kamanawa, to deceitfully entice Keōua to Kawaihae. The counselors arrived at Keōua's compound and gave their speech but Keōua's men (Ka'ie'iea and Uhai) were skeptical and attempted to persuade Keōua to kill the two counselors:

Keoua's people nodded at each other, and Ka'ie'iea said to Keōua, "It will be a good thing to kill these counselors of Kamehameha." Keoua answered, "They must not be killed for they are younger brothers of my father." Ka'ie'iea went on, "If these are killed he will have but two counselors left, and the government will become yours." "I can not kill my uncles." The two messengers rolled along in the dirt until they came to the place where Keoua was sitting, when they grasped his feet and wept. When the weeping was over Keoua asked, "What is your errand?" Keawe-a-heulu answered, "We have come to fetch you, the son of our lord's older brother, and to take you with us to Kona to meet your younger cousin, and you two to be our chiefs and we go to be your uncles. So then let war cease between you." "I consent to go with you to Kona," answered Keoua. (Kamakau 1992:155)

After agreeing to go to Kawaihae, Keōua sailed via canoe while his men traveled on foot over the mountain. Keōua sailed along the Kona coast, stopping at different locales including Honomalino, Ka'awaloa, and Kailua. At each stop, Keōua's men urged the killing of the counselors to which the chief consistently refused. After leaving Kailua, Keōua sailed to Luahinewai in the Kekaha portion of North Kona. While at Luahinewai, "Keoua went to bathe, and after bathing he cut off the end of his penis ('*omu* 'o), an act which believers in sorcery call "the death of Uli," and which was a certain sign that he knew he was about to die" (Kamakau 1992:156). Before departing Luahinewai, Keōua arranged his chiefs and officers about him in his double canoe and placed his royal regalia and weapons in the canoe of Keaweheulu as a sign that he knew he would be killed.

Keōua and his men were enticed to the dedication of the Pu'ukohola Heiau by this ruse and when he neared Pu'u Kohola, Keōua was killed and sacrificed to complete the dedication of the *heiau* (Kamakau 1992). While the body of Keōua was being carried to the *heiau*, a chief named Kaiheki'oi uttered the following chant, which is still used "by the old people of Ka'u who retain their love of Keoua and hatred for Kamehameha" (Kamakau 1992:158).

<i>Ku'u haku i ka ua Ha'ao e,</i>	My lord of the rain of Ha'ao,
<i>Ke lele a'e la ka ua,</i>	The rain flies fast,
<i>Ma uka o 'Au'aulele,</i>	Flies over the upland of 'Au'aulele,
<i>Lele ka ua, lele pu no me ka makani.</i>	The rain flies driven by the wind.
<i>E lele po'o and ka wai o ka ha,</i>	The rain drives down from the cliffs above,
<i>Ku'u haku mai ka wai</i>	The tears for my chief

Ha'ule po'e e.

Drops down on the heads of the people.

The assassination of Keōua gave Kamehameha undisputed control of Hawai'i Island, however, the people of Ka'ū never acknowledged Kamehameha as their chief (Greene 1993). So beloved and attached to their land and chiefs, the people of Ka'ū continued their unwavering support for Keōua even in the face of grave political conquest. Like the *mele* cited above, this staunch attitude is widely celebrated in many compositions. Once such *mele* (songs) quoted below is a *mele inoa* (name chant) composed for Kupake'Ī, who was a descendant of the 'Ī line. Kupake'Ī along with Keōua reigned during the time of Kamehameha and Kupake'Ī would have succeeded Keōua as the district chief had Kamehameha not killed him. In the following *mele*, the Ka'ū chiefs draw upon their knowledge of their lands to counter and demonstrate their disdain towards the intruding political forces of Kona. The following is a portion of the *mele* that was documented and translated by Pukui (1949:251-252).

'Aole au i makemake ia Kona

I do not care for Kona,

O Kau ka'u

For Kau is mine.

O ka wai o Kalae e kahe ana i ka po a 'ao.

The water from Kalae is carried all night long.

I ke kapa, i ka 'upi kekahi wai,

(Wrung) from tapas and some from sponges.

Kulia i lohe ai he 'aina wai 'ole.

This land is heard of as having no water,

I Mana, i Unulau ka wai kali,

Except for the water that is waited for at Mana and Unulau,

I ka pona maka o ka I'a ka wai aloha e,

The much prized water is found in the eye socket of the fish,

Aloha i ka wai malama a kane

The water prized and cared for by the man,

E hi'i ana ke keiki i ke hokeo,

The child carries a gourd container in his arms.

E hano ana, e kani 'ouo ana,

It whistles, whistles as the wind blows into it,

Ka leo o ka huewai i ka makani,

The voice of the water gourd is produced by the wind

Me he hano puhi ala i ke aumoe,

Sounding like a nose-flute at midnight,

Ka hoene lua a ka ipu e o nei.

This long-drawn whistling of the gourd, we hear.

E lono i kou pomaika'i, Eia!

Hearken, how fortunate you are!

Mamuli o kou hope 'ole, okoa ka ho'i,

There is no going back, (our) ways are different.

A ma ka wa kamalii nei, mihi malu,

In childhood only does one regret in secret,

'U wale iho no.

Grieving alone.

Aloha 'ino no ka ho'i ke kau mamua.

(Look) forward with love for the season ahead of us.

'U'ina 'ino noho'i ke kau i hala aku nei.

Let pass the season that is gone

By 1796, with the aid of foreign weapons and advisors, Kamehameha conquered all of the island kingdoms except Kaaui. In 1810, when Kaumuali'i of Kaaui gave his allegiance to Kamehameha, the Hawaiian Islands were unified under a single leader (Kuykendall and Day 1976). He and his high chiefs participated in foreign trade but continued to enforce the ancient *kapu* system (Kamakau 1992). Kamehameha would go on to rule the islands for another nine years until his passing in 1819 at his home at Kamakahonu, Kailua.

Death of Kamehameha, the Overturning of the 'Aikapu

Kamehameha died in 1819 at his royal residence of Kamakahonu in Kailua, Kona, and his son Liholiho (Kamehameha II) was named heir to the newly consolidated kingdom. Upon his death, Kamehameha's wife, Ka'ahumanu, announced the last *kauoha* (commands) of her late husband:

O heavenly one! I speak to you the commands of your grandfather. Here are the chiefs; here are the people of your ancestors; here are your guns; here are your lands. But we two shall share the rule over the land. Liholiho consented and became ruling chief over the government. (Kamakau 1992:220)

Following the death of a prominent chief, it was customary to lift all the *kapu* that maintained social order and the separation of men and women, as well as elite and commoners. Under the ancient *kapu* of the land, merely naming a chief as heir was only a part of the process. As tradition required, the newly established ruling chief had the arduous task of performing a prescribed set of ancient rituals (referred to as the 'aha ritual) at the *luakini heiau* until the proper signs from the gods, particularly Kū were received (Malo 1951). Successful completion of the complex 'aha ritual was a means to verify that the gods were in favor of and supported the new chief. Immediately upon the death of Kamehameha, Liholiho was sent away to Kawaihae to keep him safe from the impurities at Kamakahonu brought about by the death of his father. Liholiho in his initial unsuccessful attempts to secure the proper signs from the gods, left Kawaihae and circuted Hawai'i Island, visiting several *heiau* of the *luakini* class, including Punalu'unui in Punalu'u, southeast of the project area (Ii 1993; Kamakau 1992). After purification ceremonies Liholiho returned to Kamakahonu:

Then Liholiho on this first night of his arrival ate some of the tabu dog meat free only to the chiefesses; he entered the *lauhala* house free only to them; whatever he desired he reached out for; everything was supplied, even those things generally to be found only in a tabu house. The people saw the men drinking rum with the women *kahu* and smoking tobacco, and thought it was to mark the ending of the tabu of a chief. The chiefs saw with satisfaction the ending of the chief's tabu and the freeing of the eating tabu. The *kahu* said to the chief, "Make eating free over the whole kingdom from Hawaii to Oahu and let it be extended to Kauai!" and Liholiho consented. Then pork to be eaten free was taken to the country districts and given to commoners, both men and women, and free eating was introduced all over the group. Messengers were sent to Maui, Molokai, Oahu and all the way to Kauai, Ka-umu-ali'i consented to the free eating and it was accepted on Kauai. (Kamakau 1992:225)

Liholiho's cousin, Kekuaokalani, caretaker of the war god Kūka'īlimoku, was distressed by the socioreligious turn of events and rebelled. A battle between the forces of Liholiho and Kekuaokalani was fought in December 1819 at Kuamo'o in North Kona. Kekuaokalani's forces were defeated and the old religion fell with them. Liholiho sent edicts throughout the kingdom renouncing the ancient state religion, ordering the destruction of the *heiau* images, and commanding that the *heiau* structures be destroyed or abandoned and left to deteriorate. He did, however, allow personal family religion, the *'aumākua* worship, to continue (Kamakau 1992; Oliver 1961).

EARLY EUROPEAN VISITORS AND MISSIONARY ACCOUNTS

One of the first European explorers to write specifically of Kapāpala was Archibald Menzies, a botanist who made several trips to Hawai'i, first in 1787 and 1788 under Captain Colnett and later in 1792, 1793, and 1794 with Captain Vancouver. The second visitor to pass through Kapāpala was William Ellis who wrote about the area during his 1823 visit.

Archibald Menzies 1794 Trip to Mauna Loa via the 'Ainapō Trail in Kapāpala

On his 1794 trip, Menzies made a successful ascent of Mauna Loa by way of Kapāpala. The route taken by Menzies was the 'Ainapō trail, which would become the preferred route used by inquisitive visitors to ascend Mauna Loa. Menzies took a canoe from Kealakekua Bay, stopping first at Manukā and then at Pakini Village near Ka Lae, where he left the canoe and set out overland. Menzies (1920) noted that when Hawaiians visited the eastern side of the island by this southern route, they typically traveled by canoe as far as Pākini, where they would leave their canoe, because of the strong trade winds, and continue eastward by land, reclaiming the canoe on the return trip. This journey, however, required that the traveler first climb a steep precipice near the coast known as Pali o Kalani. Menzies (1920) reported that:

...On gaining its summit [of Pali o Kalani], which was not an easy task, an extensive tract of the most luxuriant pasture we had yet seen amongst these islands rushed at once upon our sight, extending itself from the south point to a considerable distance inland...

From the summit of this bank we pursued a path leading to the upper plantations in a direct line towards Mauna Loa, and as we advanced the natives pointed out to us on both sides of our path, places where battles and skirmishes were fought in the late civil wars between the adherents to the present king [Kamehameha I] and the party of Keoua, who was king of the island in Captain Cook's time. Kamehameha's warriors were headed by Kaiāna, who at that time made free use of firearms, which obliged Keoua's warriors to entrench themselves by digging small holes in the ground, into which they squatted flat down at the flash of the musquets. Many of these little entrenchments were still very conspicuous and they were pointed out to us by natives with seeming satisfaction, as it was to them a new method of eluding the destructive powers of firearms on plain ground. Here then we behold the first beginnings of fortifications amongst them. We also see that the same mode of fighting naturally begets the same mode of defense in every part of the world. It was in these wars that Kaiāna by his knowledge of firearms gained so much ascendancy on the island and became so powerful a chief. We continued our ascent through a rich tract of land which appeared to have laid fallow or neglected ever since these wars, till we came to a grove of kukui trees, and under their shade we stopped to rest and refresh ourselves in the heat of the day. (Menzies 1920:181-183)

Menzies (1920:184) continued on a narrow winding path five or six miles from the shore, which he described as "the public road leading to the east end of the island." As Menzies followed an inland trail, many of his descriptions are centered on the plantations and horticultural techniques he encountered along the way (Kelly 1980). He spent the night at a village called Kī'ōlokū on a plantation belonging to Keaweāheulu, and then continued on his journey, stopping at

other inland plantations at Punalu‘u and Kapāpala that belonged to Kamehameha. The exploring party approached Kapāpala and wrote of their experience:

Though we had much reason to be satisfied every step we went, with the kind attentions and unbounded hospitality of the natives, yet we could not being now a little out of temper with them at the great distance they were taking us as it were round the foot of the mountain, till the afternoon we reached a fine plantation called Kapapala, belonging to the king, from which they told us we were to ascend the mountain. As the chief had here to provide his last supplies of provisions for our journey up, we were obliged to stop for the night to allow him some time for that purpose.

In the evening we sent back one of the natives to Kealakekua with a note to Capt. Vancouver to relieve any anxiety he might be under respecting us, and to acquaint him with the distance we had come and the probable time it would still take us to accomplish our object. We were now within a few miles of the volcano, [Kīlauea] of which there seemed to be this day a considerable eruption, and as the wind blow from that direction, the smoke, dust and ashes arising from it proved very troublesome to our eyes in traveling with our faces towards it.

February 13th. Before we set out on the morning of the 13th, I observed the barometer at eight, when the mercury stood at 28 in. 20 pts., which made our height at this place 1800 feet above the level of the sea. The thermometer was at the same time 67 degs. [degrees].

After breakfast, everything being got ready, and the party arranged, we continued our march through the plantation for two or three miles further, and then began our ascent up the south-east side of Mauna Loa in an easy slanting direction, passing through groves of trees and clear spots alternately by a narrow rugged path without meeting any more cultivated ground after we quitted the plantation of Kapapala, or any houses till towards sunset, when we came to two or three old huts where our guides told us we must encamp for the night. The chief no longer depended on his own knowledge of the path, but brought men with him from the last plantation to conduct the whole party up the mountain, which now lay between us as Kealakekua. We had the volcano to our right most part of this day and in the forenoon the smoke and ashes arising from it made the air very thick, which at times proved very tormenting to our eyes.

At sunset the thermometer was at 54 degs., and the barometer stood at 26 in. 50 pts., which made our height from the sea 3,510 feet. (Menzies 1920:187-189)

The following day, on February 14th, Menzies (1920:189) and his entourage continued up the slopes of Mauna Loa, which was covered in snow, passing through the same elevation as the current project area where he commented that “and yet we were not here advanced half way up the woody region of the mountain.” Menzies (1920) commentary continued thusly:

...we again set forward up the mountain in a reversed oblique direction to what we came the day before, but in so winding and circuitous manner and through such pathless and rugged tracts, avoiding clumps of forest here and there, that, had we not good guides with us, we should have met with insurmountable difficulties.

Towards the evening, we reached the upper verge of the forest nearly over Kapapala, where we encamped for the conveniency of having wood at hand to burn and erect our huts with. The natives having pitches upon a clear spot overgrown only with strong tall grasses, they all set to work and in the course of two hours erected a small village of huts sufficient to shelter themselves and us comfortably for the night. These huts, though finished with such hurry, were neatly constructed and well thatched all over with long grass. A large one was built in the middle of the village for us to eat and sit in, besides a small one for each of us to sleep in, where they spread our bedding on a thick layer of the long grass, so that we enjoyed our repose comfortably as we could wish. (Menzies 1920:189-190)

Concerning the plants observed by Menzies while passing through Kapāpala (at the same elevation as the project area), he wrote:

In this day’s march we saw many strange looking plants, different from any we had before observed, but very few of them being either in flower or seed, it was not possible to make out what they were. Near our encampment I found a large beautiful species of *Vicia* clambering up amongst the thickets in full bloom. (Menzies 1920:190-191)

Unwilling to endure the icy conditions and in fear of becoming ill, the native guides and the “old chief Luhea” refused to accompany the entourage further up Mauna Loa beyond the 6,500 foot elevation (Menziess 1920:192). Menziess parted way with his guides and proceeded up the snow-capped summit of Mauna Loa. It would another three decades after Menziess 1794 visit that the next western visitor would pen a description of Kapāpala.

William Ellis’ 1823 Pass Through Kapāpala

Efforts to grow Hawai‘i’s Calvinist mission commenced in 1823 when British missionary, William Ellis arrived on the island of Hawai‘i with the goal of touring the island to identify potential locations in which to establish future church centers. While circuiting the island, Ellis journaled his experiences in which he wrote about the places he visited as well as the customs and mannerisms of the native people. Ellis visit post-dates the arrival of the first missionaries by four years, thus his descriptions sometime reflect the early religious and socio-cultural changes of the island during this period. Ellis spent some time in Ka‘ū and while traveling northward from Honu‘apo to Hokukano, Ellis expressed to his native guide, Makoa, his desire to visit Kīlauea. Unwilling to accompany Ellis and his party to Kīlauea for fear that the foreigners might “offend Pele or Nahoaaarii, gods of the volcano...,” Ellis describes the interaction with Makoa:

If we were determined on going, he [Makoa] said, we must go by ourselves, he would go with us as far as Kapapala, the last village at which we should stop, and about twenty miles on this side of it; from thence he would descend to the sea-shore, and wait till we overtook him.

The governor, he said, had told him not to go there, and, if he had not, he should not venture near it, for it was a fearful place. (Ellis 1917:154)

Continuing with their journey, Ellis passed through the village at Ka‘ala‘ala which he described thusly:

The land, though very good, was but partially cultivated, till we came to Kaaraara [Ka‘ala‘ala], where we passed through large fields of taro and potatoes, with sugar-cane and plantains growing very luxuriantly.

Maruae, the chief of the place, came down to the road side as we passed by, and asked us to stay for the night at his house; but as Kapapala was only four miles distant, we thought we could reach it before dark, and therefore thanked him, and proposed to walk on. As our boys were tired with their bundles, we asked him to allow a man to carry them to Kapapala. He immediately ordered one to go with us, and we passed on through a continued succession of plantations, in a high state of cultivation. (Ellis 1917:161)

After departing Ka‘ala‘ala, Ellis and his party ventured north to Kapāpala where they met the head man, Tapuahi. Ellis described the features of his host’s house as well as some of the customs and traditions:

About seven o’clock in the evening we reached Kapapala, and directed our weary steps to the house of Tapuahi, the head man. He kindly bade us welcome, spread a mat in front of his house for us to sit down upon, and brought us a most agreeable beverage, a calabash full of good cool fresh water.

The thermometer at sun-set stood at 70°, and we sat for some time talking with the people around us. The air from the mountains, however, soon began to be keen. We then went into the house, and, although we were in a tropical climate, in the month of July, we found a fire very comfortable. It was kindled in a hollow place in the centre of the earthen floor, surrounded by large square stones, and gave both light and heat. But as there was only one aperture, which, as in the houses of the ancient Britons, answered the triple purpose of a door, a window, and a chimney, the smoke was sometimes rather troublesome. (Ellis 1917:161-162)

Few of the Hawaiian females are without some favourite animal. It is usually a dog. Here, however, we observed a species of pet that we had not seen before. It was a curly-tailed pig, about a year and a half old, three or four feet long, and apparently well fed. He belonged to two sisters of our host, who formed part of his family, and joined the social circle around the evening hearth.

In the neighbourhood of Kapapala we noticed a variety of the paper-mulberry, somewhat different from that generally cultivated, which grew spontaneously, and appeared indigenous. Large quantities of the dried bark of this plant, tied up in bundles, like hemp or flax, were piled up in the house where we lodged. It is used in manufacturing a kind of tapa, called mamake, prized throughout the islands on account of its strength and durability.

About eight o’clock a pig was baked, and some taro prepared by our host for supper. At our particular request he was induced to partake of it, though contrary to the etiquette of his country.

When we had finished, Tapuahi and his household assembled for family worship, after which we retired to rest. We had travelled more than twenty-miles, and two of our number had since the morning spoken four times to the people.

Soon after sunrise on the 31st, the people of the place were collected around our house. I requested them to sit down in front, and, after singing a hymn, preached to them a short and plain discourse. Mr. Thurston concluded the service with prayer. The people remained in the place for nearly an hour, and made many inquiries.

Kīlauea was erupting during Ellis's visit as an article published in the missionary newspaper *The Friend* explained:

During 1823 Kilauea was again in action, sending out a great flow which reached the sea at Kapapala, where it extended for six miles. Mokuaweoweo, the summit crater of Mauna Loa, was active for eighteen days in June, 1832, but the flows did not reach the ocean. (The Friend 1907)

According to an 1863 *Report of Churches in South Kona Hawaii* prepared by John D. Paris, by 1826, the first church located in South Kona was established under the Reverend James Ely. This church serviced members from “Kapuohao [Pu‘u ‘Ōhau] on the border of North Kona to Kapapala—the distance of more than one hundred miles” (Paris 1863:1). Paris (1863) also reported that the Chief Naihe and chiefess Kapi‘olani were among the first Hawaiian converts to be admitted into this church. Kamakau (1992) reported that in 1824 just a year after Ellis' visit to Kapāpala, Chiefess Kapi‘olani, who was the daughter of Hilo chief Keawemauhili and Ululani, made a trip to Kīlauea where she defied the priestess of Pele, and her *kapu* and professed her faith in Jehovah. Such act reflects the Christianization of some of the *ali‘i* during this period.

E.W. Clark's Brief Visit to Kapāpala

In February of 1829, missionary, E. W. Clark submitted a letter to the American Board of Commissioners For Foreign Mission (ABCFM) detailing his trip around Hawai‘i Island. Entering Kapāpala from Kīlauea, Clark penned the following:

After passing this lava, we came to a rich & fertile soil & about 8 o'clock in the evening arrived at Kapapala exceedingly fatigued, & wet to the skin by the tall grass through which we had travelled. We lodged with the same man with whom the deputation put up when they passed this way. We arose after a restless night & pursued our way over a fertile county to Punaluu, a small village on the seashore in the division of Kau. (Clark 1829:763)

An 1835 missionary census counted a total of 4,766 Hawaiians living in the district of Ka‘ū with some 394 residents listed for the lands between Keāiwi to Kapāpala (Schmitt 1973:30). Mission station reports from 1844 indicated that there was a mission school with 45 students “near Kapapala” (Paris 1844:3), however, no other locational information was provided. By the early 1840s the ABCFM saw the need to establish a permanent mission station in Ka‘ū. The decision to build the Protestant mission was influenced in part by the remoteness of the Ka‘ū District and the difficulties that the South Kona and Hilo missionaries had servicing it, but was also a response to the growing influence of Catholic missionaries, who had arrived in the islands in 1828, and were themselves looking to establish a permanent presence in Ka‘ū (Brandt et al. 2019). In November of 1841, the first Protestant church—a grass house built on a large stone enclosure—was erected at Wai‘ōhinu (Paris 1926).

Chester H. Lyman, 1846 Observes Canoe Sheds in Kapāpala and Population Decline in Ka‘ū

Another missionary to tour through Kapāpala was Chester H. Lyman who visited in 1846 and approached Kapāpala from Kīlauea. As reported by Handy and Pukui (1998:231) Lyman “encountered dwellings and canoe-making sheds, the first of such to be seen on descending the mountain.” Handy and Pukui (1998:231) further add:

He was impressed with the green hills, the moist state of the soil, the “several horses with cattle and goat” feeding near the chief's house; and “the fires of Kilauea which shone up magnificently on the clouds like the light of a conflagration at evening.”

As noted above, during Lyman's visit, Kīlauea was erupting which impacted a portion of Kapāpala, as described below:

He [Lyman] found the usually lush country below Kapapala (and extending as far as Waiohinu) “recently burned over, the black roots of the tufts of grass, the wilted and blackened shrubs, and the smoke stones [presenting] a most disman prospect for many miles.” (Handy and Pukui 1998:239)

The population of Ka‘ū in 1843 was estimated by missionaries to be nearly 5,000 people, less than half of the estimated population at the time of European contact (Kelly 1969, 1980). By 1847, when the first government census

2. Background

was taken, the population of the Ka‘ū District had declined to 3,010 persons (Kelly 1980). There is no single reason for the decrease in population, rather it occurred through an accumulation of changes that took place after Western contact. One often cited reason is that Westerners brought foreign diseases with them, to which the Native Hawaiians had no resistance. A large portion of the Hawaiian population (perhaps as much as half) is said to have been lost to a plague that ravaged the islands in ca. 1804 (Malo 1839; Schmitt 1968); in 1848-49 the inhabitants of the Islands were struck by a series of epidemics, including measles, whooping cough, influenza, and dysentery (Kelly 1969). In addition to population reduction caused by disease, many people moved to other islands; for example when Governor Kuakini moved from Hawai‘i Island to O‘ahu, many of his people followed him. Also, men who began working on whaling ships emigrated to foreign countries and rarely ever returned to Hawai‘i (Schmitt 1973).

Another major factor in the decline of Ka‘ū’s population was famine caused by drought and fires (Kelly 1980). After visiting Ka‘ū in 1846, Chester Lyman, who described Honu‘apo as a pleasant village set among coconut trees, with a canoe landing, and “the hills back of it...cultivated with sweet potatoes, taro, etc.” (Lyman 1846:9) noted that a recent fire, which began at Honu‘apo and then spread quickly westward by the trade winds, had “consumed houses taro & potato patches & produced a famine” (Lyman 1846:14). Lyman was told that another fire occurred in 1830 or 1831 that “burnt nearly the whole district”, and he reported that, “the natives speak of four such burnings as having taken place within the memory of their aged men” (Lyman 1846:14). The Government’s taxation policies were another contributing factor to the depopulation of Ka‘ū. As the Rev. Paris wrote in his 1846 annual report:

...The population of Kau from all the information I have been able to gather, has been gradually diminishing for years but during the past year and especially the last six months it has been much more rapid. The influenza swept off a great many of the aged, the more feeble & infirm, & laid the foundation of disease on many of the strongest & most healthy constitutions which has greatly swelled the lists of mortality ever since.

Long and pinching famine for the last few months, has also contributed not a little to increase the number of deaths. Few, if any have died of actual starvation. But the sufferings of the very poor, the aged & sick, have been very great, & the nature of their food has been such as to produce diarrhea & other diseases [sic] which have terminated in death. Mortality has been very great among the children.

Another cause of depopulation has been the course pursued by Government officers, in reference to taxes. They require that all taxes be paid in Silver & gold & nothing else. But there is no silver in Kau. It does not grow there. The soil is good but is not adapted for the cultivation of silver & gold. Consequently all our able bodied men have gone money hunting - Some with their whole families & not a few of them have taken up their abode in the Cities of dollars & cents. If the people are compelled to pay their taxes in money only, I am satisfied it will be the cause of draining Kau of its inhabitants. This will also be the case with all districts similarly situated, they will be depopulated, to enrich the Government & their inhabitants will become hewers of wood & drawers of water to a foreign people. (ABCFM 1846 in Uyeoka et al. 2012)

Taxation levied on the people took the form of poll taxes, land taxes, and labor taxes (Kuykendall 1938). The labor tax required that an individual work six days out of the month—three days for the chief landlord, and three days for the King—or a pay a fee of nine dollars (Kelly 1969). Prior to 1840 the schools in the Ka‘ū District were supported by the Protestant mission, but in that year, under pressure from the missionaries, a law was enacted for a national system of Hawaiian schools supported by the government. At first the schools were subsidized from the King’s share of the labor tax, but in 1846 the burden of a school tax was also placed directly on the people (Kelly 1969).

In 1847, there were 764 pupils enrolled in school in the district of Ka‘ū (460 Protestant, 340 Catholic). By this time instruction at the Protestant school at Punalu‘u had ceased, but 50 students were still enrolled at the nearby Ninole school (Kelly 1969). A decade later (by 1857), enrollment in the entire district of Ka‘ū had decreased even further to a total of 235 pupils, and the school at Ninole had also shut its doors (ABCFM 1849).

In addition to population decline, Paris describes other changes to lifeways that he had noticed in the Ka‘ū District since 1841. Paris (1849) writes that most of the Natives were now clothed on the Sabbath in European fabrics, and even European style, that the structure and comfort of the Native houses had been considerably improved, and that many of the yards and gardens were now enclosed, in his opinion, greatly improving their appearance. In 1849, Rev. Paris’ time in Ka‘ū came to end. During that year Paris returned to the United States with his daughters for an extended sojourn. In 1851, Paris returned to Hawai‘i with his family and a new wife to continue his missionary work at the Ka‘awaloa/Kealakekua mission station in South Kona where he remained until his death in 1892 (Paris 1926). Father Maréchal of the Catholic mission continued to serve in Ka‘ū and Puna until 1848, when he transferred to Kona, where

he died in 1859 at the age of forty-five. Paris and Maréchal were the first of many missionaries to reside in Ka‘ū during the sweeping social and economic changes of the mid-19th century.

KAPĀPALA DURING THE MID TO LATE 19TH-CENTURY TO PRESENT DAY

The mid to late 19th century brought about sweeping changes including the conversion to a Euro-American model of private property which paved the way for large-scale commercial industries including ranching and sugar. These industries significantly altered the traditional lifeways and had a profound impact on the social fabric and physical landscape of eastern Ka‘ū.

Māhele ‘Āina of 1848

By the mid-19th-century, the Hawaiian Kingdom was an established center of commerce and trade in the Pacific, recognized internationally by the United States and other nations in the Pacific and Europe (Sai 2011). As Hawaiian political elites sought ways to modernize the burgeoning Kingdom, and as more Westerners settled in the islands, major socioeconomic and political changes took place, including the formal adoption of a Hawaiian constitution by 1840, the change in governance from an absolute monarchy to a constitutional monarchy, and the shift towards a Euro-American model of private land ownership. This change in land governance was motivated in large part by ex-missionaries and Euro-American businessmen in the islands who, in pursuit of self-interest, challenged the rights of the King and chiefs to dispossess them of lands at will. During the reign of Kamehameha III, the *ali‘i* and foreigners compelled the government to enact a series of laws that would ultimately westernize the traditional land tenure system (Lam 1989).

The *Mō‘ī* (Ruler) Kamehameha III, through intense deliberations with his high-ranking chiefs and political advisors, separated and defined the ownership of all lands in the Kingdom (King n.d.). They decided that three classes of people each had one-third vested rights to the lands of Hawai‘i: the *Mō‘ī*, the *ali‘i* and *kono‘hiki*, and the *hoa‘āina* (a persons to whom the *kono‘hiki* or *haku‘āina* commits the care of their land). In 1846, King Kamehameha III formed the Board of Commissioners to Quiet Land Titles (more commonly known as the Land Commission) to adopt guiding principles and procedures for dividing the lands, grant land titles, and act as a court of record to investigate and ultimately award or reject all claims brought before them (Bailey in Commissioner of Public Lands 1929). All land claims, whether by chiefs for an entire *ahupua‘a* or *‘ili kūpono* (nearly independent *‘ili* land division within an *ahupua‘a*, that paid tribute to the ruling chief and not to the chief of the *ahupua‘a*), or by *hoa‘āina* for their house lots and gardens, had to be filed with the Land Commission within two years of the effective date of the Act (February 14, 1846) to be considered. This deadline was extended several times for chiefs and *kono‘hiki*, but not for native tenants (Soehren 2005a).

The King and some 245 chiefs spent nearly two years trying unsuccessfully to divide all the lands of Hawai‘i amongst themselves before the whole matter was referred to the Privy Council on December 18, 1847 (King n.d.; Kuykendall 1938). Once the King and his chiefs accepted the principles of the Privy Council, the *Māhele ‘Āina* (Land Division) was completed in just forty days (on March 7, 1848). The names of nearly all of the *ahupua‘a* and *‘ili kūpono* of the Hawaiian Islands, as well as the names of the chiefs who claimed them, were recorded in the *Buke Māhele* (*Māhele Book*) (Buke Māhele 1848; Soehren 2005b). As this process unfolded, King Kamehameha III, who received roughly one-third of the lands of Hawai‘i, set aside a portion which was designated as public lands that could be sold to raise money for the government and also purchased for fee simple title by his subjects. Accordingly, the day after the division when the name of the last chief was recorded in the *Buke Māhele*, the King commuted about two-thirds of the lands awarded to him to the government (King n.d.). Unlike the King, the chiefs and *kono‘hiki* were required to present their claims to the Land Commission to receive their Land Commission Awards (LCAw). The chiefs who participated in the *Māhele* were also required to provide to the government commutations of a portion of their lands in order to receive a Royal Patent giving them title to their remaining lands. The lands surrendered to the government by the King and chiefs became known as “Government Land.” The lands personally retained by the King became known as “Crown Land.” Lastly, the lands received by the chiefs became known as “Kono‘hiki Land” (Chinen 1958:vii; 1961:13). To expedite the work of the Land Commission, all lands awarded during the *Māhele* were identified by name only, with the understanding that the ancient boundaries would prevail until the lands could be formally surveyed.

At the time of the *Māhele*, the 172,780-acre *ahupua‘a* of Kapāpala was retained by the King Kamehameha III thus establishing it as Crown Lands (Buke Māhele 1848; Iaukea 1894). Additionally, Keauhou, an *‘ili* of Kapāpala containing roughly 50,740 acres was claimed by the chiefess Victoria Kamāmalu as parcel 11 of LCAw. 7713. This division effectively established Keauhou as an *ahupua‘a* independent from Kapāpala.

As the King and his *ali‘i* and *kono‘hiki* made claims to large tracts of land via the *Māhele*, questions arose regarding the protection of rights for the native tenants. To resolve this matter, on August 6, 1850, the *Kuleana Act* (also known as the Enabling Act) was passed, clarifying the process by which *hoa‘āina* could claim fee simple title to any portion of lands that they physically occupied, actively cultivated, or had improved (Garavoy 2005). The *Kuleana Act* also clarified

access to *kuleana* parcels, which were typically landlocked, and addressed gathering rights within an *ahupua'a*. Lands awarded through the *Kuleana* Act were and still are, referred to as *kuleana* awards or *kuleana* lands. The Land Commission oversaw the program and administered the *kuleana* as Land Commission Awards (LCAw) (Chinen 1958). Native tenants wishing to make a claim to their lands were required to register in writing those lands with the Land Commission, who assigned a number to each claim, and that number (the Native Register) was used to track the claimant through the entire land claims process. The native tenants registering their *kuleana* were then required to have at least two individuals (typically neighbors) provide testimony to confirm their claim to the land. Those testimonies given in Hawaiian became known as the Native Testimony, and those given in English became known as Foreign Testimony. Upon receiving the required information, the Land Commission rendered a decision, and if successful, the tenant was issued the LCAw. Finally, to relinquish any government interest in the property, the holder of a LCAw obtained a Royal Patent Grant from the Minister of the Interior upon payment of the commutation fee.

No known *kuleana* claims for land in Kapāpala were made by the *hoa'āina*, thus no additional information concerning land use and practices of the mid-19th century were obtained. Although the *Māhele* was meant to provide native tenants with fee-simple parcels of land from which they could earn a living, it also resulted in the land becoming a commodity to be bought and sold (Kelly 1969). Those with money could buy (or lease) land, and those without, could not. As one Hawaiian writer of the time put it, “if anyone of us becomes assistants of the chiefs, his pay for the most part is in goods; the most of the dollars are for the foreign chiefs... foreigners come on shore with cash, ready to purchase land; but we have not the means to purchase lands; the native is disabled like one who has long been afflicted with a disease upon his back... we are not prepared to compete with foreigners” (Kenoi et al. 1845:119). During the middle part of the nineteenth century, the majority of the Hawaiian population was still participating in a subsistence based economy, while foreigners had access to extensive monetary resources. As a result, many Hawaiian families, who were new to land ownership and the market economy, were dispossessed of their homes and fields, and foreigners were able to buy up large tracts of land. The *Kuleana* Act of August 6, 1850, even prohibited the landless *maka'āinana* from conducting economic activities on unassigned Government Lands, from which they had previously secured a living. Forced to pay taxes or lose their land and houses, families with no local source of income sent the young and able-bodied to trade centers such as Hilo and Honolulu to earn money. Some families lived in fear of being jailed or pressed into hard labor because they had no money to pay the taxes demanded of them (Ladd and Kelly 1969).

Boundary Commission Testimony

In 1862, the Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawai'i to legally set the boundaries of all the *ahupua'a* that had been awarded, by name only, as a part of the *Māhele*. Subsequently, in 1874, the Boundary Commission was authorized to certify the boundaries for lands brought before them. As a part of this process, the Boundary Commission gathered testimony from informants, who were typically older native residents who learned of the boundaries from their ancestors, relatives, or neighbors. The boundary information was collected primarily between 1873 and 1885 and was usually given in Hawaiian and simultaneously transcribed into English. Although hearings for most *ahupua'a* boundaries were brought before the Boundary Commission and later surveyed by Government employed surveyors, in some instances, the boundaries were established through a combination of other methods. In some cases, *ahupua'a* boundaries were established by conducting surveys on adjacent *ahupua'a*. Or in cases where the entire *ahupua'a* was divided and awarded as Land Commission Award(s) and or Government-issued Land Grants (both of which required formal surveys), the Boundary Commission relied on those surveys to establish the boundaries for that *ahupua'a*. Although these small-scale surveys aided in establishing the boundaries, they lack the detailed knowledge of the land that is found in the Boundary Commission hearings.

One of the challenges with transcribing handwritten documents is legibility. In some portions of the testimony, the handwriting could not be deciphered with great certainty. Thus, in those areas, question marks (?) have been added to indicate illegibility. Furthermore, to improve readability, the authors of this study have italicized Hawaiian words and phrases (which are used frequently through the testimony); bracketed texts have been added to clarify information or define Hawaiian words and phrases used (on the first mention); traditional place name specific to Kapāpala have been bolded; and any described cultural practices or historic resources have been underlined for emphasis.

For Kapāpala, the Boundary Commission held a hearing at the home of James W. “John” Kauhane in the neighboring land of Keāiwa. Kauhane, who originally worked as a pastor servicing the Ka'ū District, later became a district judge, which was his role at the time the Boundary Commission hearings were gathered (Morris and Benedetto 2019). On October 20th, 1873, upon the application of John O. Dominis, Agent of Crown Lands, the Boundary Commission heard testimony from several native residents to help settle the boundary of Kapāpala. Testimony was heard from two *kama'āina*, a native-born or a person familiar from childhood with any locality (Lucas 1995:48), Kenoi and

Kaonohi, as well as Kauhane and Rufus A. Lyman, the Commissioner of Boundaries. Their testimony, which has been transcribed (from scans of the original documents) in its entirety, is presented below.

Kenoi^K sworn

I was born at **Kapapala** Kau [Ka'ū] at the time of Kiholomua [ca. 1804]. Moved to Oahu ten years ago before that time I had always lived at **Kapapala**. Am a *kamaaina* [kama 'āina] of said land and know the boundaries. They were pointed out to me in olden times, when it was *kapu* [prohibited] to catch birds on any land but the one you lived on and if you did so the birds were taken away from you. Keaweehu and Kama his nephew pointed out the boundaries to me. Both of the men are now dead. They pointed out the boundary lines between **Kaalaala** and **Kapapala** from shore to mountain. Kaheana, my father who was a *kamaaina* of **Kapapala** showed me the boundary line between this land and **Keauhou** in Kau from seashore to mountains. He is dead and buried in Kapapala.

Kaalaala bounds **Kapapala** on the south side from the shore. Then **Pohakuloa**, then to **Ahulili 1st** and **Ahulili 2nd**. Thence to **Waimuku 1st** and **Waimuku 2nd**, **Kailiula 1st**. Thence to **Kailiula 2nd**. Then to **Kaaimakamaka**, thence to **Puukoa** and to **Makakupa 1st**, **Makakupa 2nd**, **Makakupa 3rd** and from thence to **Makakupa 4th**. Then **Kaalaala**. The boundary at shore between **Kaalaala** and **Kapapala** is at a hill on **puu lepo** [dirt hill] call **Napuonaelemakule**. Thence mauka to **Kukalaula** a cave in the *pahoehoe* [pāhoehoe], where people used to live. The boundary follows along an old trail all the way from the seashore. Thence the boundary runs to **Keanaonaluahine**, *aa* ['a'ā] and a cave in the *pahoehoe*. Thence to **Puuahi** two hills and two *ahuas* ['āhua; mound or heap of stones] running between the hill. Thence to **Kapai** an *awaawa* [valley or gulch] and (old trail from shore runs along boundary) cave. Thence to **Puulehuopaniu**, on *pahoehoe* [pāhoehoe]. Thence to a hill of ??? called **Punahaha**, along the road to where **Kukuilauliili** used to stand. Thence along **Makakupa** to **Moomamani** a *heiau* [temple] and *ahi pu* [?]. Thence along **Puukoa** to **Kapaliokee** *ili aina* ['ili 'āina; land division smaller than an *ahupua'a*] and *awawa*. Thence along **Pohakuloa** to **Puokamalii** at the Government Road on the edge of the *pahoehoe* towards Hilo. Thence to **Naunu** the *mauka* corner of **Pohakuloa** the *lae ohia* ['ōhi'a covered promontory] on *pali* [cliff]. Thence along **Ahuiliili** to **Kaholoina**, *kauhale mamaki* [māmaki settlement] + *kahawai* [stream]. The boundary runs up in the *kahawai* from **Kaholoina** to **Waiheka**. Thence up the *kahawai* to **Puhoakalei** *piha kauhale kalaiwaa in koa* [full canoe carving settlement in the *koa* forest]. Thence up the *kahawai* to **Omalunui** a large *ohia* grove. This is the strip of *ohia* (running *mauka* and *makai* through the woods) that you see from the Government Road. Thence up the *kahawai* through the *lae ohia* to **Kapapaulaula**, the red *pahoehoe* above the woods. Thence to **Kilohana** a small hill. Thence the boundary runs *mauka* to a **Poohina**, where Kaalaala is cut off by **Kahuku**. Thence along a *poohina* along the land of Kahuku to **Pohakuhanalei**. Thence along the district of Kona to **Mokuaweoweo**. I have heard that **Keauhou** of Kona gave to Pohakuhanalei, a hill on Mauna Loa. Thence to **Puulaula**, a large hill on the brow of the mountain at the *mauka* corner of Keauhou of Kau. I do not know what land bounds Kapapala from Mokuaweoweo to Puulaula. Thence the boundaries runs *mauka* from Puulaula along the land of Keauhou of Kau, to **Kilomoku**. The boundary follows along the edge of the *aa* which is in Kapapala, to this point [Kilomoku] which is a *lae ohia*. Thence to **Wekahuna**, the high bluff on the *mauka* side of **Kilauea** where the old horse bones die, close to the road and a little towards Kau from the highest part of the bluff. Thence to **Kamokukolau** the boundary passing through the crater and south lake; Kamokukolau is a *lae ohia makai* of the crater where I used to live. The boundary passes a short distance to the south of the small crater called **Kaanakaakai**, said crater being on Keauhou. From Kamokukolau the boundary runs *makai* to **Aiaawa** a *lae ohia awaawa*. Thence cross the Kau Road to Puna and run to **Kailiohia**, on the *pahoehoe*. Thence to a hill and *pali* called **Haleolona** where you can see the shore at Keauhou and **Halapee**. This is where Kapahee killed my wife and child. There are two hills at this place and the boundary passes between the hills. Thence down the *pali* and to another *pali* called **Lapo**. Thence to the *heiau* called **Makaloo** at **Kuuhala** on the seashore. Ancient fishing rights extending out to sea.

C.X. ^d by J. Kauhane.

The tall woods and at Papaulaula. All trees end below Kilohana. An *ahupohaku* used to stand below Kilohana. I have been as far as this place but not to a poohina. The *kamaaina* told me that the boundary run to *aa* but did not tell me of any mark that denoted the boundary. It is some distance from **Papapaulaula** to Kilohana.

C.X. ^d by Commissioner

I stated before that these lands were cut off at the *mauka* edge of the woods by Kahuku cutting of Kaalaala a *kamaaina* induced me to join these at the *poohina*. The truth is that Kahuku and Kapapala join above Kilohana at a *poohina*; and do not join at Papaulaula on at the edge of the woods at a *poohina*. Papaulaula is at the south end of the *pali* of **Waaloo**. What I have testified to today is as the boundaries were pointed out to me in olden times. I never heard in olden times that Kaalaala cut off Kapapala at the upper edge of the woods. I heard that the day I have evidence in Hilo (see folio 155). The geese and *uwau* on the mountain all belonged to Kahuku and from the aa to Hamakua they all belonged to Kaalaala. The *Oo* and *Mamo* all belonged to Kapapala. There was formerly a road running from Aua's to Kalanihale, (where *halau* used to stand). Thence running past **Keawewai Kamokuiliahi** and to **Kalaieha** but I never heard of any *ili* or *ahupuaa* or *kihapai* on said road. The land belonged to Kapapala; but the geese and *uwau* all belonged to Kaalaala [Kaalaala]. I heard that when Nuunu and Kakohi *kaikaina* (younger brothers) of Liiloa [Liloo] (?? King of Hawaii) *he mau kahuna* [some *kahuna*; *priests or experts*] were taken on a canoe and carried to Naelemakule and set up there. They were ordered to take these *kahuna* to a hill called **Kapukapu**. They went from **Punaluu** in a canoe and fell asleep on the way. The canoe men thinking Naelemakule was the hill woke the *kahuna* up and so that became the boundary of the land. Taking a strip of land from Kapapala and giving it to Kaalaala.

They lived where Aua lives at Moeala. Kaun?? Was their *kahu* [attendant] and as he was sick the Kau people carried them over the foot of the mountain into **Hamakua**, the *uwau* and geese were their meat and so the birds became the property of Kaalaala.

When the people used to gather sandalwood the *alii* [chiefs] of Kapapala Naihe and Aikanaka took it for Kaahumanu. The Kaalaala people went after sandalwood from their chief but the people of other lands in Kau used to go after sandalwood on Kapapala and take to their chiefs. This was at the last gathering of sandalwood for Kamehameha III to pay the debt. I do not know about the boundaries of Kaalaala and other lands, only those adjoining Kapapala. I do not know about the boundaries of Kapapala on the slopes towards Mauna Kea. I have never heard that Kapapala extends down that slope but that Mokuaweoweo and Puulaula are at the end of Kapapala.

Kaonohi^k sworn

I was born at Hilo at the time of making the Peleleu [pre-1795] and have lived at Kau ever since the Okuu [ca. 1804]. Know the land of Kapapala and its boundaries. Commencing at the sea shore at a place called Puunaelemakule a hill between Kapapala and Kaalaala. Thence *mauka* to Makahuna a cave. Thence to Kilohana, an *oioina* [resting place for travelers] on the road to Puna. Thence to a cave called Kukalaula, on said road. Thence to **Nahuakahoalii a heiau**, thence to Puuainako. Thence to Keanaanaluahine, a cave near the Government Road. Thence to **Hapai** an *awaawa* and caves. Taro are *mauka* and one *makai* and the road between is the boundary. Thence to a *mawae pele* [volcanic fissure], an *oioina* on the road. Thence to Puulehuopaniu. The boundary used to run from this point to **Moenaoniau**, an *oioina* and from thence to **Keanoaloa** [on *makai* side of it] but in the time of Kamehameha I the boundary was changed from Puulehuopaniu to Puunahaha, a *puu* or *oioina*, and from thence it runs to **Keanoano** on *pahoehoe*. Thence to **Keanapaki** a cave and thence along Makakupa 1st (Kukuilaulii is on Kaalaala) [small lands ??? ??? to **Kapaliohee**]. Thence the boundary of Kapapala runs along the edge of the *pahoehoe* along Makakupa 1st, Makakupa 2nd, Makakupa 3rd and Makakupa 4th. **Pukoa**, **Kamakamaka**, **Kailiula** 1st and Kailiula 2nd, **Waimuku** 1st and Waimuku 2nd and **Ahulili** 1st and Ahulili 2nd to Pohakuloa. Thence along Pohakuloa to the east corner where Pele (F.S. Lyman) surveyed. Thence *mauka* to the Hilo side of **Puokamalii**. Thence to *kahawai* **Opilopilo** on the Hilo side of **Puuhana**. The *mauka* corner of Pohakuloa, thence along Ahulili to the *mauka* corner of this land (this is as Kaili, *kaikaina* of Halimanui pointed it out ?? as along Kaalaala, the boundary running towards Hilo to a *kahawai* called Opilopilo. Thence along this *kahawai* (I have never been above this place and what I know is from Keaweehu and Kama). They told me the boundary runs up the *kahawai* passing **Puuhaokalai** and thence still following the *kahawai* to *lae ohia*. The tall trees being on Kapapala and the short ones on Kaalaala. Through the woods but I do not know the name of the point at the *mauka* edge of the woods.

Have been told that Kaalaala cuts Kapapala off at the *mauka* edge of the woods. That area fit for timber and that from thence Kaalaala runs along the *pahoehoe*, above the woods to Kona, Hamakua, and Hilo.

I went with Keaweehu to Keawewai after sandalwood, and he said it was on Keauhou. He then went to **Keahoaimakakoloa**, then to **Makapani** a cave. He said part of it was **Olaa** and part Kau. Kapapala or Keauhou. Then to **Nahaleawai kauhale**. Thence to **Punaluu a heiau**. The sand at Punaluu came from this place. Thence to Kaamau??loa, *aa makai* of a hill. Said hill being a Puuulaula but that aa was covered up by the flow of 1852.

Keaweehu said that the sandalwood belong to Kapapala.

I do not know the boundaries between Kaalaala and Kapapala on the mountain but have always heard that Kaalaala cuts Kapapala off at the upper edge of the woods.

There was a road running along where the Government Road to Kilauea now is and up to Keawewai and the place I saw when I went after sandalwood and the uwau and geese on the mountain all belonged to Kaalaala, and the other birds belonged to Kapapala.

C.X. ^d

Kuihelani was konohiki [headman] of Kahuku and Kapapala. Kaalaala and Makaka all had different *konohiki*, as they used to be large lands. All the sandalwood growing on the pahoehoe above the woods belonged to Kapapala but the uwau and geese to Kaalaala and we used to go after the sandalwood on the *pahoehoe* above the tall trees but the geese and *uwau* belonged to Kaalaala and Kapapala people could not take them.

Kaholoina is a *kahawai* on Kaalaala, **Waiheka** is a *kahawai* on Kapapala at some little distance from the boundary [further than from here to A?? ???]. I have not been on the mountains above Kaalaala [?? Makaka] Puuhaokalai is on Kaalaala. I do not know the old name for the small gulch on the boundary now called Opilopilo. It runs to Lae ohia Omalunui.

No more witnesses at hand.

Cas & continued until further notice is given to all interested parties.

R.A. Lyman

Commission of Boundaries 3^d J.D.

From the testimony cited above, we learn that knowledge of the *ahupua'a* boundaries was vital to the *kama'āina* that lived therein as the boundaries firmly established their rights to certain resources (i.e. what resources were permissible and prohibited) as well as the consequences for not adhering to these restrictions. The transmission of the *ahupua'a* boundaries along with its restrictions and consequences was the cultural practice that upheld the rules governing resource procurement over the generations. The testimonies also give insight into trails that extended along the boundaries of Kapāpala, settlement areas, and the use of *āhua* to mark the *ahupua'a* boundaries. As described in the testimony, sometimes boundaries were obscurely marked by changes in the substrate or vegetation. The informants also identified specific plant resources including *māmaki* (*Pipturus albidus*), *koa*, *ōhi'a*, and *īliahi* (*Santalum freycinetianum*) and avian resources in Kapāpala including the now-extinct *ō'ō* (*Moho nobilis*) and *mamo* (*Drepanis pacifica*). *Nēnē* (*Branta sandvicensis*) and *uwa'u* (*Pterodroma sandwichensis*) were also identified, however, the informants specify that these resources belonged to Ka'ala'ala. The informants also specified forest settlements specifically around the *māmaki* growing areas (described as *kauhale māmaki*) as well as at least one extensive canoe carving area in the *koa* forest noted as *piha kauhale kālaiwa'a* at Pu'uhoakalei. Collectively, the informants also identified four *heiau* including Makaloa located at Ku'uhala on the shore near the Keauhou boundary; Mo'omamani located along the Makakupa boundary, Nāhuaokahoali'i located along the southeastern boundary between the old Puna trail and the Government Road; as well as Punalu'u whose location could not be determined from the available information.

***Pulu* Trade and Other Mid-19th-Century Agricultural Endeavors**

With few economic options available, some people of Ka'ū turned to the *pulu* trade, an industry centered on the endemic *hāpu'u pulu* (*Cibotium glaucum*), a tree fern commonly found in the wet forested areas of Hawai'i. Harvesters, many of whom were of native descent went after the *pulu* or the soft, golden-colored fibers found at the top of the fern trunk. Although *pulu* was used traditionally to embalm corpses, the *pulu* harvested for this industry was exported to North America and used to stuff mattresses and pillows (Kepler 1998). The fibers were collected by cutting off the fern fronds and scraping the fibers of the stipe and sometimes the large tree ferns were cut down entirely or pushed over to get to at fibers. Once harvested, the *pulu* was transported to the factories one of which was located near Nāpau Crater, in what is present-day Volcanoes National Park, for drying and processing (Cuddihy and Stone 1990).

The widespread trade in *pulu* began in Hawai‘i around 1851. By 1859, 300,000 pounds of *pulu* were being exported from the islands annually, and at its peak in 1862, *pulu* exports reached 649,000 pounds (Cuddihy and Stone 1990). The *pulu* trade had a detrimental effect on the people of Ka‘ū. However, in some cases, families were able to procure money from the trade to pay their taxes, but just as often they ended up in debt to the traders and lost their property as payment. Many gardens also suffered as the people spent more time in the forests gathering *pulu* than they did cultivating their fields (Kelly 1980). This led to crop failures, and at times resulted in famine.

In addition to the *pulu* trade, other crops that were cultivated at this time included corn, beans, and wheat. The February 18, 1858 edition of the *Pacific Commercial Advertiser* reported that in the “remote and little known district of Kau... the natives have gone largely into the cultivation of wheat this year” (The Pacific Commercial Advertiser 1858:2). The incoming wheat crop was estimated from 2,000 to 3,000 bales, and that the bean crop was estimated at 20,000 pounds. That same article relates that more than half of the bales of *pulu* brought to Honolulu on the last shipment were from Ka‘ū. The article goes on to report that the district is in need of a suitable harbor, or a good road to Kona, as the one to Hilo was a long and wet route. The lack of suitable infrastructure made the marketing and selling of produce and goods especially challenging, thus this industry was shortlived (Kuykendall 1953).

Another detriment to agricultural pursuits in Ka‘ū during the mid-nineteenth century was free-roaming livestock, such as cattle, sheep, and goats which had been brought to Hawai‘i on the ships of Western explorers during the late 18th century. Upon the introduction of these animals, Captain Vancouver advised Kamehameha to place a protective ten-year *kapu* on the animals to allow them to multiply and roam freely throughout Hawai‘i Island. By the mid-19th century, the unregulated population of livestock became a nuisance to the native farmers and evidence of the impact on the greater environment was cause for major concern. Native residents were also left to defend their gardens and homes from the destruction caused by the free-roaming animals. During the 1830s, under the administration of Kauikeaouli (Kamehameha III), *vaqueros* (cowboys of Mexican, Indian, and Spanish descent) were brought to Hawai‘i to train Hawaiians in the handling of both horses and wild cattle (Bergin 2004). An article published in the Hawaiian Language newspaper *Ka Nūpepa Kū‘oko‘a* by W. Kahalelaau in 1862 describes some of the impacts of the free-roaming livestock in Ka‘ū:

There are great troubles in our lands here in Kau, and here are the troubles. 1. the heat; 2. famine; 3. animals. Of the three said troubles, the animals are of greatest concern. We are not troubled by the animals owned by the natives, rather those belonging to the Haole, they dig the land bare, swarm the land and crush the plants. There is little we can do; the natives work and the cattle crushes our work. The places previously cultivated by the ancient people were known for its fertility and produced much food, like melons, sugarcane, and other things. However, within the last two years we have realized our trouble and our great misfortune. It is appropriate for the Haole’s animals to roam on their own land, but the trouble is they roam on our land. We did have a famine a few years ago because of too much sun, however when the rain fell life was possible, and we planted plants and the trouble ended. Now, there is no suitable place to plant the plants. The only appropriate places are those paid for with money, with the misfortune of another.

How do we resolve this trouble of ours? If any of you, my dear friends know the source to address this trouble, please make it public known... (Kahalelaau 1862:4)

The matter of dealing with the free-roaming livestock, eventually led to the emergence of formal ranching on the islands. For Ka‘ū, Kapāpala and later Kahuku emerged as the epicenter of the district’s ranching operations.

History of Kapāpala Ranch, the 1868 Eruption, and the Establishment of the Ka‘ū Forest Reserve

The first organized ranching operation in Ka‘ū were centered at Kapāpala when around 1860, Frederick S. Lyman, the third son of Hilo’s founding missionary family established a small ranch at ‘Ainapō. Lyman’s ‘Ainapō ranch eventually grew to become Kapāpala Ranch, the largest and longest running ranch to operate in the district. Lyman constructed a small grass hut at ‘Ainapo where he lived with his wife Isabella Chamberlain until the disastrous earthquake of 1868 (Vredenburg 1952). Lyman’s ranch was eventually acquired by Hilo businessmen, Charles Richardson and William H. Reed who on March 1st, 1860 expanded Lyman’s ranch by co-leasing the entire Kapāpala Ahupua‘a from King Kamehameha IV (Alexander Liholiho) to start their joint venture, Kapāpala Ranch (Cahill 1996).

Reed was known for constructing bridges (including the third and most substantial bridge across the Wailuku River), the first harbor, landing, and streets throughout Hilo, while Richardson was involved in lumber, leasing land, shipping, retail, and ranching (Valentine 2014). The ranch encompassed large tracts in Kapāpala and Keāīwa Ahupua‘a (acquired from F.S. Lyman in a separate transaction) and extended from the shoreline to the summit of Mauna Loa to include roughly 200,000 acres (Cahill 1996:129). It is important to highlight that there are no major streams on the ranch

property, however, there were numerous springs throughout the pastures and frequent rainfall attributed to the lush vegetation. The ranch, as it existed in 1861, was described by a visitor passing through Ka‘ū. The excerpt below describes the extent of the ranch as well a brief background on its founders:

...Mr. Richardson, an American who has a lease from the King of land to the amount of (at the lowest estimate) 70,000 acres, at a rental of only about \$300...His limits are not very well defined, and *he* considers that he has much more than that number of acres for his rent. He is keeping stock and goats, which last are very valuable. He asked us to have some coffee at his house which we were to pass, and we stopped there a few minutes on our way to Mr. Lyman’s where we were to pass the night. (Korn 1958:58)

Mr. Richardson, an American...Probably Charles Richardson (1817-1879), a native of Vermont; arrived in the Islands in 1850. He and a cousin, Julius Richardson, together with a partner named W.H. Reed, owned an extensive tract in the Kau District called the Kapapala Ranch. In the mid-1860s they established the first hotel at the volcano. Lady Franklin described Richardson as “tall, delicate looking, humble & modest, wd [would] not sit down till I begged them to do...”(Korn 1958)

By 1862, fifty heads of cattle were purchased at auction by the partners and were put to pasture at Kapāpala. The two businessmen purchased additional cattle from Harry “Jack” Purdy, a cattleman at Parker Ranch in Waimea (Cahill 1996; Henke 1929). Reed and Richardson’s business proved to be lucrative for meat, cream, and butter—products the ranch produced for many years—that were readily available for sale in Hilo and Honolulu (Cahill 1996:96). In addition, hides from cattle and goats, as well as wool from sheep were sold along with *pulu*, that was once exported to California (Cahill 1996; Pukui and Elbert 1986). Reed and Richardson split their time between Hilo and Kapāpala where they oversaw ranch management and long cattle drives from pasture to pasture. After cattle were fattened, they were herded to the landing at Punalu‘u and shipped interisland via steamer to their destination.

Reed met Jane Stobie Shipman who was previously married to missionary William Cornelius Shipman, who had died of Typhoid fever in 1861. Reed and Shipman most likely met at one of the many gatherings for the “foreign” community ca. 1867, such as church or a social gathering at a private home (Cahill 1996:97). On July 6, 1868, Reed and Shipman were married at Haili Church in Hilo by Reverend Titus Coan, an American minister and missionary (Cahill 1996:98). The union between Reed and Shipman resulted in Reed gaining three step-children: William “Willie” Herbert, Oliver “Ollie” Taylor, and Margaret “Clara” Clarissa. For Reed, education was of utmost importance for his new step-children and as a result, he enrolled and paid for all three children to attend Punahou School on O‘ahu often writing to them and keeping them abreast on Hilo and homelife.

Several months before Reed and Shipman’s marriage, between March and April of 1868, a series of tremors culminated in a violent volcanic eruption that spewed from the southern flanks of Mauna Loa and cause significant damage throughout Ka‘ū. On April 2nd, 1868, in the afternoon, a powerful earthquake shook the Ka‘ū District with the epicenter emitting from the southern rift of Mauna Loa. This great earthquake triggered several natural disasters including a mudflow in Wood Valley (south of the project area), an avalanche at Pōhina cliff near Honu‘apo, and a localized *tsunami* that devastated many coastal communities (Dana and Coan 1868). As a result, wood and stone buildings in Ka‘ū were leveled including the Protestant stone church in Wai‘ōhinu (Cahill 1996). Many homes and lives were lost due to the earthquake and a subsequent landslide that devastated the residents of Wood Valley, south of the project area. Concerning the impacts of the landslide and the *tsunami*, W.D. Alexander in his book *The Great Eruption in Kau* wrote:

At length, on the 2nd of April, a terrific earthquake took place, which shook down every stone wall and nearly every house in Kau, and did more or less damage in every part of Hawaii

At Kapapala in eastern Kau, it caused a destructive landslip commonly known as the “mud flow.” An enormous mass of marshy clay was detached from the bluff at the head of the valley, and in a few minutes swept down for a distance of three miles, in a stream about half a mile wide and thirty feet deep in the middle, it moved so swiftly that it overtook and buried thirty-one human beings and over five hundred horses, cattle, and goats.

Immediately after this earthquake, a tremendous wave, forty or fifty feet high, rolled in upon the coast of Kau, sweeping away all the villages from Kaalualu to Keauhou, and destroying some coconut groves. Over eighty persons perished in a few minutes, and the survivors were left destitute and suffering. At the same time the crater of Kilauea emptied itself of its lava through underground fissures toward the southwest. The central part of the floor of the crater fell in, forming a pit three thousand feet long and five hundred feet deep, with sloping sides. (Alexander 1891:292-293)

2. Background

By April 7th, the lava that had emptied from Kīlauea via subsurface chambers burst out on the southwest slope of Mauna Loa in Kahuku Ahupua‘a at approximately the 5,000-6,000 foot elevation, southwest of the current project area (Alexander 1891; Hawai‘i Volcanoes National Park n.d.). Dana and Coan (1868:118) reported that “[i]n Kapapala, we were told that the fire had been seen several nights in a southeast direction, and that the natives had reported flowing lava there [at Kapapala]”. The lava flow that emerged at Kahuku “...spouted up in great fountains, several hundred feet high, and flowed to the sea, a distance of ten miles, in two hours” where it destroyed several houses, hundreds of cattle, and covered some four thousand acres of land (Alexander 1891:293). Although Kapāpala Ranch was somewhat spared, Reed still suffered losses. As a result of the 1868 eruption, the district of Ka‘ū was devastated and a giant crack extending in a southeast direction from Kīlauea through Kapāpala emerged, the location of which is shown on Hawai‘i Registered Map 510 from 1874 (Figure 15). This 1874 map depicts the project area within the “koa woods” portion of the ranch.

While the aftershocks eventually subsided and life returned to a semblance of normal, the coastal villages were destroyed by the *tsunami*, and most coastal residents moved to inland towns such as Nā‘ālehu, Wa‘ōhinu, or Pāhala, or moved out of the district altogether (Handy et al. 1991). By 1872 the population of Ka‘ū had further declined to 1,865 persons (Kelly 1969). The resilient nature of the Ka‘ū people was once again demonstrated as they directed their efforts toward rebuilding the impacted communities. Even in subsequent seismic events including one in 1887 that broke the ranch’s water tanks, shifted buildings off its foundations, and caused stone walls to crumble, homes were eventually rebuilt and material items replaced. Although altered, life in these communities resumed as it had for generations (Clark 1985).

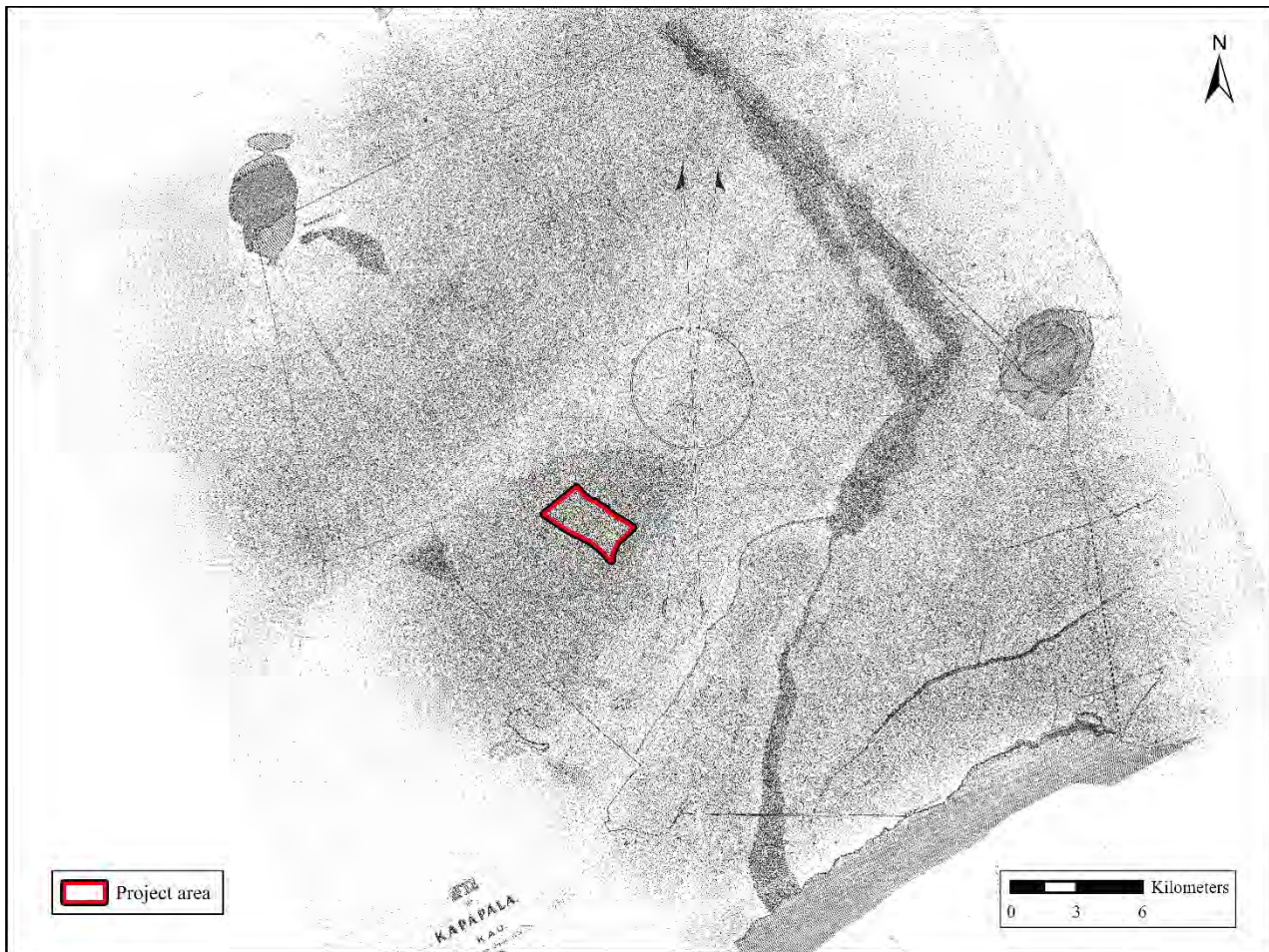


Figure 22. Hawai‘i Registered Map 510 from 1874 by Lydgate showing project area in the “koa woods” portion of Kapāpala Ranch and fissure extending from Kīlauea through Kapapala.

By 1870, Willie and Ollie were enrolled at Knox College in Galesburg, Illinois to pursue higher education. Willie was interested in pursuing medicine, however, Reed suggested that his eldest step-son enroll in an accounting course as it “would prove valuable in almost any career” (Cahill 1996:116). In 1873, Willie enrolled in business school where he took bookkeeping and general business courses. A letter from Willie to Reed asked, “Don’t you want me to come home

& help keep books for you next fall?" (Cahill 1996:116). A month later, Reed wrote back to his step-son expressing satisfaction with his decision to enroll in "Commerical School" but also dropped a bombshell, that he purchased Charles E. Richardson's shares for Willie for \$17,000 granting him half of the business interests (Cahill 1996:116). Reed encouraged Willie to stay and complete his studies as when he returned home, he had three ranches and the lumber business to manage.

Willie returned to Hilo in the fall of 1873, where he was trained by Reed on the daily operations of running the ranch, knowledge of property management, and bookkeeping duties. For the next two years, Kapāpala Ranch served as Willie's new home. In 1875, *The Hawaiian Guide Book* described Kapāpala (noted as Reed's Ranch) as:

...a tract of land bounded by the ocean and the sky, or as high on Mauna Loa as grass can grow, and has an extent of pasturage like a pampas in Brazil. At the shore the cattle are tame and form a rich herd; but in the upper forest region they are wild, and are hunted only for their hides. The proprietor [Reed] counts cattle, sheep, goats and acres by the tens of thousands. Here the stranger is sure of a cordial reception, and at this point preparations may be made for the ascent of the 14,000 feet elevation to the summit crater of Mokuaweoweo. (Whitney 1875:93)

Correspondence between Willie, Reed, and Mrs. Jane Reed occurred often—once to twice a week by way of a courier who they affectionately referred to as "butterboy" as it was his task to take several kegs of butter to Hilo along with letters via mule. Although *The Hawaiian Gazette* described Kapāpala as a verdant landscape, Reed and Willie offered a contrasting outlook as they were often excited for rain alluding to the periodic drought conditions. Letters also offered a rare glimpse into the daily events that occurred between all three parties, but especially minute details at the ranch. For example, Mr. Reed shared with his wife how well his stepson and new business partner got along with the ranch hands despite ninety-five percent of the workers being Hawaiian and only speaking their native language. Mrs. Reed did not doubt that her son got along with the workers and shared that one time when Willie was returning to Kapāpala from Hilo, darkness fell and he saw another traveler on horseback ahead on the trail:

He spurred his horse until he came abreast of the stranger and they were soon engaged in Hawaiian conversation. When Willie learned that his traveling companion had a great distance still to go, he invited him to spend the night at the ranch house, an invitation the man accepted gladly. The house was dark, and the first thing Willie did was to strike a light for the lantern in the room. No sooner had he done so than the stranger looked at his host with amazement and then uttered, "E ka haole!!"—loosely translated, "Hey, you're a white man!!" (Cahill 1996:134)

In addition to handling the ranch's daily operations, the family often hosted numerous visitors who made the trek to the volcano and into Ka'ū. Brief descriptions of visitors taking lunch, coffee, or spending the night at the headquarters (Figure 23) of Kapāpala Ranch fill the newspapers of the late 19th and early 20th century. In June of 1875, British explorer and naturalist, Isabella Lucy Bird wrote of her time at 'Ainapō in Kapāpala and made note of the *koa* forest she had encountered during her trek up the slopes of Mauna Loa:

...I was glad when the cold stars went out one by one, and a red, cloudless dawn brok over the mountain, accompanied by a heavy dew and a morning mist, which soon rolled itself up into rosy folks and disappeared, and there was a legitimate excuse for getting up. Our host provided us with flour, sugar, and doughnuts, and a hot breakfast, and our expedition, comprising two natives who knew not a word of English, Mr. G. [Green] who does not very much more Hawaiian than I do, and myself, started at seven...

We went off, as usual, in single file, the guide first, and Mr. G. last. The track was passably legible for some time, and wound through long grass, and small *koa* trees, mixed with stunted *ohias* and a few common ferns. Half these *koa* trees are dead, and all, both living and dead, have their branches covered with a long hairy lichen, nearly white, making the dead forest in the slight mist look like a wood in England when covered with rime on a fine winter morning. The *koa* tree has a peculiarity of bearing two distinct species of leaves on the same twig, one like a curved willow leaf, the other that of an acacia. (Bird 1875:399-400)

In November of 1875, a letter from Reed to his wife was the first indication that things were not going well at Kapāpala Ranch between Willie and his stepfather. Willie preferred to be in the mountains and travel occasionally, whether it was to visit his mother in Puna or sail to Honolulu. Reed expressed his frustrations to his wife, stating that he preferred for his stepson to be at the ranch every evening instead (Cahill 1996:137). Tensions between the two ebbed and flowed into the next year with Willie writing to his mother in August of 1876 wishing that "he would take my one-third and keep it and pay me wages for the time I have been here" and called himself "foolish" for going into business with his stepfather (Cahill 1996:140). A letter from Reed to his wife also in August of 1876 indicated a possibility of

2. Background

selling the ranch as the ranch, stock, and buildings were all assessed at \$67,200 (Cahill 1996). A letter from Willie to his mother in October of 1876 hinted again at a possible sale stating, “I hope he will not sell the ranch to Rufus [Anderson, an ABCFM executive]” (Cahill 1996:140). In October 1876, Reed sold the ranch lease, livestock, and buildings to Charles R. Bishop for \$75,000 and after two months, Bishop sold the same property in its entirety for \$120,000 to the Hawaiian Agriculture Company (C. Brewer & Co.) to which Bishop and others cofounded (Cahill 1996:141). With a pared-down ranch, Reed had a newfound interest in sugar as he saw the possibility of profits as the Reciprocity Treaty had taken effect and the tax on sugar exported to the U.S. was now removed. Willie also took to growing sugar and with Reed’s other businesses, Kapāpala was no longer of interest to him and the correspondence discussing the ranch also ceased (Cahill 1996).

By 1877, the Hawaiian Agricultural Company had taken ownership of Kapāpala Ranch and they would go on to operate the ranch for another ninety-nine years. The Hawaiian Agricultural Company’s main operations were centered around Pāhala on some 50,000 acres, much of which was owned by the Bishop Estates (Robins et al. 2016). The ranch continued to grow in importance as it provided support, meat, and other supplies to the plantation and its laborers (Elwell and Elwell 2015). Cane was also grown on portions of the ranch, *makai* of the project area below the 3,000-foot elevation, in isolated pockets where soil conditions were most suitable, however, livestock rearing remained at the heart of the ranch’s operations.



Figure 23. Kapāpala Ranch headquarters ca. late 19th or early 20th century (from Kapāpala Ranch website).

In 1894, the Commissioner of Crown Lands, Curtis Iaukea prepared the following description of Kapāpala in which he describes the then owners and land use:

One of the largest lands in Kau. Extends along the coast more than twenty miles, then to summit of the crater on Maunaloa. The road to the Volcano from Punaluu runs across the land. All below that road is very rocky, but above this lies a belt of valuable land now occupied by the Hawaiian Agricultural Co., which has on it a large number of cattle. There is not a very great extent of woodland. Where the Company has a Dairy there is ample water to be found. The land in this neighborhood would make excellent homestead lots as almost all agricultural products will grow well. Fine oats and wheat have been raised there in years past. The nearest landing is Punaluu, distant about ten miles. The rainfall is generally sufficient for all purposes (Iaukea 1894:20).

In the remaining years of the 19th century, Hawai‘i’s agricultural sectors along with the government began to recognize the importance of forests in providing water for household consumption and ranching but more importantly for the irrigation and processing of sugar, which required tremendous amounts of water. The combined effects of drought, forests clearing to make way for sugar fields, the diversion of water, wildfires along with indiscriminate

pasturing were impacting water resources across the islands (Cox 1992). With sugar as the islands' largest economic industry, the government began formalizing a division of government that would oversee Hawai'i's agricultural industries and forests. This led to the establishment of the Bureau of Agriculture and Forestry in 1892 whose focus was primarily livestock, however, they also implemented programs to work with private landowners to create forest reserves and control wild goats and cattle that were damaging the forests (Walker 1978). By 1903, following the unlawful overthrow of the Kingdom government (in 1893) and the subsequent creation of the Territorial Government (in 1900), the territorial legislature with the influence of plantation owners established the Board of Agriculture and Forestry, which among other duties, called for the employment of a "professional forester" to head the forestry division and provided the legal means to create forest reserves on both private and public lands (Cox 1992:169). In that same year, Ralph S. Hosmer was hired as the first Superintendent of Forestry (Cox 1992).

By June of 1906, upon the urging of the Hawaiian Agricultural Company and the Hutchingson Co. (another large plantation in Ka'ū) and under the consideration of Hosmer, the Board of Agriculture and Forestry recommended that some 75,000 acres in eastern Ka'ū be set aside as a forest reserve. An article published in the June 21st, 1903 edition of the *Pacific Commercial Advertiser* describes the Ka'ū Forest Reserve and makes reference to Kapāpala. That portion of the article reads thusly:

Lying on the lower southern slope of Mauna Loa, bounded on the west and north by the land of Kahuku, on the east by the forest fence erected within the land of Kapapala by the Hawaiian Agricultural Company, and on the south by a line drawn across the various lands back of Pahala and Hutchingson plantations, at approximately the lower edge of the existing forest, and containing an approximate area of 75,000 acres, as recommended by a report of the Superintendent of Forestry, dated March 31, 1906...the boundaries of which proposed reservation more particularly appear by and on a map and description made in May 1906, by the Hawaiian Government Survey Department, which said map is on file in said Survey Department and marked "Registered Map number 2361"...be approved as a forest reserve to be called the Kau Forest Reserve. (The Pacific Commercial Advertiser 1906b:2)

On August 2nd, 1906, Governor George R. Carter, by proclamation officially established the 65,875-acre Ka'ū Forest Reserve a portion of which encompasses lands in Kapāpala. As noted by *The Pacific Commercial Advertiser*, the reserve:

...comprises 59,618 acres of government land, the balance being the mauka ends of tracts now leased to plantations, but to go into the reserve at the expiration of the leases and now fenced off by the plantation people to preserve the forest growth. Of this reserve, about 33,000 acres will become forest at one, the balance being taken in hereafter from time to time until the whole tract is covered. (The Pacific Commercial Advertiser 1906a:2)

The Hawai'i Registered Map No. 2631 (mentioned above) prepared in 1905-06 is included below as Figure 24 and shows the project area just outside of the forest reserve's northeastern boundary. Annotations on the map identify several plant species, (which were used as boundary markers by early surveyors) including 'ōhi'a in the lower elevation of the project area and koa in the central portion of the project area. Two other territorial survey maps of Kapāpala prepared in 1907 (Figures 25 and 26) provide insight into land use and features in the project area. Notations on the map describe the upper elevations of the project area as having a "thick forest and ferns" and "good soil" whereas the lower section is described as "forest of ferns" with "good soil" and "hilo grass starting in." Furthermore, the north, south, and east sides of the project area are marked by fencing. The information from these maps indicates that the project area or at least the lower portions were used by the ranch for cattle grazing.

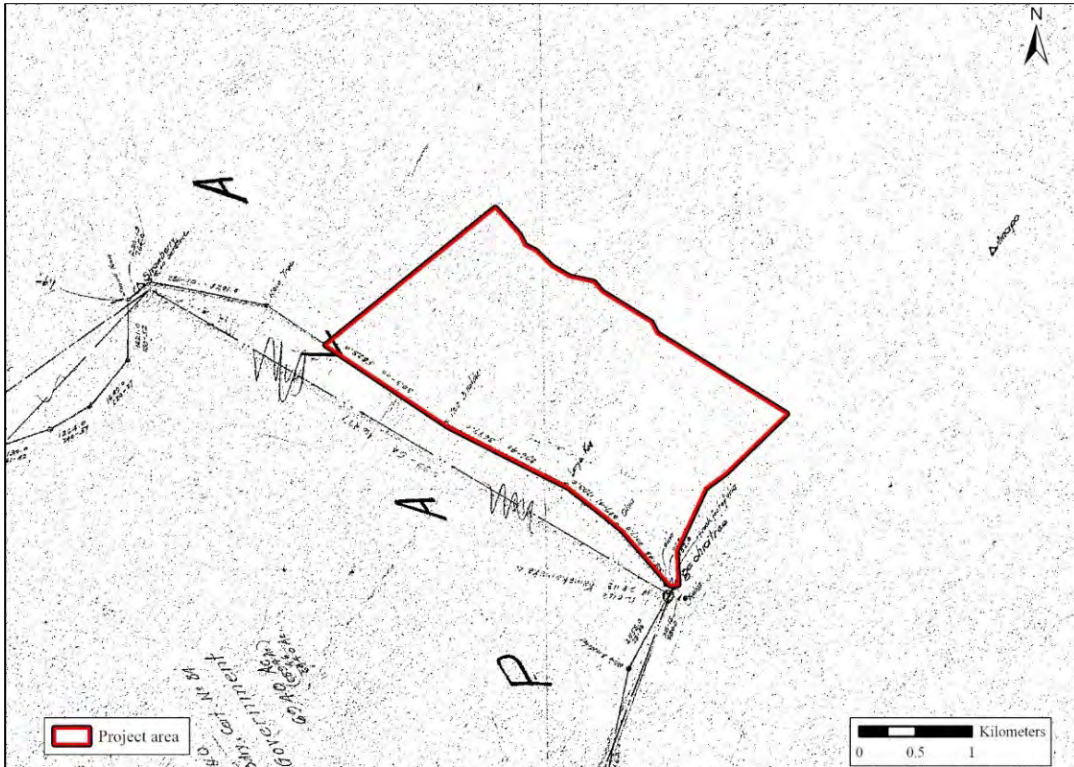


Figure 24. A portion of Hawai'i Registered Map No. 2361 prepared by Geo Wright in 1905-06 shows the project area adjacent to the northeastern boundary of the Ka'u Forest Reserve.

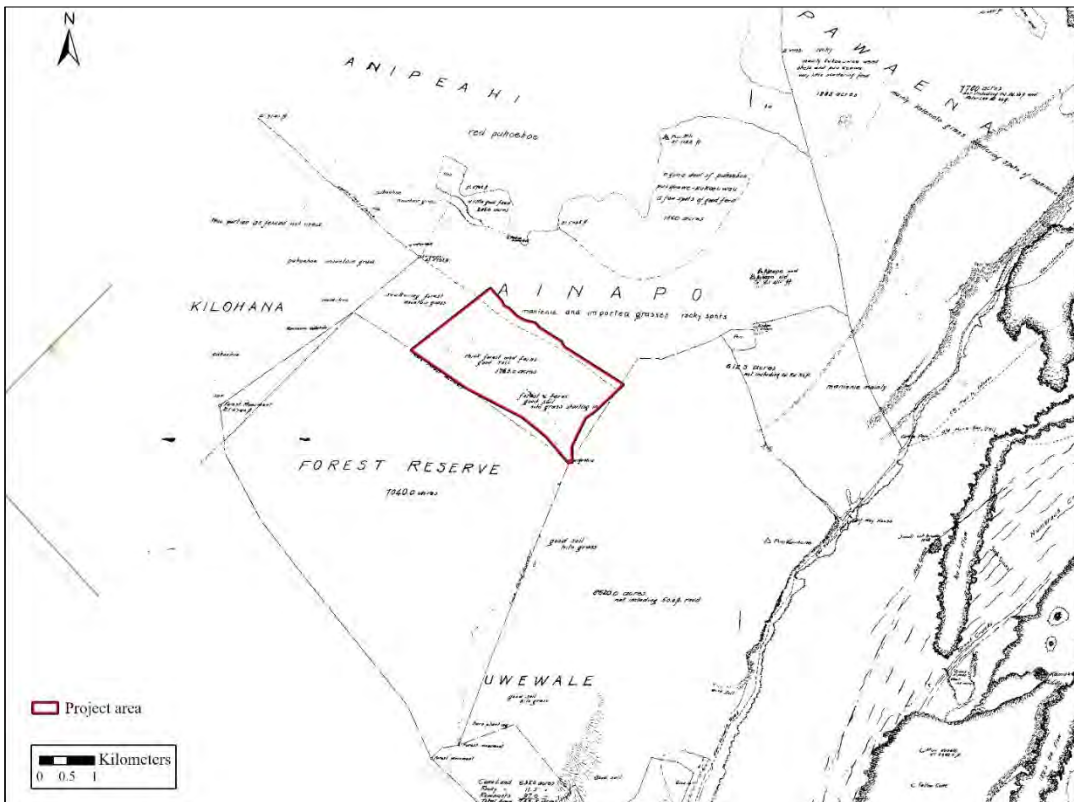


Figure 25. Territorial survey map of Kapapala from 1907 by E.D. Baldwin (From the collection of Lani Petrie at Kapapala Ranch).

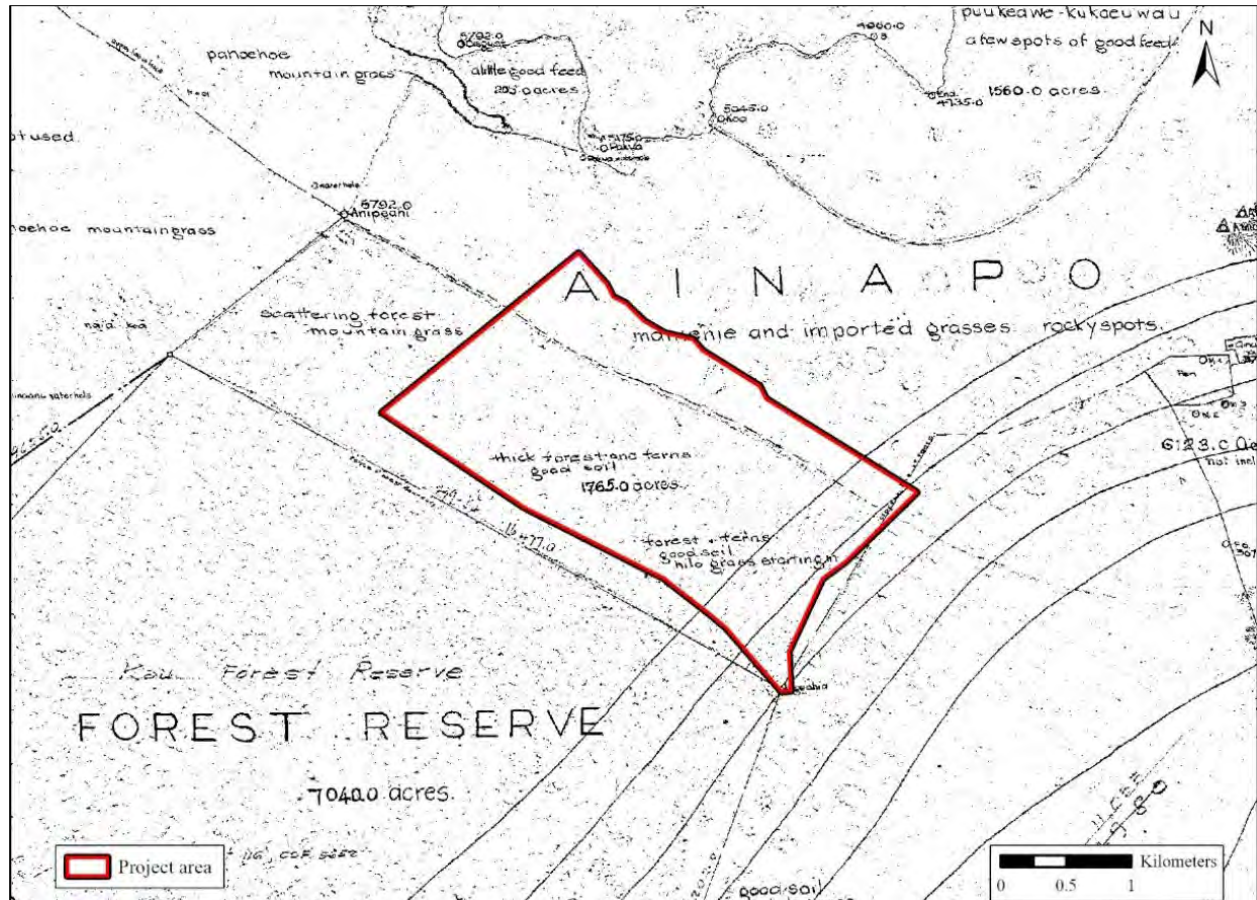


Figure 26. Portion of Hawai'i Registered Map 2388 from 1907 prepared by E.D. Baldwin and Geo F. Wright showing project area adjacent to the Ka'ū Forest Reserve.

When the Hawaiian Agricultural Company took over management of the ranch in 1877, Julian “Mauna Kea” Monsarrat of Honolulu was serving as ranch manager and William Johnson Yates as foreman (the great-great-great-grandfather of the current owner, Lani Cran Petrie) (L.W. 2016). Monsarrat, who arrived at the ranch in September of 1883 was preceded by at least three other managers including Harry “Handsome Harry” Webb, Conrad, and G. Pracht (The Honolulu Advertiser 1923:7). Monsarrat went on to manage Kapāpala Ranch for forty years (until 1923) and during that time he managed about 4,000 head of cattle, improved the ranch’s cattle breeds, and began transitioning the ranch from sole dependence upon rainfall to establishing a reliable water supply. He also undertook a forestation and preservation program to help increase rainfall and made the ranch “one of the most profitable operations” of the Hawaiian Agricultural Company (The Honolulu Advertiser 1956:19). Monsarrat lived at the ranch house “Kalanihale” (built around 1860) where he hosted many distinguished guest and “saddle sore” visitors who sometimes mistook the private residence for a hotel (The Honolulu Advertiser 1923:7).

Following Monsarrat’s tenure as ranch manager was Bradford “Haole” Sumner who worked there for thirty-four years (until about 1957) (L.W. 2016). Under his oversight, the ranch totaled 75,000 acres from sea level to 6,500 feet in elevation; 40,000 acres of which ranged from good to fair grazing lands. He established a water head source from mountain resources at 3,750 feet and implemented 25 miles of pipelines for the lower pastures as well as installing some 47 miles of fencing for the ranch. Up until the 1920s, the ranch, for the better part of sixty years relied solely on rainfall which meant that the ranch was susceptible to drought and costly operational disruptions. In the 1920s a water tunnel was built which provided a consistent water supply to the ranch (L.W. 2016). The cattle totaled 3,000 Herefords, 40 of them being bulls, and were expected to increase in numbers to 4,000 once the fences were completed. USGS maps from 1921 (Figure 27) and 1924 (Figure 28) show the installation of pipelines throughout the ranch. These maps also identify a “Forest Boundary Trail” traversing in a *mauka-makai* direction along the southwestern boundary of the project area.

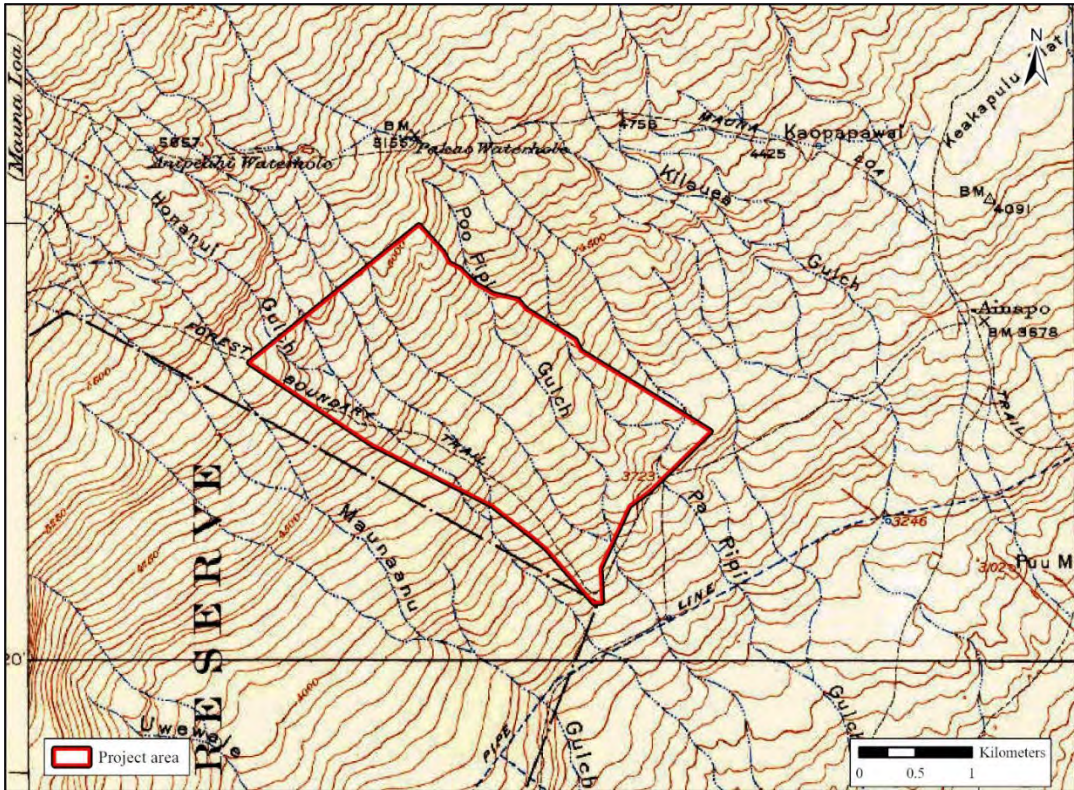


Figure 27. 1921 USGS Kilauea Quadrangle map showing the project area and water pipelines throughout the ranch.

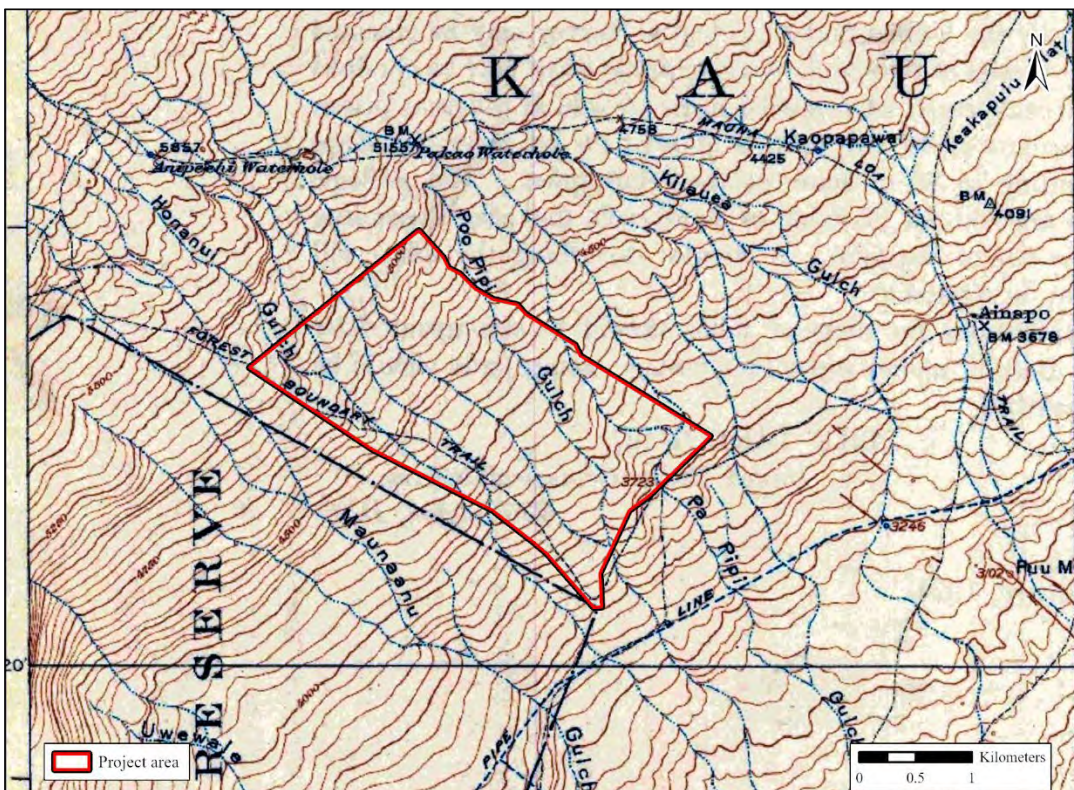


Figure 28. 1924 USGS Kilauea Quadrangle map showing the project area and water pipelines throughout the ranch.

In 1927 the average weight of steers sold from Kapāpala Ranch was 535 pounds, and the ranch marketed around 700 head of cattle aged three to five years. These cattle were marketed in Honolulu and Hilo, either shipped by steamer from Ka‘alu‘alu to Honolulu or by train from Glennwood to Hilo. Aside from the cattle on the ranch, there were also about 250 horses and mules, 10 Percheron mares, and one Kentucky jack for breeding mares for mule production (Henke 1929). Concerning vegetation on the ranch, Henke (1929:36) reported:

On the lower elevations Bermuda grass (*Cynodon dactylon*) and Pili grass (*Andropogon contortus*) are common. *Paspalum dilatatum* is found as low as 500 feet and up to 5,000 feet elevation. Rhodes grass (*Chloris gayana*) does well at 1,000 feet and above. Redtop (*Tricholaena rosea*) and buffalo grass (*Stenotaphrum americanum*) are found to only a slight extent. Kukuyu grass (*Pennisetum clandestinum*) is being tried experimentally and does very well at 2,100 feet and fairly well at 3,000 feet elevation. Other grasses are also under observation for possible future planting. Hilo grass (*Paspalum conjugatum*) is found scattered over various parts of the ranch.

In addition to ranching livestock and growing cane, during the 1930s, some 600 acres, extending from sea level to the 3,000-foot elevation were planted in pigeon peas (*Cajanus indicus*) (Henke 1929). Efforts were also undertaken to improve certain pastures including the planting of *Haole koa* (*Leucaena leucocephala*) and certain grasses including *kikuyu* and *paspalum dilatatum* in the Pu‘ukaunene Paddock located *makai* of the project area (Honolulu Star-Bulletin 1933). On October 17th, 1930, by proclamation of the Governor, Lawrence M. Judd, 37,416 acres of land in Kapāpala extending above the 5,000-foot elevation (adjacent to the *mauka* boundary of the project area) was established as the Kapāpala Forest Reserve (The Honolulu Advertiser 1930). Hawai‘i Registered Map No. 2829 (Figure 29) by Chas L. Murray shows the project area in 1928 and depicts the Ka‘ū Forest Reserve Boundary trail (demarcated by the dashed line) extending along the southwestern boundary of the project area adjacent to the Ka‘ū Forest Reserve. Another map produced by Murray in 1930, Hawai‘i Registered Map No. 2838 (Figure 30), depicts a similar scene with the addition of the Kapāpala Forest Reserve adjacent to the project area’s *mauka* boundary.

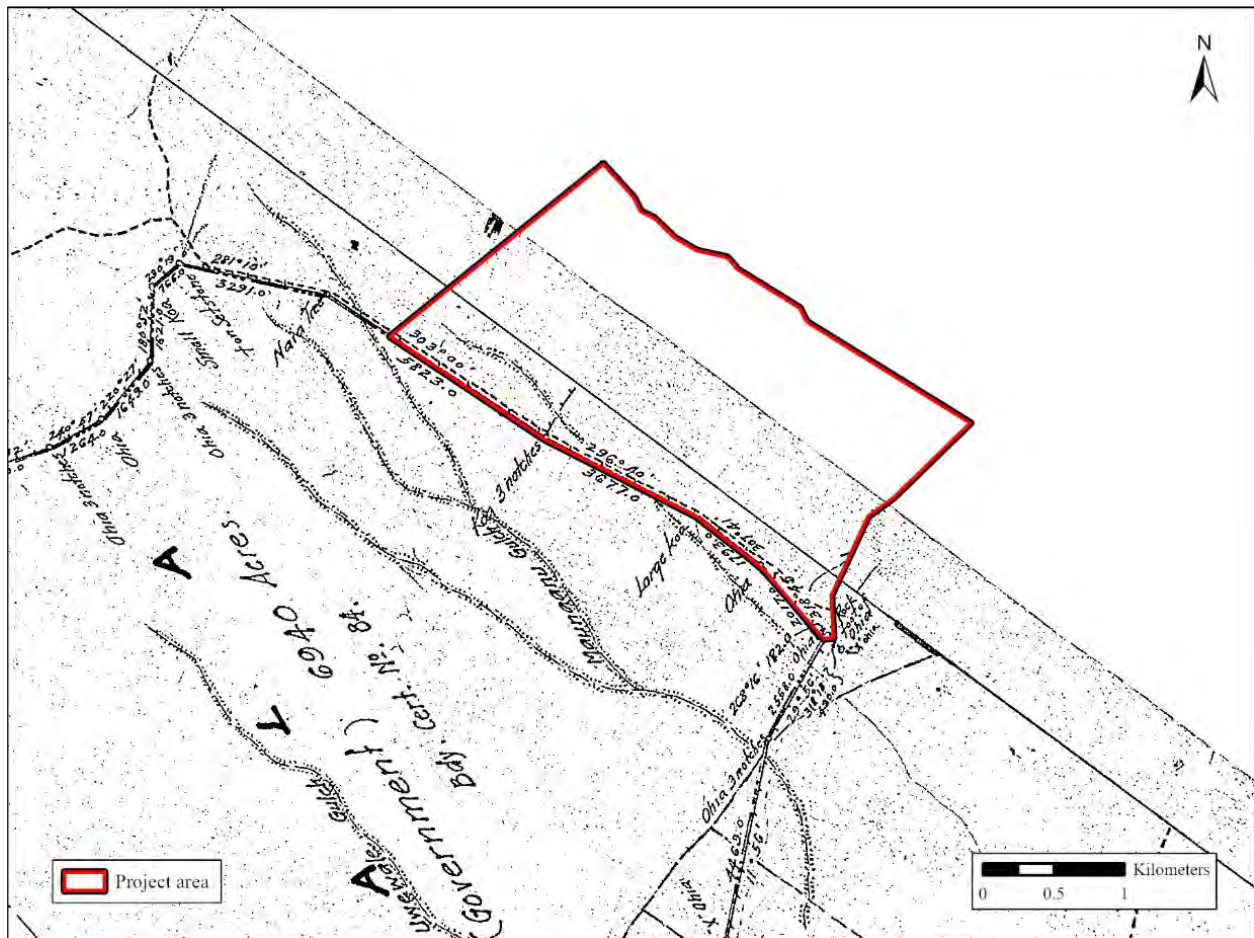


Figure 29. Hawai‘i Registered Map No. 2829 by C. Murray shows the project area in 1928.

2. Background

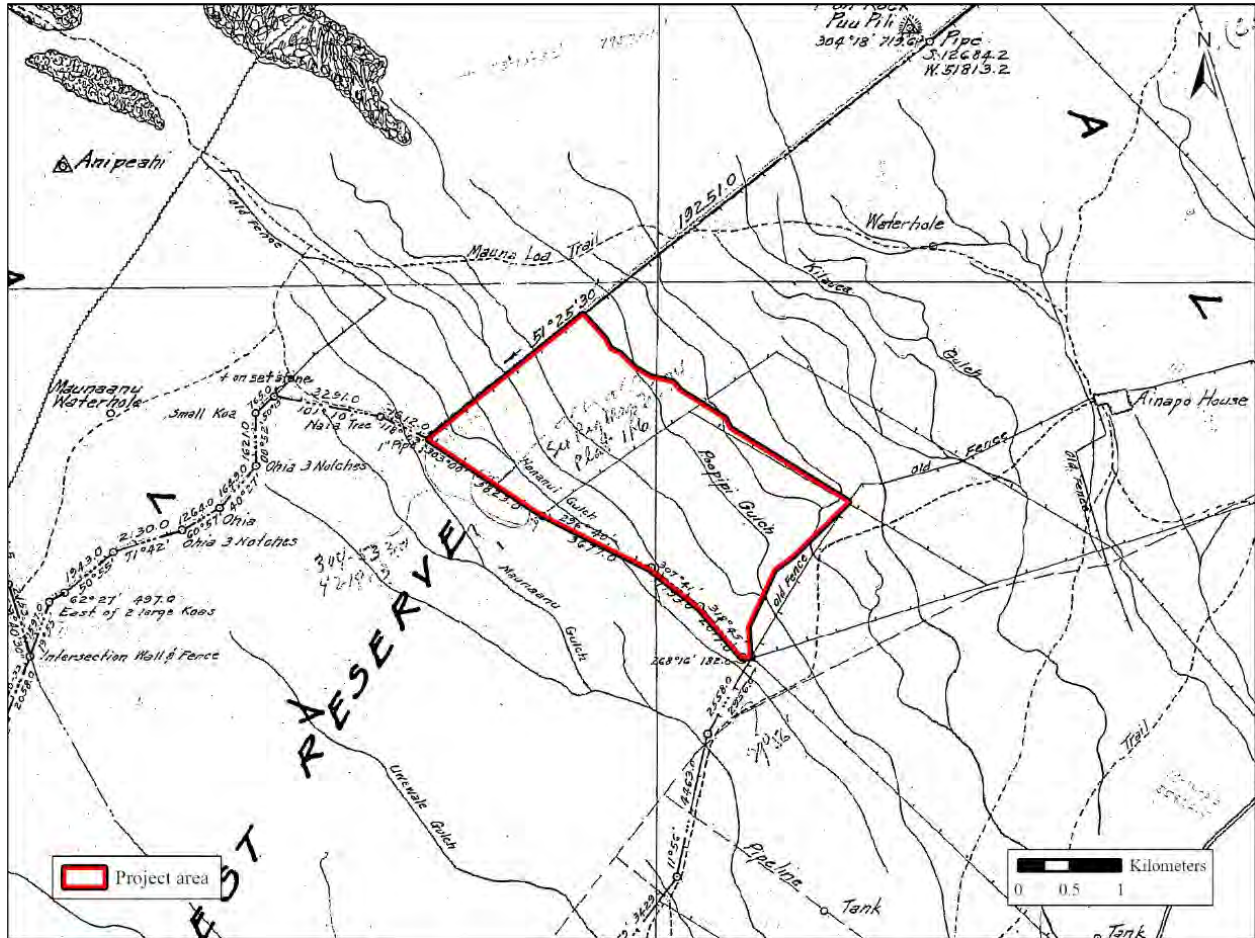


Figure 30. Hawai'i Registered Map No. 2838 by C. Murray depicts the project area in 1930.

By the 1930s, 1,151 acres comprising much of the central and lower portions of the project area were a part of what the ranch dubbed Yamaoka Paddock No. 1—a name likely associated with a ranch employee or someone who conducted work such as fencing of the area. Whereas the upper portion of the project area was within the Ainapo Mauka Paddock which was comprised of 5,417 acres. The Yamaoka Paddock included two areas, the 1,151-acre Paddock No. 1 and the adjacent 775-acre Paddock No. 2. A map (provided by Lani Petrie at Kapāpala Ranch) prepared by Peter E. Arioli in July of 1930 (Figure 31) shows the project area within a portion of the Yamaoka Paddock No. 1 and the southwestern portion of the Ainapo Mauka Paddock. This map also identifies a waterhole “Koiki Waterhole” within the Ainapo Mauka Paddock just outside of the project area. The boundaries of the Yamaoka Paddock can also be seen in a 1967 USGS map along with the addition of the north-south oriented road that extends across the project area (Figure 32).

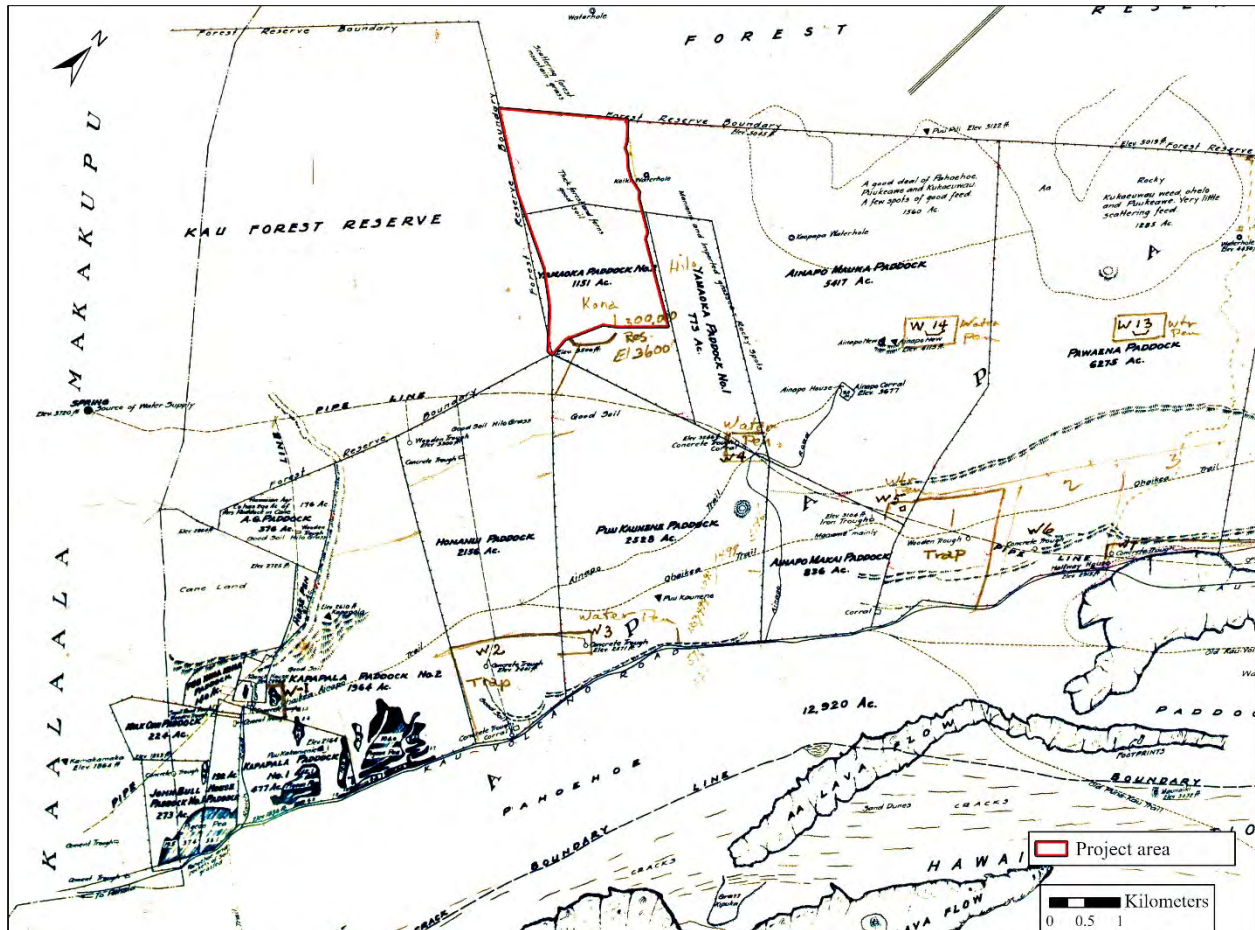


Figure 31. Map titled “A Portion of Kapapala Ranch Kau-Hawaii” prepared by Peter E. Arioli in 1930 shows the project area within a portion of Yamaoka Paddock No. 2.

Following Sumner, as ranch managers were Allan Johnston, Fred Shuttauer, Bob Hunter, Tom Liggett, and Joe Serrao, all of whom managed the ranch for less than ten years during their tenure (L.W. 2016). After Serrao, in 1975, C. Brewer’s (who was looking to withdraw from the livestock business and did not renew their lease with the State), sold the ranch to Parker Ranch. In an effort to keep their feedlot on O‘ahu full, Parker Ranch purchased several of C. Brewer’s interest in Ka‘ū, including three ranches, Keauhou, Kapāpala, and Ka‘alu‘alu. Within a few short months, Parker Ranch, who was operating on a revocable permit issued by the State’s Department of Land and Natural Resources, withdraw its interests from Kapāpala Ranch as it soon realized that the ranch was not profitable due to its sheer size, rugged terrain, and long overdue repairs to fencing. After securing a farm loan, John “Gordon” Cran took over Kapāpala Ranch in 1977 and his name was added to the revocable permit (Loomis 2003; The Honolulu Advertiser 2007). This would be “the greatest test” of his career as he oversaw and managed 30,000 acres along with catching and selling wild cattle, and worked as a laborer, farrier, goat herder, cook, and fence mender (Loomis 2003:1). An aerial photo from 1977 (Figure 33), shows the project area northeast of the Ka‘ū Forest Reserve and within the boundaries of the Yamaoka Paddock No. 1. Also depicted in this photo is the north-south trending road that cuts across the project area. In the area *makai* (southeast) of this road, cattle trails can be seen meandering through the forest.

2. Background

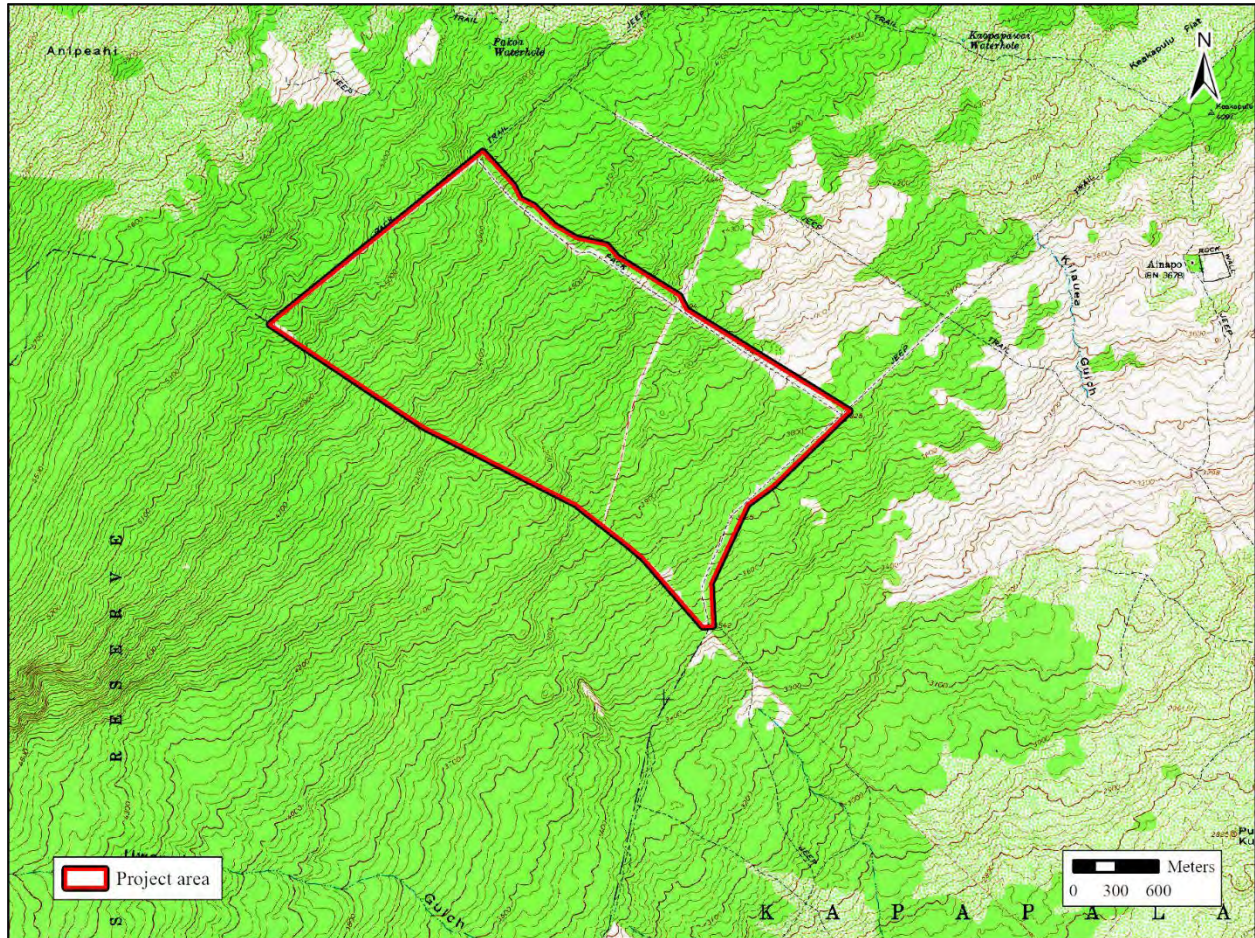


Figure 32. 1967 USGS map showing the project area within the Yamaoka Paddock No. 1 and Ainapo Paddock.

In 1983, a 6.7-magnitude earthquake shook the ranch and within seconds thirty miles of water pipelines were damaged and riddled with 200 breaks (Thompson 2007). Cran was tasked with finding water for 1,500 cattle within twenty-four hours and was aided by a Kaʻū agribusiness that hauled water to the ranch daily. Around 1989, with the support of Cran, the project area was taken out of the ranch’s operations and by 2009 was added to the Kaʻū Forest Reserve where it was established as Kapāpala Koa Management Area (Honolulu Star-Bulletin 2009). In the early 1990s, challenges associated with the State’s permit renewal process and rent increases made operating the ranch exceptionally difficult. Cran’s daughter, Lani Cran, and her husband Bill Petrie worked part-time at the ranch all while holding salaried jobs outside of the ranch. Much of the day-to-day operations were run by Cran and his wife, Genevieve (Bertlemann) Cran. Cran eventually formed a partnership with his wife and daughter, Lani Petrie (L.W. 2016). When Cran died in 2007, the ranch was operated by his wife. Upon her passing in 2016, the ranch passed to Lani and Bill, who now operate Kapāpala Ranch (The Honolulu Advertiser 2007).

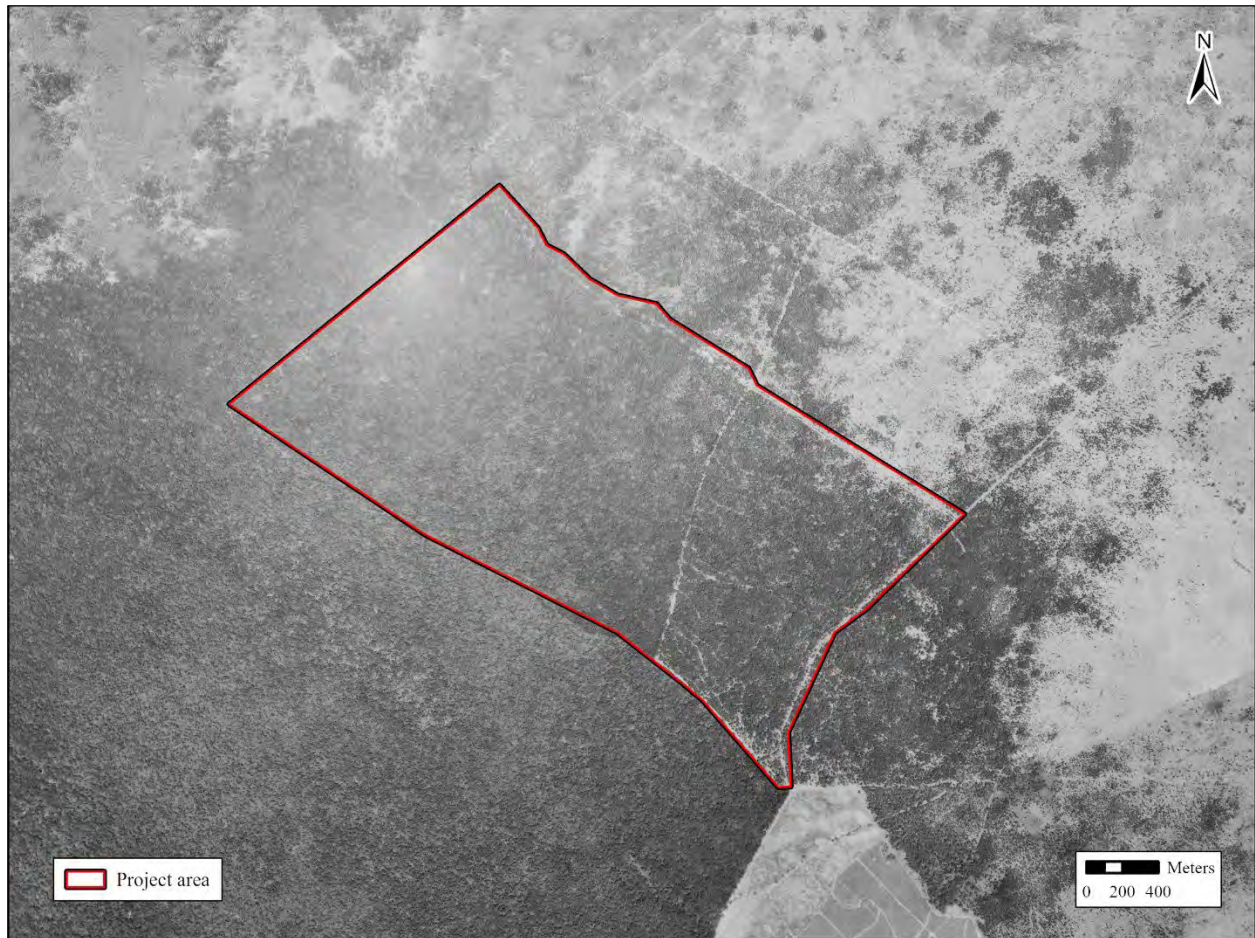


Figure 33. 1977 aerial photo showing the project area within the Yamaoka Paddock No. 1.

PREVIOUS ARCHAEOLOGICAL AND CULTURAL STUDIES IN KAPĀPALA

Archaeological and cultural studies conducted in Kapāpala Ahupua‘a are limited and have largely concentrated *makai* of the project area along Highway 11 and within the Ka‘ū Desert portion of Hawai‘i Volcanoes National Park. One of the most significant sites to be identified in Kapāpala is the 4,284-acre site known as “Footprints” (Site 50-10-61-5505) where some 1,773 human (and animal) footprints have been preserved in the desert ash from the fallout of the 1790 eruption that killed a portion of Keōua’s army. In addition to the footprints that are believed to represent a minimum of 441 individuals, a total of 55 sites comprised of 516 structures and features along with 73 isolated artifacts, roads, and trails were identified (Moniz Nakamura 2003). This site was nominated to the National Register of Historic Places (NRHP) in 1973 and listed on the register in 1974 (Apple 1973a).

Another historic site recorded in Kapāpala includes a portion of the original 34-mile long ‘Ainapō Trail (Site 50-10-50-5501), the upper portion (extending above the 11,600-foot elevation) of which was nominated to the NRHP in 1973 (Apple 1973b). This trail is located to the north-northeast of the project area and extends from 2,000 feet to 13,200 feet elevation. As described by (Apple 1973b:4), “Prehistoric Hawaiians laid out the Ainapo foot trail to assure the availability of shelter, drinking water, and firewood between their nearest permanent settlement, Kapapala village, and Mokuaweoweo...” This foot trail was utilized first by Hawaiians to ascend Mauna Loa, then later by foreign explorers, and was modified after 1870 to accommodate horses and mules. Also associated with this trail are two campsites, “one at the upper edge of the forest (Camp 2) [about the 6,500-foot elevation], and one further upslope with a large lava tube (Camp 3) in the barren area” as well as irregularly spaced *ahu* to mark the trail (Apple 1973b:4). Although the NRHP registry did not include the lower portion of the trail due to the lack of integrity, an 18.2-mile long section of trail is now managed by the Department of Land and Natural Resources-Nā Ala Hele Trail & Access Program as a public recreational trail.

In 2015, ASM Affiliates conducted an archaeological study in compliance with Section 106 of the National Historic Preservation Act for the then-proposed Hawai‘i Electric utility replacement project located along a portion of Highway CIA for the Kapāpala Koa Canoe Management Area, Kapāpala, Ka‘ū, Hawai‘i

11 (Barna 2017). Six previously recorded sites and ten newly recorded sites were documented. The previously recorded sites included the Peter Lee Road (Site 50-10-52-22997), the Halfway House Trail (Site 50-10-52-23032), the Ke‘āmoku Cross Trail (Site 50-10-52-23033), the Ka‘ū-Volcano Road (Site 50-10-52-23034), Lithic Block Quarry Features (Site 50-10-52-23467), and a Historic rubbish incinerator (Site 50-10-52-23794). The newly recorded features include three Historic borrow pit complexes (Sites 50-10-52-30275, -30278, and -30284), a Precontact/ early Historic trail (Site 50-10-52-30276), a Historic telephone pole alignment (Site 50-10-52-30277), a Historic scatter of ceramic fragments (Site 50-10-52-30279), the former Ka‘ū park entrance sign base (Site 50-10-52-30280), an L-shaped alignment (Site 50-10-52-30281), a portion of the Uwekahuna-Bird Park Road Trace and an associated culvert (Site 50-10-52-30282) and a Historic steam bath house foundation (Site 50-10-52-30283). All of the sites were avoided during the utility removal and installation, thus Barna (2017) concluded that the project would have no effect on historic properties.

In 2012 on behalf of the Department of Land and Natural Resources, Ke Ala Pono, an archaeological consulting firm prepared a CIA for the Ka‘ū Forest Reserve. As part of this study, Uyeoka et al. (2012) compiled cultural historical background information including traditional *mo‘olelo*, *mele*, and historic accounts and reviewed mid-19th century *Māhele* documents, historical maps, and summarized prior archaeological studies conducted in the uplands of Ka‘ū. They also undertook an ethnographic survey with sixteen individuals, who were either *kama‘āina*, agencies, and groups that were “recognized as having a cultural, historical, genealogical, or managerial connection to the forest reserve” (Uyeoka et al. 2012:5). From the ethnographic interviews and historical sources cited throughout their study, Uyeoka et al. (2012:151) found that “...the forested *mauka* regions of the Ka‘ū Forest Reserve were commonly used for specialized resource procurement activities...” that “...were likely centralized in specific area that contained important resources for catching/collecting birds, harvesting hardwoods for crafts and other uses, collecting medicinal plants, and spiritual practices.” They added that cultural practices continue to be perpetuated within the Ka‘ū Forest Reserve including the gathering of plant resources, gathering of *wai* from springs for ceremonial purposes, and hunting for subsistence purposes. Uyeoka et al. (2012:151) ultimately concluded that DOFAW’s proposed activities “...should have little impact on the known cultural, resources, and beliefs...” and that several of the activities “have the potential to benefit the cultural resources of the Reserve.” To mitigate the potential impacts and community concerns specifically lifestyles changes, restricted access, and watershed management, Uyeoka et al. (2012) conveyed the importance of maintaining the Ka‘ū way of life, ensuring continued and increased access into the forest reserve to allow for continued subsistence and gathering activities, and protection of the watershed through ungulate removal, invasive species control, and propagating native plants.

3. CONSULTATION

Gathering input from community members with genealogical ties and long-standing residency or relationships to the project area is vital to the process of assessing potential cultural impacts on resources, practices, and beliefs. It is precisely these individuals that ascribe meaning and value to traditional resources and practices. Community members often possess traditional knowledge and in-depth understanding that are unavailable elsewhere in the historical or cultural record of a place. As stated in the OEQC (1997) *Guidelines for Assessing Cultural Impacts*, the goal of the oral interview process is to identify potential cultural resources, practices, and beliefs associated with the affected project area. It is the present authors’ further contention that oral interviews should also be used to augment the process of assessing the significance of any identified traditional cultural properties and informing the recommendations. Thus, it is the researcher’s responsibility to use the gathered information to identify and describe potential cultural impacts and propose appropriate mitigation as necessary. This section of the report begins with a description of the level of effort undertaken to identify persons believed to have knowledge of past land use, history, or cultural information specific to Kapāpala or the practice of *kālaiwa‘a*. This is followed by the consultation methodology and concludes with a presentation of the interview summaries that have been reviewed and approved by the consulted parties.

OUTREACH EFFORTS

In an effort to identify individuals knowledgeable about traditional cultural practices and/or uses associated with the current project and study area, a public notice containing (a) locational information about the project area, (b) a description of the proposed project, and (c) contact information was printed in a newspaper with state-wide readership. The public notice was submitted to the Office of Hawaiian Affairs (OHA) on October 1, 2022, for publication in their monthly newspaper, *Ka Wai Ola*. This notice was published in the November edition of *Ka Wai Ola* and a copy of the public notice is included in Appendix A of this report. From the public notice, no responses were received.

Furthermore, in 2015, DLNR-DOFAW assembled a working group comprised of key stakeholders including *kūpuna* and residents of Ka‘ū, canoe clubs and associations, cultural practitioners, canoe builders, conservationists, and adjacent landowners. A full list of the members who were invited to the Working Group is provided below in Table 4.

Table 4. Members of the Working Group.

<i>Name</i>	<i>Affiliation</i>
Aileen Yeh	Hawaii Agriculture Research Center
Aku Hauani‘o	Canoe Builder
Andy Cullison	DOFAW
Aviva Gottesman	Forest Solutions
Bill Rosehill	Canoe Builder
Bobby Puakea	Canoe Carver, Puakea Foundation
Colleen Cole	Three Mountain Alliance
Darlyne Vierra	<i>Kama‘āina</i> of Ka‘ū
David Smith	DOFAW
Doug Bumatay	Canoe Carver, President of the Moku O Hawai‘i Outrigger Canoe Racing Association
Elias Nakahara	Hawaiian Canoe Racing Association
Gary Puniwai	Canoe Builder/Repairer/Paddler
Hovey Lambert	Canoe Carver/Puakea Foundation
Irene Sprecher	Forest Solutions
Jan Pali	DOFAW
Jay Hatayama	DOFAW
Jerome Mauhili	Paddler, Moku O Hawai‘i Outrigger Canoe Racing Association
John Repogle	<i>Kama‘āina</i> of Ka‘ū, Retired from The Nature Conservancy
Jonathan Grayson	Hawaiian Canoe Racing Association
Ka‘ili Mo‘ikeha	Hawaiian Canoe Racing Association
Katie Kamelamela	Ethnoecologist/ Akaka Foundation
Keahi Warfield	Moku O Hawai‘i Outrigger Canoe Racing Association
Keola Dayton	Hawaiian Canoe Racing Association
Keri Mehling	Hawaiian Canoe Racing Association
Lani Petrie	Kapāpala Ranch
Luana Froiseth	Hawaiian Canoe Racing Association
Mike Atwood	Hawaiian Canoe Racing Association
Mike O‘Shaughnessy	Moku O Hawai‘i Outrigger Canoe Racing Association
Nick Koch	Paniolo Tonewoods/Formerly with Forest Solutions
Nohea Ka‘awa	<i>Kama‘āina</i> of Ka‘ū, The Nature Conservancy
Riley De Mattos	DOFAW
Samantha Moikeha	Hawaiian Canoe Racing Association

Since its inception, the Working Group—whose goals are to provide direction and guide decisions on the management of the KKCFMA and the sustainable use of its natural and cultural resources—has met anywhere between once to three times a year except for the years 2019 and 2020 (Table 5). Furthermore, not every member of the Working Group participated in each meeting and likely because of the long duration of the project, some group members went inactive. However, at each meeting there was representation by some members of the Working Group. At the last meeting held on November 17, 2022, the Working Group requested that the preparers of the CIA review all past meeting notes for information that is relevant to this CIA study and include that information in the analysis. Also, the Working Group felt that most of the people that would likely participate in the CIA or be sought out by the preparers of the CIA were already included in the Working Group and had shared their knowledge or recommendations in prior meetings. In light of this request, the authors of this study obtained, with the assistance of Forest Solutions and DLNR-DOFAW staff, all Working Group meetings notes from the following dates, which are tabularized chronologically by year (see Table 5). Rather than reproduce transcripts of the meeting notes (which are available through Forest Solutions and DLNR-DOFAW), the following section presents those relevant themes that emerged from the meeting notes.

Table 5. Dates of Working Group meetings.

<i>2015</i>	<i>2016</i>	<i>2017</i>	<i>2018</i>	<i>2021</i>	<i>2022</i>
September 18	January 9 July 31 November 5	July 9	January 18 December 7	April 8	September 22 November 17

Lastly, ASM staff contacted the following individuals, listed in Table 6 via phone and or email. These individuals were identified as persons who were long-time residents of the area and were believed to have knowledge of past land use, history, or cultural information specific to Kapāpala or the practice of *kālaiwa 'a*. Each of the persons contacted was provided with a consultation packet that contained maps of the project area, a description of the proposed project, and the proposed activities. Of the sixteen people/organization contacted, eight—Doug Bumatay, Lani Petrie, Dale and Jody Fergestrom, Bobby Puakea, John Repogle, Jessie Ke, and Katie Kamelamela, Ph.D.—agreed to be interviewed for this study. Of the eight interviews conducted, seven were able to review and approve their interview summaries; all of which are included below.

Table 6. Persons and organizations contacted for consultation.

<i>Name</i>	<i>Affiliation</i>	<i>Result of Contact</i>	<i>Contact Date</i>	<i>Notes</i>
Doug Bumatay	Canoe Carver/President of the Moku O Hawai'i Outrigger Canoe Racing Association/ member of the Working Group	Interviewed	7/15/2022	See summary below
Bobby Camara	Retired from the Hawai'i Volcanoes National Park	Provided referrals	7/14/2022	Recommended outreach to Bill and Lani Petrie, Dale Fergestrom, Edith Kanaka'ole Foundation, Aku Hauani'o, Kalani Nakoa at Na Pe'a, Kekaulua 'Ohana, Doug Bumatay.
Lani Petrie	Kapāpala Ranch owners/ member of the Working Group	Interviewed	10/14/2022	See summary below.
Dale and Jody Fergestrom	Director and Nā Pe'a Instructor	Interviewed	n/a	Invited by Lani Petrie to interview held on October 25, 2022. See summary below.
Jerome Mauhili	Moku O Hawai'i Outrigger Canoe Racing Association/Kailana Canoe Club/ member of the Working Group	No response	10/14/2022	n/a
Bobby Puakea	Carver/ Puakea Foundation/ member of the Working Group	Declined interview	11/29/2022	n/a
Kalā Mossman	Edith Kanaka'ole Foundation	Interviewed	11/29/2022	See summary below.
Kalani Nakoa	Nā Pe'a/Nakoa Foundation	No response	11/29/2022	n/a
Nohea Ka'awa	<i>kama'āina</i> of Ka'ū/ member of the Working Group	No response	11/29/2022	n/a
John Repogle	<i>kama'āina</i> of Ka'ū/ member of the Working Group	Interviewed	11/29/2022	See summary below.

Table 6 continues on next page.

Table 6. continued.

<i>Name</i>	<i>Affiliation</i>	<i>Result of Contact</i>	<i>Contact Date</i>	<i>Notes</i>
Sophia Hanoa	<i>kama'āina</i> of Ka'ū/ Ka'ū Kupuna Council	Provided referral	11/18/2022	Recommended outreach to Kupuna Jessie Ke.
Office of Hawaiian Affairs	Office of Hawaiian Affairs	No response	8/5/2022	n/a
Gary Puniwai	Canoe carver/ member of the working group	No response	10/14/2022	n/a
Chad Paison	Senior Captain Nā Kālai Wa'a	No response	11/29/2022	n/a
Jessie Ke	Ka'ū Kupuna Council	Interviewed	11/21/2022	Could not get in touch with Kupuna Ke to approve interview summary.
Katie Kamehamela, PH.D.	Ethnologist	Interviewed	12/5/2022	See summary below.

End of Table 6.

CONSULTATION METHODOLOGY

Prior to the interview, ASM staff provided information about the nature and location of the proposed project and informed the potential interviewees about the current study. The potential interviewees were informed that participation was completely voluntary and that they could withdraw from participation at any time. Furthermore, if they agreed to be interviewed they would be asked to review their interview summary prior to inclusion in this report to verify the information for accuracy, tone, and content. Upon their consent, ASM staff then asked questions about their background, their knowledge of past land use, and the history of the project area, as well as their knowledge of any past or ongoing cultural practices or valued resources. Where necessary, ASM staff also asked follow-up questions to gain clarity on certain information shared by the consultees. The informants were also invited to share their thoughts on the proposed KKCMA project and offer mitigative solutions. The interviews were informal, that is they were done in casual settings at locations specified by the interviewees and were more conversational in style. Below are the interview summaries that have been reviewed and approved by the consulted parties.

SUMMARY OF WORKING GROUP MEETING NOTES

To fulfill the request made by the Working Group, ASM staff carefully reviewed all available notes from the prior meetings (see Table 4). The meeting notes contained a variety of information specific to the KKCMA project including general project updates, extensive discussion about the log allocation/application process, thoughts and concerns about the harvesting process, statistical information about canoe clubs and number of paddlers, project schedule, and outline of EA components. Also, tucked within these discussion were comments and information on past and ongoing cultural practices, valued resources, cultural beliefs associated with the forest, and a variety of recommended mitigative actions to limit impacts to the forest resources and improve management of the KKCMA. Presented below are those broad themes that emerged from the Working Group meeting notes. It is recognized that some of the comments/recommendations can be applied to one or more themes.

Cultural Beliefs and Protocols

- Forest is sacred. (September 18, 2015)
- Forest are living and removal of trees is not the end of the forest. (September 18, 2015)
- Cultural protocol for those groups/organization outside of Hawai'i Island. (July 31, 2016)
- Develop appropriate cultural protocol for tree selection, harvesting, and carving. A general protocol developed for entering the KKCMA. (November 5, 2016)
- Groups receiving logs should be involved in visiting the forest before harvest and establishing a cultural connection with the forest. (November 17, 2022)

Cultural Resources and Practices

- Trails located in the KKCMA forest. (January 9, 2016)
- Maile gathering occurs in the KKCMA. (July 9, 2017)
- Forest bird resources located in the KKCMA include ‘*apapane*, ‘*amakihī*, ‘*elepāio*, ‘*i‘iwi*, and ‘*ōma‘o*. (December 7, 2018)
- Native species: ‘*apapane* (most abundant), Hawaii ‘*amakihī* (also abundant), ‘*ōma‘o*, ‘*i‘iwi*, ‘*alawī*, Hawaii ‘*elepāio*, *akiapolaau*, ‘*io* (April 8, 2021)
- *Koa* volume average 1-2 *koa* trees per plot. 5.4-5.5M board feet of *koa* in the forest. Most of the volume is being stored in *mauka* sections of reserve. Probably because of past harvesting, grazing, land use etc. Most of the volume in the 40-50” diameter trees. The oldest logs are the highest elevation logs. (April 8, 2021)
- We have limited resources on Hawaii island. Only 5 guys who can move a log, bring it down. Backwards engineering this within the group would help. Context is helpful. Ideal cultural practices and practical cultural practices with safety in mind. This is a part we need to put more time in for safety and partnership. (November 17, 2022)

Balancing Science and Culture

- Would like to see a balance between the culture and science when reviewing what trees will be selected. (November 5, 2016)

Utilizing Existing Infrastructure and Invasive Species/Disease Control

- Utilize and improve the existing wood platform located in the KKCMA by adding a roof which can be used as a gathering space for groups visiting the forest. This space can be utilized by groups that can assist with road maintenance, outplanting efforts, seed collection, weed control, watershed education, or similar activities. (September 18, 2015)
- Cautioned against constructing new roads in the forest as roads facilitate the introduction of invasive species. Use existing roads during harvesting operations. (January 9, 2016)
- Public presence will have a big impact on spread of invasives.
- Pretty sure there is ROD near the bottom left corner [of KKCMA], however, ‘*ōhi‘a* in plots look generally very healthy. (November 17, 2022)

Harvesting and Extraction

- Logs must be extracted properly to prevent damage to forest resources. (September 18, 2015)
- Ensure there will be logs available for future generations. (September 18, 2015)
- Want to ensure a variety of tree sizes are removed and not only large trees otherwise there will not be any big trees left in the forest. (September 18, 2015)
- Carvers should be present when the tree is extracted from the forest. (September 18, 2015)
- Management plan should allow for the hand collection of *koa* logs for cultural and spiritual purposes. (September 18, 2015)
- Logs extracted from the KKCMA should not be sold and there should be close tracking of the log to ensure they are utilized for canoes. (September 18, 2015)
- There are limited number of carvers, this only a limited number of logs can be extracted annually. (September 18, 2015)
- Harvesting of *koa* will help create space in the forest which would prompt tree to grow tall and straight which are more suitable for canoes. (January 9, 2016)
- Anticipate some destruction to native habitat during the harvesting process which could be mitigated by reforestation of disturbed areas. (January 9, 2016)
- Skidding logs out of the forest to the closest road will have less of an impact and skid trails will eventually help regenerate more *koa* seedlings. Skid trails can also be reused to limit impacts to the forest. Explore alternative harvesting methods to reduce impacts. (January 9, 2016)

- Ensure logs extracted from the KKCMA are used appropriately and for the same reason it was harvested. Extra *koa* should not be sold by the club to fund the construction of the canoe. (January 9, 2016)
- Auxiliary harvest can be used for other parts of the canoe or paddles. (January 9, 2016)
- Do not want to reenter harvested area and damage any seedlings. (November 5, 2016)
- Some clubs are mostly about paddling and competition. Other clubs are all about culture, with paddling being but one aspect of the culture. Consideration during log allocation, the role of culture in the activities of the club and perpetuation of the cultural values. (July 31, 2016)
- Ensure harvesting period considers weather and seasonality of bird populations (nesting in spring). (July 9, 2017)
- Consider machines creating disturbances which create opportunities for both natives and weeds (November 17, 2022)
- We should have plots and take everything (mature *koa* logs, dead *koa* logs, decadent (high risk) *koa* 'ōhi 'a trees/logs, and felled logs; young healthy *koa* trees and healthy 'ōhi 'a trees to remain along with islands of existing native vegetation) from an area at one time then let that area rest. If we harvest, we will get regeneration and we should not go back to that area with machinery and disturb the native regeneration. (November 17, 2022)
- Downed logs should be considered before living trees for carving. (November 17, 2022)
- A lot of discussion on how to track logs, takes a while to cure, how to keep track? (November 17, 2022)

Education and Stewardship

- The KKCMA can serve as a good educational resource. (September 18, 2015)
- Hunters need to be made aware of the plan and notified when there are activities in the forest. (January 9, 2016)
- Involving club who utilize a log from the KKCMA in stewardship activities. (July 31, 2016)
- Community stewardship inclusive of HCRA members can assist with outplanting. (November 5, 2016)
- Involving young upcoming carvers. (January 18, 2018)
- Group has been talking about having more information about the area available to people visiting the site – many have no idea what this area is or that it is set aside for *koa* canoe logs or *koa* sustainability (November 17, 2022)
- HCRA History Committee has offered to document and publish each of the builds (photographically and orally) and they would host that for the club participating in the process. Hope that this becomes a model. (November 17, 2022)

Reciprocation

- What is being reciprocated to the forest when a *koa* is extracted? (September 18, 2015)
- Give back to the Ka'ū community, perhaps a log can be used for fishermen or a school to build a canoe. (September 18, 2015)
- There must be some giveback by those who receive a log from the KKCMA. Canoe clubs receiving logs from the KKCMA can help with reforestation efforts. (January 9, 2016)

Sustainable Funding

- Identify funding resource to help sustain the management of the KKCMA. (September 18, 2015)
- Auxiliary harvest can be sold to raise funds for the KKCMA. (January 9, 2016)
- Seek funding (i.e. grants) to help support and sustain the KKCMA management activities. (November 5, 2016)

Declining Health of Native Forest and Conservation Strategies

- Incorporate both natural regeneration of seedlings and outplant to encourage growth of canoe quality logs. (November 5, 2016)
- Native forest is not regenerating on its own. Many native forest lack an understory of young trees that would regenerate the forest. (July 9, 2017)

- Fencing and public education is necessary. (July 9, 2017)
- Suggestions for Future Management: Creation of a long-term harvest plan, preserve forest for Hawaiian cultural practices, increase diverse public access opportunities, maintain & enhance the health of the native forest. (November 17, 2022)

DOUGLAS “DOUG” BUMATAY

On August 31, 2022, ASM staff Lokelani Brandt conducted an in-person interview with Mr. Douglas “Doug” Bumatay at the Paddlers of Laka’s *hālau wa ‘a* at Hilo Bayfront to discuss the proposed project and scope of the current CIA. Doug comes from a long lineage of *koa* canoe carvers and paddlers—a legacy that was passed down to him by his father, the late, Mr. Raymond “Ray” Bumatay. Doug and his sister, Pua Kalani‘ōpio are the Head Coaches for Paddlers of Laka, a Hilo-based canoe club and he currently serves as President of the Moku O Hawai‘i Outrigger Canoe Racing Association. Much of the information shared during this interview focused on Doug’s background with the Moku O Hawai‘i Outrigger Canoe Racing Association, his family’s *koa* canoe carving legacy, the canoe carving community, the types of canoes and what they are utilized for, and the role of *koa* canoes in Hawaiian culture.

Doug was born July 28, 1971, into a long heritage of canoe paddling and carving. Doug shared that at around age two, his parents helped establish the first Moku O Hawai‘i Canoe Association, and shortly thereafter, his father, Ray, founded Wailani Canoe Club (known today as Kailana Canoe Club). A year after the club’s establishment, around age three, Doug recalled his father, Ray acquiring his first *koa* log from Kona—the log from which his dad built his first *koa* canoe. This would be Doug’s first memory of canoe carving with his father. He remembered being around three years old and handing his dad various carving tools and raking up saw dust around the workshop.

When asked how his father, Ray acquired the knowledge of canoe carving, Doug shared that when his father was young, he watched his grandfather build the canoes in Kalapana. He added that his father, Ray was born in ‘Opihikao but was raised in Kalapana and later moved to Hilo. As Doug’s father got older, the desire to carve his own *koa* canoe grew. Finally, one day his father, decided to talk with his mother (Jenny Kama), about his grandfather’s work and gather as much information about his grandfather’s canoe carving process. Since acquiring that first *koa* log, canoe carving was a passion of Doug’s father, and he became known as the “canoe builder.” Doug shared that his dad taught both himself and his brother Alika the process of canoe carving. He elaborated that the process he follows today, though the techniques have been refined, is the same process handed down from his father.

Having grown up in this practice, Doug laughingly shared that he always assumed every family participated in canoe carving. However, it wasn’t until he was in high school—as more and more people came up to him asking about his father and canoe carving—did he begin to realize the uniqueness of his upbringing, the significance of his father, and their family practice. Doug added that because there are so few people who hold this knowledge, it is vital for him to continue to perpetuate his father’s legacy. He related that about twenty years ago, Uncle Manny Veincent of Kawaihae Canoe Club encouraged him to start his own club. Doug added that at that time, he pondered deeply on whether to focus on canoe building and repairing or the paddling aspect, but in the end, Doug chose to perpetuate both.

When asked if he could share about the tree selection process, Doug clarified that when his father built his first canoe around 1974, he was very young and could not speak to the tree selection process or the coordination with the landowner. However, Doug did recall that this canoe was built from a standing tree. Doug shared that about 1979, there was a coordinated project to get *koa* logs from Kona to different canoe clubs. He was not sure about the log selection or the distribution process, however, he recalled that twenty-nine logs were harvested and taken down to Kawaihae to be shipped; of the twenty-nine logs, three were kept here on Hawai‘i Island the rest were shipped to O‘ahu. Doug recalled during the log allocation process, his father trying to make his selection but was told that the logs he had chosen were already allocated. Annoyed at not being able to obtain the logs he had selected, Doug’s father, instructed “Doug, crawl under there [the trailer] an pick us one log.” Doug related that he selected two logs that turned out to be some of the better logs for canoes and that some of the logs that were shipped to O‘ahu were later found to be rotten. Furthermore, from that batch of twenty-nine logs, one was used to build Laka, the *koa* racing canoe of Paddlers of Laka that is still in use today. He shared that the log from which Laka was built was a log that no one wanted because it was smaller and contained a big hole with rot. He described how this log was kept at Bayfront for about six months before his dad was approached to negotiate the purchase of the log. After his father purchased the log, the initial shaping took place at the beach after which they were able to transport the semi-hewn canoe to their home for finishing.

In sharing more about the tree selection process, Doug elaborated that for the most part, he has not had the opportunity to pick standing trees rather he often harvests trees that have already fallen over. Thus, he harvests more on a salvage basis and works directly with the landowner to discuss the harvesting process and to negotiate the price of a

log. Doug related that depending on the preference of the landowner, he has utilized heavy machinery to harvest, and sometimes, he has had to take a more manual approach to remove the tree from the forest.

When asked what he looks for when selecting a tree, Doug shared that a suitable length and diameter are the two most important factors. If the log is too small, it takes a lot of work to build it up and you don't necessarily want a log that is too big. However, even with bigger trees, any excess wood can be repurposed and used in the construction of another canoe. He added that most of the time after the tree is cut down, it is hauled out of the forest and taken to the workshop. In addition to a suitable length and diameter, he expressed that the most preferred trees are those that grow straight and noted that most of the *koa* found in the forests don't typically grow in that manner.

When asked about rituals or ceremonies that practitioners do in obtaining a log, Doug expressed that traditionally, ceremonies were held, however, few practitioners continue this aspect of the process, including himself. Furthermore, this aspect of the process has been neglected because there are so few opportunities for carvers to go into the forest and select trees to cut. Doug reiterated that most of the carvers today work on logs that are fallen and salvaged.

Concerning the preferred locations of where *koa* logs are harvested from, Doug jokingly shared that wherever the "big enough" logs are, is where one would harvest from. He mentioned that Kapāpala has the potential to be a good harvesting spot and recalled that the forest of South Kona has likely supplied the most *koa* canoe logs.

Concerning the types of canoes that were built, Doug shared that traditionally, *koa* racing canoes as it is practiced today did not exist. Traditionally, canoes were used for specific purposes such as fishing, voyaging, war, general transportation, and even for burials. He added that, when compared to modern-day *koa* racing canoes and excluding the voyaging canoes and those used in war, the majority of the traditional canoes were shorter in length and wider to accommodate things like fishing gear and fish. Doug continued, when canoe racing grew in popularity during the 20th century, the first canoes that were used were fishing canoes that ranged in length from 30-35 feet. As the sport evolved to become more competitive, so did the style of the canoes. The shorter fishing canoes were adapted—the overall length increased by an additional 10 feet and the width and height tapered down to create less drag in the water. He explained that the modern *koa* racing canoes now range anywhere between 30-45 feet. In addition to these adaptations, Doug elaborated that how the canoe is to be used will determine the general shape of the canoe. For example, shorter canoes allow for better turning capabilities thus they are better suited for regular regatta races and longer canoes are more appropriate for long-distance channel racing.

Aside from *koa* racing canoes, Doug shared that he has made a four-man Albizia surfing canoe for a guy on Maui, a 20-foot *koa* canoe for a homeowner in Kūki'o, and a canoe made of mango wood for Kamehameha Schools. Another type of canoe-making technique Doug spoke about is the plank method, in which small planks of *koa* or other types of wood are fixed together to form a canoe. Doug however revealed that technique is not his preferred method, however, he will build whatever type of canoe someone asks for, given that there is a purpose for its use. When asked if he has had to build a canoe for a burial, Doug related that this is the only type of canoe has not built because canoe burials are not common today.

When asked about the size and status of Hawai'i's canoe carving community, Doug shared that this community is very small. He explained that there are two primary groups of canoe carvers in Hawai'i, a handful of carvers who specialize in refurbishing and modifying existing canoes and even fewer who have the knowledge and capacity to transform a log into a usable canoe. He noted that it takes a lot of work, dedication, and financial investment to be a carver, especially for those in the latter category. Doug related that for those who are inexperienced, it can be challenging to simply start the shaping process. He identified the following individuals as the community of canoe builders who can transform a log into a useable canoe: Sonny Bradly from O'ahu, Uncle Manny Veincent from Waimea (now retired from building) and his family, and Doug's family, the Bumatays. Doug also identified Bill Rosehill, a Kona native who is also a part of the project's working group, as a carver who is sought out for refurbishing. Doug shared that since the racing association requires that clubs race with *koa* canoes to keep with tradition, these handful of practitioners are the ones who are usually sought out to build *koa* racing canoes.

When asked about the process canoe clubs go through to have a *koa* racing canoe made, Doug shared the first step is for the club to acquire the log. He added, he does not undertake this part of the process for the requesting clubs because it is a long process. Once the log is acquired by the club, he will then inspect it carefully looking for any rot or peculiarities that will influence the shape and size of the canoe. Doug related that in the past, pre-1980s, most of the canoe clubs went out in search of a log, built their own canoe, collected *hau* for their '*ama* and '*iako* and even made their own repairs. However, he lamented that over the years most clubs no longer do this, rather they will "call and order" a canoe. Doug shared how this shift away from building and repairing your own canoe has, in part, impacted the appreciation one has for the canoe and carving as a practice.

In perpetuating this practice beyond his family, Doug spoke about his family's participation in the International Festivals of Canoes held annually during a two-week period on Maui. He explained that at this festival, canoe builders from Tahiti, Tonga, Aotearoa, and other Pacific Islands come together to showcase their styles and techniques of canoe building. Doug noted that his family first attended this festival sometime around 2000 when his father was approached to participate in the festival, noting that there wasn't a good representation of Hawai'i's canoe builders at that time. Prior to participating, his father attended the previous festival to get an idea of what to expect, and upon his return, they planned out how they would accomplish building a canoe from log to the launching ceremony. Taking into consideration a working crew of four, they prepared plans, templates, goals, and refined their technique for the event. This aided immensely as they were able to finish the canoe within the first week, noting that in reality the work would be stretched out for months, sometimes even years. While working on their canoe, he shared how the other groups would observe them and at times took their discarded pieces to be utilized in their canoes. Doug shared that the biggest takeaway from this festival was their ability to share their knowledge with all the Pacific Island groups.

In 2012, Doug along with his father, brother, and friend showcased their skills and art in an event held in Japan. In Japan, he compared their ceremonial practices to that of the traditional practice of Hawaiian canoe building. He recalled an elaborate ceremony for cutting the tree. He shared how this trip was one of the most challenging events because there was a language barrier and obtaining the tools needed to finish the job was difficult. Luckily, he shared there was a boat-building company in the town where the event was held, and they loaned their tools to Doug and his family. In the end, Doug folks finished a 35-foot mahogany canoe within 11 days and they eventually returned to Japan a few years later to complete another canoe project.

When asked about the "life span" of a canoe, Doug asserted that with proper maintenance and storage, a *koa* canoe can last hundreds of years. He shared how currently there is a canoe being repaired at his father's house that belongs to a family in Waimea. This canoe, he explained, was previously on Kaua'i for several years and then utilized by the Kaua'i Canoe Club for an additional twelve years. He approximated the age of this canoe to be about 100 years old. He does not doubt that there are racing canoes that are close to this age, bringing attention to the 60s, 70s, and 80s when the majority of *koa* racing canoes were built. Additionally, he spoke his club's *koa* canoe, Laka, and how this canoe has allowed many generations of kids and families to continue paddling because it is properly maintained and stored.

When asked about his thoughts on the proposed project and the dedication of Kapāpala as a harvesting spot for practitioners, Doug expressed how important this project is for traditional canoe building. Taking into account the current process, Doug revealed that there aren't many places that are easily accessible to carvers. He added that while there are landowners who are willing to allow harvest and the State offering reserves as potential spots, he explained that these areas often lack roads to get into the forest as well as restrictions on the use of heavy machinery that would otherwise aid in the felling and hauling of the log. Doug elaborated on how the use of heavy machinery is a lot more effective in clearing enough space around the tree and getting the logs out. He emphasized that the scarification caused by the machines is very beneficial to the forest because it activates the dormant *koa* seeds that would otherwise not germinate.

Concerning the impact the proposed project will have on the practice of *koa* canoe-making, Doug reflected that although canoes today can be made from various types of wood, *koa* is still the choice wood and is required by the canoe racing association so that we can continue to keep within Hawaiian canoe-making traditions. If provided with this resource, Doug elaborated, *koa* canoe carvers can continue to perpetuate this long-standing practice and train another generation to do the same. Because *koa* suitable for a canoe is scarce, those carvers in training typically have to practice on other types of wood, however, he felt it is vital to train upcoming carvers on *koa*. Doug opined that *koa* is only found in Hawai'i and that alone makes it particularly special. The other reason is that the physical characteristics of the *koa* are unmatched, especially for canoes. He added that it is one of the few native trees that can grow big enough to a workable size to make a canoe. In closing, Doug shared that the canoe is perhaps, one of the most important aspects of Hawaiian culture. Canoes are how Hawaiians got to these islands, it is how they got their sustenance; it was their primary mode of transportation and the vessel in which some were buried.

LANI CRAN PETRIE AND DALE & JODY FERGESTROM

On October 25, 2022, a site visit/ group interview was conducted with Lani Cran Petrie, owner of Kapāpala Ranch, and Dale Fergestrom, Instructor of Nā Pe'a, a youth program that instills social and environmental responsibility through the perpetuation of traditional Hawaiian sailing—a program of the Nakoa Foundation. Dale is also a Nakoa Foundation board member and has spent the past fifty years paddling, sailing, and repairing canoe. Also present at this interview was Dale's wife, Jody Fergestrom, Lani's eldest son Alex Petrie, and ASM staff, Manuel Lopez. The interview commenced at the Kapāpala Ranch headquarters followed by a drive and stops at different places in the project area where discussions resumed.

The group convened at the Kapāpala Ranch headquarters for introductions and discussions about the scope of the current study. Lani shared a few historical maps including the 1907 map of Kapāpala (see Figure 25) and a 1930 map of Kapāpala Ranch (see Figure 31). Lani pointed out the location of the project area on these maps and noted that the project area was once part of the ranch's Yamaoka Paddock. She believes the paddock was named after the contractor that constructed the fence around the parcel. She explained that it was a common practice on the ranch to name different paddocks and even gates after those who built them. A brief discussion was also had about the historic battles between Keōua and Kamehameha that occurred in 'Ōhaikea and 'Ainapo and the trails that were used in these battles. In discussing the location of these battles, Lani shared that she believes these battles took place in the area north of the project area and referenced historical descriptions that indicate how the ocean was viewable from the battlefield. She elaborated that there are a few areas on the ranch where the ocean is clearly viewable but noted that the project area is not one of those locations. The group then loaded up on two side-by-side utility terrain vehicles and headed to the project area.

While driving to the project area, Lani shared that today, the ranch is comprised of some 34,000 acres with more than half (~20,000) of that acreage used as free-range. She noted that historically because much of the ranch is on *pāhoehoe* lava with very thin soils, only those areas within the ranch with deeper soils were used for growing sugar cane. It is within these former cane-growing areas that the ranch carries out intensive grazing for livestock production. The ranch maintains about 2,000 head of cattle along with goats which they rotate in different areas to manage vegetation. She explained that ranching did occur in the project area but since the establishment of the project area as a *koa* management area some thirty or so years ago, the ranch ceased operations in that section. Lani noted that just prior to the project area being set aside, sometime in the late 1980s and early 1990s, a man named Steve Baczkiewicz operated a sawmill in the project area. She recalled that her father, John "Gordon" Cran was instrumental in setting aside the project area for forest management. Lani stated that when the ~1,200-acre area was first set aside, it was for *koa* management and harvesting of dead and or downed trees but this later changed to the present scope which is for the sustainable harvest of *koa* for *koa* canoes.

In talking more about the unique landscape of Kapāpala Ranch, Lani described it as a working landscape—a place where people live and work responsibly to strike a social, economical, and ecological balance. She explained that the ranch is adjacent to the Ka'ū and Kapāpala Forest Reserve and within the Kapāpala Cooperative Game Management Area all of which are "State-managed areas". Because of this arrangement, areas of the ranch areas are accessible to the public for certain recreational activities such as seasonal game bird hunting, hiking, and access to the forest reserves for subsistence, recreational, or commercial gathering.

The site visit continued into the lower elevation of the project area. Here, Lani pointed out a 1.5-acre *koa* test plot that was planted by Horticulturalist, Aileen Yeh of the Hawai'i Agriculture Research Center. The purpose of this test plot, as Lani remembered was to study thrips and other *koa* diseases. Lani recalled that 30 years ago, she could ride her horse through the project area with ease which made accessing and managing the forest much easier. However, since the State acquired the project area, this forest has become more overgrown and difficult to access. She added that although *koa* is found throughout the project area, the size of the trees varies greatly because of the local substrate which influences the tree's ability to access deeper pockets of soil, nutrients, and water. Lani and Dale shared that some of the choice trees for *koa* canoes are found along the roadways in previously disturbed areas and that the old-growth *koa* forest where some of the largest trees are found is in the mid to upper elevations *mauka* of the north-south oriented road that cuts across the project area. Concerning the fencing, Lani believes the first fence was put in around 1906 during which time no equipment was used but later her father dozed the fenceline.

When asked about any past or ongoing cultural practices, Dale and Lani shared that there are people who access the forest to harvest *maile* (*Alyxia oliviformis*), mostly for commercial purposes and that such activities require a permit from the DLNR. She believes that the *maile* pickers is one user group that has not been engaged in the proposed project and recommended that the State and or ASM staff attempt to reach out to them.

Both Dale and Lani expressed that to manage the project area as a *koa* canoe management area, the State if they are genuine about this goal, needs to implement activities that encourage the regeneration (i.e. replanting, scarification) and growth (i.e. thinning, pruning) of *koa* in a way that makes them suitable as canoe logs. They contended that the current method of passively managing the forest will not yield the desired results and that the State must take action to intensively manage this *koa* tract if they hope to extract any *koa* suitable for canoes. Dale elaborated that the shape of the canoe is found in the tree and that the tree determines the overall shape and features of a canoe. Lani opined that if you don't take care of the *koa* forest, like any living species, it will eventually die and that to perpetuate this forest as a *koa* canoe forest—which is a long-term initiative—you must interact with it regularly. Additionally, Lani and Dale felt that undesirable plant species need to be kept at bay and that the State must consider the economics of managing this forest because relying solely on State funds, which is the status quo, is unsustainable. Lani expressed that there are all sorts of

“values” that people attach to forest resources, including but not limited to cultural and economic, and that the Ka‘ū Forest Reserve because of its sheer size and resources, has a very high cultural and economic value. She stressed that as a rancher, whatever resources are within and even beyond the ranch boundaries (pastures, fencing, gates, water, plants, animals, etc.) are assets and she must do all she can to maintain and protect these resources to ensure the long-term sustainability of the ranch. She reflected that without proper management of these resources, the ranch would be nonexistent thus she urges the State to make the financial investments needed to properly care for this *koa* forest.

In speaking more with Dale, he reflected that without the canoe, there would be no Hawaiians and that the canoe is a defining feature of Polynesian cultures. He shared that the Hawaiian canoe, although it lacks ornamentation, its fundamental design has been masterfully adapted to Hawaiian waters. He added that traditionally, the canoe was used for fishing and travel and that over the decades, it has been adapted for racing. Some of these adaptations, Dale noted, include the overall increase in the length of the canoe, the decrease in weight, and the narrowing of its hull. However, he affirmed that the core design for racing canoes remains unchanged from tradition. Dale recalled that carvers have in the past tried to innovate beyond the traditional design, however, they always return to tradition because its design has already proven to be the most superior on the ocean. The Hawaiian canoe, Dale shared never overpowers the ocean because it was designed by Kanaka in a way that allows it to move fluidly on the ocean. In reflecting on the current project and the challenges Hawaiians have and continue to face in their ability to perpetuate their cultural practices in today’s political climate, Dale stated that the Hawaiian canoe is the perfect metaphor for the Hawaiian concept of *pono* (balance, excellence, equity) and what should be achieved as part of this project. He articulated that for a canoe to float and move efficiently on the ocean, it has to contain three main parts, the *wa‘a*, *‘iako* (outrigger boom), and *ama* (outrigger float), all of which at any given time is in a state of constant tension. He elaborated that all three components are not equal and are useless unless each component is lashed together which distributes the tension across all three parts; only then will the canoe be able to move efficiently and do the work it was designed to do.

Lani and Dale recalled that this project has been ongoing for at least thirty years and within that time, the State has made very little progress, which has caused a lot of frustration, especially amongst those in the working group. Lani, who has been a part of the working group assisting with the development of the management plan for this forest, expressed concern over certain elements of the draft management plan and provided the following recommendations. She felt that harvesting of *koa* should be scheduled, preferably during the summer when the weather is drier, and any logs approved for extraction should be harvested at once, rather than each approved club/group harvesting on their own schedule at different times of the year. She noted that the road that runs along the perimeter of the property is in poor condition and that it gets washed out during heavy rains. Thus, she cautioned that if the State has to fix the road every time a club/group is ready to harvest a log, it will be costly. Jody recommended that the State have a list of approved vendors who have the proper equipment and knowledge of how to properly decontaminate, harvest, and extract *koa* from the forest. Jody and Lani felt that in this way, all the harvesting activities are consolidated to once a year and that the forest is allowed to rest and regenerate for the rest of the year. Also, Jody believes there are probably not enough logs to sustain an annual harvest and those harvest intervals could well be at less frequent intervals. Based on their experience, Lani and Dale believe that the disturbance caused by the harvesting and extraction process will most likely result in the emergence of more *koa* seedlings and increase diversity in the *koa* gene pool. Dale shared that because there are so few carvers with the knowledge and expertise to transform a log into a usable canoe, he felt that the number of logs that would be extracted from this forest annually would be very low. He added that because it can take anywhere from 1-2 years or sometimes longer to make a single canoe he was certain that harvesting can be done sustainably. In thinking back to the draft management plan, Dale expressed his support for each club/group demonstrating their capacity and having a plan to construct a canoe from the *koa* extracted from this forest. Dale asserted that with today’s carving methods, there is very little waste as all wood can be used; smaller planks can be transformed into seats or *manu* (bow and stern endpieces) or other smaller components. Dale and Lani expressed grave concern and were not supportive of the proposed no-take/restriction areas in the draft management plan. Dale reasoned that some of the best *koa* canoe trees are found in these areas and that prohibiting the take of *koa* within any part of the project area runs counter to the purpose and intent of the KKCMA. He added that clubs/groups already face many difficulties in obtaining a *koa* log thus implementing no-take/restriction areas, within a management area whose primary purpose is for the sustainable harvest of *koa* for *koa* canoes, only adds to the difficulties of perpetuating canoe carving as a traditional cultural practice.

JOHN REPOGLE

A telephone interview was conducted with Mr. John Repogle by ASM staff, Lokelani Brandt on December 6, 2022. Mr. Repogle was born in Laupāhoehoe and moved to Na‘ālahu when he was three years old. He currently resides in Ocean View and is retired from The Nature Conservancy, and currently works as a substitute teacher at Na‘alehu Elementary

School and Pāhala Intermediate and High School. Since 2015, Mr. Repogle has been an active member of the KKCMA Working Group.

Mr. Repogle recalled that shortly after their initial 2015 kickoff meeting, he and other members of the working group made a site visit to the KKCMA. He shared that he had been to the KKCMA in prior years when Aileen Yeh of the Hawaii Agriculture Research Center was investigating the *koa* wilt disease in which they outplanted *koa* in test plots to better understand why some *koa* were being affected and others were demonstrating resistance against this disease.

As far as cultural practices, Mr. Repogle shared that hunting and *maile* gathering are two practices he recalled occurring in the project area and general vicinity. He recalled a story from his childhood in which some kids from Pāhala went hunting on the ranch and got caught by the ranch manager. He added that because of the road around the perimeter of the KKCMA, *maile* pickers very much prefer to gather from this tract. Mr. Repogle recalled garbage bags full of *maile* being extracted from this tract, which for the most part, is sold commercially. He worries that the extensive harvesting of *maile* may be unsustainable.

He reflected that there has always been tension between the hunters and the ranch. More specifically, he shared that in the KKCMA, hunters will sometimes leave the gate open and cattle will go in and graze. He highlighted that the cattle will also eat and destroy plants and sometimes injure the *koa* trees. Mr. Repogle expressed that cattle won't stay in there for long because there is no water source, however, they can sometimes be in the KKCMA for a few days and sometimes weeks. He noted that the issue with cattle entering the KKCMA creates a unique and sometimes difficult dynamic in which there is much finger-pointing between the hunters, the ranch, and the State who often takes a very passive management approach. Mr. Repogle stated that hunters have for many years consistently asserted themselves when it comes to the use of State lands and that the State has consistently given in to their demands. He explained that the use of the forest is a privilege and that the State must hold hunters and the ranch accountable. He added, "everyone must do their part to protect our forest."

Mr. Repogle expressed that the entire perimeter of the project area is fenced, however, it is not hog-proof. He opined that if the State is serious about utilizing this parcel for *koa* canoes, they must install hog-proof fence to prevent the pigs from rooting and digging and damaging the forest and *koa* trees. Mr. Repogle reminded that growing *koa* suitable for canoes doesn't happen overnight, thus proper protective measures such as hog and cattle fencing must be installed and maintained as part of long-term management.

In speaking about the KKCMA's importance and potential, Mr. Repogle lamented that it is a small piece of Ka'ū's vast forest with special status. He acknowledged that although he doesn't have much experience with paddling or the paddling community, he felt that paddlers today don't have a strong connection to the forests. People most often associate paddling with the ocean because that's where it actively takes place, however, Mr. Repogle reminded that without the forest, the *koa* canoes in which paddlers are mandated to use during certain regattas would not exist. He felt it would be valuable to expose the members of *hālau* (canoe clubs) to the forest and help them build a deeper connection to their sport. He strongly believes that the KKCMA can serve as an ancient canoe gathering site where paddlers and our communities can come to learn about the forest.

In talking about his vision for the KKCMA, Mr. Repogle felt that it would be of tremendous value to have a dedicated person who is knowledgeable about the forest ecosystems and *mo'olelo* of this area. He felt that such a person would be able to help coordinate with the various groups. He imagined that *hālau* or other community groups would be able to spend the night at the KKCMA where they could be exposed to environmental education, learn the *mo'olelo* of the area, do outplanting, weeding, and immerse themselves in the forest. He contended that all *hālau* receiving a log from the KKCMA should be required to have some sort of environmental and cultural educational experience. He supposes that perhaps not all *hālau* members would want to do something like this but they should at least be invited and given the opportunity to participate. Additionally, Mr. Repogle asserted that there needs to be some reciprocation or giveback from those *hālau* who receive a log from the KKCMA. He reflected that traditionally, removing a large tree from the forest was a big deal and noted that Hawaiians had rigid protocols for taking *koa* from the forest which sometimes involved human sacrifice in exchange for the tree as a way to replace the *mana*.

Mr. Repogle asserted that it is important for those *hālau* who receive a log from the KKCMA to do more than simply take a tree. Rather, those *hālau* should see themselves as stewards of this area. He felt that *hālau* should be able to experience all parts of the process, from planting, growing, maintaining, log selection, and harvesting. He thought that *hālau* may even help with dragging the log from the forest but noted that the State always has to consider liability. Considering the reuse of any waste when the tree is prepared to become a canoe log, Mr. Repogle contended that it would be valuable to have the carvers there who know how to repurpose any excess wood. In this way, he believes there would be very minimal or no waste of the tree. He felt having an immersive approach would help build capacity for protecting and stewarding our forest resources and build greater appreciation among *hālau* members for the *koa* canoes

they paddle in. Mr. Repogle thought that clubs could be recognized by the lead canoe club organization for their time and efforts in the KKCMA forest, which might encourage other *hālau* to take part. He felt that if *hālau* and the greater community can participate regularly in cultural-environmental educational opportunities, this could make the project far more sustainable. He imagined that if a project of this nature, which incorporated such elements, could be established here in Ka‘ū, then other islands might want to follow suit and establish a similar program on their island or in other parts of Hawai‘i Island. He felt that in this way, the community can actively participate in taking care of these *koa* canoe plots rather than leaving that responsibility solely to the State.

Concerning log allocation, Mr. Repogle shared that if a *hālau* is a recipient of a log from the KKCMA, they should drop to the bottom of the list. He underscored the importance of looking at the log allocation process based on equity. Furthermore, he questioned, “what constitutes a *hālau* being ready to receive a log.” He opined that the Working Group has deliberated extensively about the log allocation process.

In closing, Mr. Repogle stated that there is great potential with this project as it relates to the enhancement and revitalization of Hawaiian canoe making. He shared that when he was first approached with this project back in 2015, there was a lot of excitement and that the Working Group felt very positive about it. However, he noted that as the project unfolded frustration began to build especially with how long this process has taken and how poorly thought out the whole process has been. Despite his frustrations and challenges, Mr. Repogle believes this project, if the State is serious about it, could be very beneficial to Hawaiian canoe practices.

KALĀHO‘OHIE MOSSMAN, EDITH KANAKA‘OLE FOUNDATION

An in-person interview was conducted with Mr. Kalāho‘ohie Mossman on December 13, 2022, in Pana‘ewa, Waiākea, Hilo. Mr. Mossman serves as the *Ilāmuku* (Executive Officer) for the Edith Kanaka‘ole Foundation, a non-profit organization established in 1990 to perpetuate the teachings, practices, and beliefs of the late Luka and Edith Kanaka‘ole.

Born in Kailua, O‘ahu, Mr. Mossman shared that he moved to Hilo in the 1980s to attend college and during that time, he met his wife, Huihui Kanahale, who is the granddaughter of Luka and Edith Kanaka‘ole. When asked about his *pilina* (connection) to Ka‘ū, Mr. Mossman shared that although his *‘ohana* had ties to Ka‘ū, much of his *pilina* comes from his wife’s family, whose *‘ohana* is also from Ka‘ū. He added that Mr. Luka Kanaka‘ole (Grandpa Luka) worked at Kapāpala Ranch for many years where he was born but the *‘ohana* came from the *ahupua‘a* of Keāiwa where there is a family cemetery. In sharing more about what he remembered of his grandfather-in-law, Mr. Mossman recalled that Grandpa Luka had at least two other brothers, Tommy and David. Although he did not know much about Tommy’s life, he added that David also worked and lived on the ranch until he died. Also, Grandpa Luka had a sister, Aunty Api who worked as a cook and nanny on the ranch. Mr. Mossman related fond memories of Aunty Api, especially her talent as a cook. He explained that Aunty Api was known, amongst other things, for her beef stew and desserts. Mr. Mossman described how during his early years with his wife, they had visited the ranch and spent the night there. But because it was “old school style” in which boys and girls had to sleep separate from each other, he laughingly shared that he had to sleep with his wife’s boy cousin on a small bed.

When asked if they ever went to Kapāpala to gather or do any other types of cultural practices, Mr. Mossman described hunting with his wife’s cousin. He noted that they did not gather any trees from there but did hunt occasionally. In sharing more about Grandpa Luka, Mr. Mossman commented that he “taught me a lot” specifically wood carving most of which was done for *hula* implements. He added that Grandpa Luka worked at the prison where he started a woodworking program with the inmates. In sharing a bit more about Grandpa Luka’s *‘ohana*, Mr. Mossman related that Grandpa Luka’s grandparents were killed in the 1868 mudslide, however, Grandpa Luka’s great-great-grandfather, Mokila was a canoe builder. He explained that he had come across an unpublished manuscript written by Mary Kawena Pukui about the Ka‘ū families in which it described Mokila as living at Waikapuna and was a “*mālama i‘a*” or the person who sets the rules regarding fish and fishing.

In speaking more about gathering forest resources, Mr. Mossman laughingly explained that although they hunted in Kapāpala, during those trips he didn’t pay much attention to the forest because they were more focused on the dogs and pigs. However, he went on to share that for *hula* they do gather various forest resources mostly from the Waiōhinu side of the Ka‘ū Forest Reserve. For their *hula* customs, gathering focuses specifically on *kinolau* of certain *akua* (deities) including, *‘olapa*, *‘ie‘ie*, *maile*, and *lehua*. Mr. Mossman added that *palapalai* is another *kinolau* however, they go elsewhere to gather this fern. In addition to gathering certain plant resources for *hula*, Mr. Mossman related that they also gather other plants including *māmaki* and the young shoots of the *hāpu‘u*, which is more for subsistence purposes. He clarified that what they gather does not destroy the tree and that is it very rare for him to kill a tree to build something, rather he prefers to use fallen trees.

In sharing more about wood carving, Mr. Mossman explained that he had trained under three carvers, mainly Alapa'i Hanapī of Moloka'i, Keola Sequeira of Maui who built the sailing canoe Mo'olele and many *ki'i* (wood images), and Ray Bumatay of Hilo who focused mainly on canoes. He added that Mr. Bumatay's sons, Doug and Alika continue to carry out their late father's carving legacy. Talking more about his time with Mr. Bumatay, he shared that, he, Mr. Bumatay along with students from Ke Ana La'ahana Public Charter School carved a canoe at Hale O Lono fishpond in Keaukaha. Mr. Mossman described how they were in search of a log and coincidence or not, a large Norfolk pine growing near the fishpond had fallen right where they were planning to carve the canoe. Thus, they utilized pine for that canoe. Mr. Mossman related that Albizia is a good wood to practice on and elaborated that *koa* may not be the necessary wood for teaching. However, he added there are "strong opinions on the use of *koa*". He stated that there are very few carvers that carve in the "traditional manner" meaning that they used mostly traditional tools and techniques. From his understanding, the sailing canoe Mauloa, which is a smaller sailing vessel was built using traditional techniques and Maulili Dickson would be the one to talk to about Mauloa. In reflecting on the traditional and modern methods of canoe carving, Mr. Mossman felt that with modern tools and techniques, there is far less waste when compared to traditional carving. He explained that traditional carving usually involves chipping out chunks, which are usually discarded, to hollow the canoe. Thus, from a large tree, when the carving is complete, only a fraction of the original tree remains. He added that with modern technology, smaller planks can be laminated thus there is far less waste.

Mr. Mossman explained that if you're going to "push the traditional aspect of using *koa*" one needs to understand that there are a lot of protocols involved. He clarified that traditionally the "*ho'okupu* (offering) is life for life" meaning that a human was sacrificed when a large *koa* was removed from the forest. He felt that today such practices are not going to happen, however, he felt there needs to be proper *ho'okupu* when a tree is removed. In describing other *ho'okupu* that could be used in place of a man, Mr. Mossman shared that a *pua'a* or an *'ulua* were sometimes used as a substitute. He noted, "there is a price to pay when you kill a tree."

In sharing some of his concerns and recommendations, Mr. Mossman expressed that if the State's intentions are true, then the trees within the KKCMA project area need to be "managed very well." He added that trees most suitable for canoes need to be big and straight with minimal rot. He also related the importance of the *'elepaio* bird in helping carvers to determine the level of rot in a tree. One of his concerns is ensuring the trees are properly tracked after they are harvested. He elaborated that "*koa* is big money" and that this is largely driven by "*koa* entrepreneurs." He explained that while many of such people may gather from ranches, their supply is finite and as access to *koa* becomes more difficult, the price goes up. He cautioned that with a project like this which gives exclusive rights to canoe carvers and that specific community, the State is setting a precedent. He cautioned, what happens when traditional weapon makers, bowl turners or others come forward seeking *koa* from the State? While he believes this project is beneficial for canoe carving, he worries that other woodworkers will come forward and question the precedent of this project. Thus, for him, a project of this nature provokes conflicting feelings and is a "double-edged sword." In closing, Mr. Mossman reflected that he is "super grateful for the learning process [carving], but I love the forest" and although he advocates for the perpetuation of traditional cultural practices, he expressed the difficulties in balancing that with conservation efforts.

KATIE KAMELAMELA, PH.D.

On February 2, 2023, ASM staff, Lokelani Brandt conducted a Zoom interview with Dr. Katie Kamelamela. Born on O'ahu, Dr. Kamelamela moved to Hawai'i Island in 2015 while pursuing her Botany Ph.D degree from the University of Hawai'i at Mānoa. Dr. Kamelamela's research has focused largely on understanding historical and contemporary Hawaiian non-timber forest plant gathering practices. She continues this work by advocating for pathways that align the needs of conservation and culturally vibrant communities—a concept she has defined through her research as "...the relative state of Hawaiian cultural health and well-being as indicated by the frequency, intensity, richness, authenticity and pervasiveness of Hawaiian language, cultural practices and the application of Hawaiian world view." She explained that while pursuing her doctorate, she began working with the State of Hawai'i-Division of Forestry where she reviewed their gathering permits. At the time she was conducting her research, the Kapāpala Working Group (KWG) was formed, and she was asked to participate in the KWG meetings as an observer. Thus, Dr. Kamelamela has been active in the proposed project for about eight years.

Although her participation in the KWG is more recent, Dr. Kamelamela shared that her maternal grandfather, Mr. Julian Ahu (Morgan) was born in Pāhala but raised on Kapāpala Ranch during the early 1900s. She added that her grandfather was a part of one of the first graduating classes from Kamehameha Schools (ca. 1891) and after graduating, he became a work hand for Kapāpala Ranch. She recalled her aunty folks visiting the ranch some years ago to see where Grandpa Ahu lived as well as a cemetery located near the ranch house.

When asked about any past or ongoing cultural practices specific to the KKCMA, Dr. Kamelamela related that *maile* gathering is ongoing within the KKCMA. She elaborated that some of the *maile* gatherers are 2nd and 3rd generation

practitioners and have been doing so with the support of Kapāpala Ranch. Dr. Kamelamela spoke extensively about gathering practices and described there being different degrees of “practice” which she explained thusly: the “I like see and try” folks—those who are seeking to learn how to gather but lack the knowledge and personal guidance of how to sustainably harvest; the “occasional gathers”—those who periodically make the trek into the forest to gather and may have some knowledge of how to sustainably harvest, and; the “I make a living gathers a.k.a. commercial gathers”—those who enter the forest regularly and have in-depth knowledge of how to sustainably harvest and are tuned into the subtle changes of the forest. Dr. Kamelamela further explained that even amongst plant or even *hula* practitioners, there are “generalists”—those who have general knowledge about plants—and “specialists”—those who have in-depth knowledge about plants, their life cycles, habitat, relationship to other plants, etc.

Dr. Kamelamela lamented that it’s the rookie—the “I like see and try” group—that causes the most damage to the forest because they lack the knowledge and personal guidance of how to harvest sustainably and appropriately. She added, even with the State-issued gathering permit, anyone can obtain that permit, therefore, it is not an indicator of ones’ gathering knowledge more so that people are gathering. Dr. Kamelamela emphasized that it is through frequency and exposure—*ma ka hana ka ‘ike* (learn by doing)—that people develop into specialists. Thus, she articulated that it is precisely the commercial gathers who have the most intimate knowledge and understanding of the inner workings of the forest. Dr. Kamelamela shared that the commercial gatherers have a “different rate of return” meaning that their livelihood and basic needs are generated directly by their ability to gather *maile*. In contrast, she added, the rookie or occasional gatherer does not face this same economic fate, however, they may develop their spiritual sense of self-worth. Commercial gathers, she explained, must also build their customer service skills and be reliable so they can continue to serve their customer base. In essence, because of their frequency into the forest, Dr. Kamelamela added, the commercial gathers’ ability to read the nuances of the forest is incomparable to the rookie or novice gatherers. Lastly, she noted that although commercial gatherers may sell a large portion of their *maile*, many of them are also known to donate their pickings to others in the community whether that be for family functions or events.

Another example here can be experiences between recreational and subsistence pig hunters. When your livelihood and/or identity of self is defined by successful production, harvest, and processing of natural resources for community, levels of observation deepen because you are dependent on the resources, physically, culturally, and economically. Many people show their *aloha* through providing food, *lei*, and stories of and from the forest in lieu of monetary exchange. These exchanges build and strengthen social networks and the cultural fabric of our island. In order to become someone with a deepened relationship, you have to go through the rookie phase. There are more people learning than who are masters, as in any profession, art, or market. Dr. Kamelamela, through her research experiences, has been the rookie in many arenas of forest gathering and although far from a master, is able to provide support through learned forest mistakes, lessons, skills at community gatherings such as *lei* making and building *imu*.

When asked about her thoughts on the proposed project, Dr. Kamelamela felt that it is a novel idea and that the current project initiatives are intended to develop a process for gathering *koa* from the KKCMA. She explained that the State has a list of log requests which is sorted by forest reserve but she does not know how many groups/individuals are currently on the Kapāpala list. She felt that some of the biggest challenges right now with this project is 1) the steepness of the terrain within the KKCMA; 2) the protocol for harvesting the logs; 3) ensuring non-racing canoe (i.e. fishing and voyaging) groups/individuals have equitable access to logs from the KKCMA. Dr. Kamelamela reflected that the project is a good idea in theory and intention, however, she felt *minamina* (expressing regret, grief, sorrow) in that the process has become unnecessarily complicated. In thinking about recommended actions for challenges 1 and 2, Dr. Kamelamela felt that it would wise for DOFAW to develop clear protocols for harvesting the logs that would include having a list of approved harvesters rather than leaving that decision to the clubs. Concerning challenge 3, she shared that there is a cost for making a canoe, so in all honesty, it is really simple in that clubs either have the funds or don’t.

In talking through some of the other challenges that have arisen during this process, Dr. Kamelamela spoke about the tensions that develop when contemporary conservation practices intersect with traditional Hawaiian beliefs and practices. For example, she pointed to the prior discussions about harvesting the logs and the potential impacts on native bird populations and plants. She explained that when it comes to “impacting the forest” the conservationists’ approach is albeit, reluctant and fearful, thus the solution is often to restrict or prohibit access. However, from a traditional Hawaiian standpoint, we want to “impact” the forest and it is precisely these beliefs and practices that challenge contemporary conservation practices. She emphasized, yes when a tree is felled, it will impact other plants, however, these impacts are inconsequential. Dr. Kamelamela added, when a tree, however, small or large is felled and dragged out of the forest, that process scarifies the land and catalyzes the regeneration of new forest growth that would otherwise not occur. She stressed, for the KKCMA harvesting process, the priority concern should be human safety. She elaborated that these sometimes competing narratives, can create *hakakā* (strife, dispute, arguments) between Native Hawaiians

and conservationists, however, this is and should not be the goal. To combat this tension, she felt that both sides must get ahead of the narrative and reenvision a path forward.

Dr. Kamelamela opined that her mission has been to “uplift the relationships that Native Hawaiians have to plants.” If the proposed project is to be “successful,” there needs to be a shift in understanding. She emphasized that measuring the success of this project should not be based solely on the number of canoes built from the logs harvested from the KKCMA, rather success should also be measured by other indicators such as are people’s relationship and engagement with the forest improving; and, if we happen to fail at any metric, “we learn, do better” and keep on with the work.

In looking to the future, Dr. Kamelamela felt it important that DOFAW provide adequate support so that people can access the forest as this will reduce potential impacts on the community and resources. She highlighted the importance of having a dedicated person or staff for the KKCMA. She added that if DOFAW is serious about this project, they need to lobby at the legislature to get a new position. She noted that currently there is no formal administrative infrastructure to support any of the activities proposed for the KKCMA and remarked that it’s all too common for agencies to want to “do Hawaiian things but don’t want to fund it.” She felt that the lack of dedicated staff will only lead to confusion among DOFAW and the community. Lastly, Dr. Kamelamela noted that because the log request application process is brand new, it must be beta tested to uncover any issues or discrepancies before being launched.

4. IDENTIFICATION AND MITIGATION OF POTENTIAL CULTURAL IMPACTS

The OEQC guidelines identify several possible types of cultural practices and beliefs that are subject to assessment. These include “...subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs” (OEQC 1997:1). The guidelines also identify the types of cultural resources, associated with cultural practices and beliefs that are subject to assessment. These include other types of historic properties, both man made and natural, submerged cultural resources, and traditional cultural properties. The origin of the concept and the expanded definition of traditional cultural property is found in National Register Bulletin 38 published by the U.S. Department of Interior-National Park Service (Parker and King 1998). An abbreviated definition is provided below:

“Traditional cultural property” means any historic property associated with the traditional practices and beliefs of an ethnic community or members of that community for more than fifty years. These traditions shall be founded in an ethnic community’s history and contribute to maintaining the ethnic community’s cultural identity. Traditional associations are those demonstrating a continuity of practice or belief until present or those documented in historical source materials, or both.

“Traditional” as it is used, implies a time depth of at least 50 years, and a generalized mode of transmission of information from one generation to the next, either orally or by act. “Cultural” refers to the beliefs, practices, lifeways, and social institutions of a given community. The use of the term “Property” defines this category of resource as an identifiable place. Traditional cultural properties are not intangible, they must have some kind of boundary; and are subject to the same kind of evaluation as any other historic resource, with one very important exception. By definition, the significance of traditional cultural properties should be determined by the community that values them.

It is however with the definition of “Property” wherein there lies an inherent contradiction, and corresponding difficulty in the process of identification and evaluation of potential Hawaiian traditional cultural properties, because it is precisely the concept of boundaries that runs counter to the traditional Hawaiian belief system. The sacredness of a particular landscape feature is often cosmologically tied to the rest of the landscape as well as to other features on it. To limit a property to a specifically defined area may actually partition it from what makes it significant in the first place. However offensive the concept of boundaries may be, it is nonetheless the regulatory benchmark for defining and assessing traditional cultural properties.

As the OEQC guidelines do not contain criteria for assessing the significance of traditional cultural properties, this study will adopt the state criteria for evaluating the significance of historic properties, of which traditional cultural properties are a subset. To be significant the potential historic property or traditional cultural property must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

- a Be associated with events that have made an important contribution to the broad patterns of our history;
- b Be associated with the lives of persons important in our past;

4. Identification and Mitigation of Potential Cultural Impacts

- c Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;
- d Have yielded, or is likely to yield, information important for research on prehistory or history;
- e Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity.

While it is the practice of the DLNR-SHPD to consider most historic properties significant under Criterion d at a minimum, it is clear that traditional cultural properties by definition would also be significant under Criterion e. A further analytical framework for addressing the preservation and protection of customary and traditional native practices specific to Hawaiian communities resulted from the *Ka Pa‘akai O Ka ‘Āina v Land Use Commission* court case. The court decision established a three-part process relative to evaluating such potential impacts: first, to identify whether any valued cultural, historical or natural resources are present and/or past or ongoing traditional customary practices; and identify the extent to which any traditional and customary native Hawaiian rights are exercised; second, to identify the extent to which those resources and rights will be affected or impaired; and third, specify any mitigative actions to be taken to reasonably protect native Hawaiian rights if they are found to exist.

SUMMARY OF CULTURAL-HISTORICAL BACKGROUND INFORMATION

In summary, the KKCMA is situated in the forested uplands of Kapāpala Ahupua‘a, a vast land division that at one time included all of Keauhou Ahupua‘a. The project area sits at the upper fringes of the *wao ama‘u/wao kanaka* and extends through the *wao nahele/wao lā‘au* into the *wao akua*. Although Handy and Pukui (1998) cautioned that *wao* were not fixed to any particular altitude, they did highlight the type of vegetation and activities that occurred in these liminal spaces. At the lower elevations, plants such as ferns and small trees prospered and *kalo*, particularly those varieties requiring more water, were sometimes cultivated in these areas. Other plants that were sometimes cultivated in these areas included *mai‘a* (bananas), *uhi* (yams), *pia* (arrowroot), and *hāpu‘u* fern, which based on Handy and Pukui’s description, appears to have been allowed to grow wild, rather than intensely cultivated. Further upslope was the heavily forested *wao* where great *koa* and *‘ōhi‘a* dominated the landscape—a realm sanctified by the *kini akua* (myriad gods) who dwelled therein.

The historical records indicate that forested spaces were integral to the traditional lifeways of Ka‘ū’s native people. Forest landscapes persist today as a highly valued cultural resource because native forests have and continue to provide the foundational resources and *mana* necessary to sustain many Hawaiian customary practices. While early Hawaiian settlers brought with them important food and medicinal plants, those resources they harvested from Hawai‘i’s native forest evidence their cultural adaptations to this environment or were, altogether, uniquely Hawaiian inventions. Timber provided a variety of hardwoods from which canoes, houses, *ki‘i* (carved images), fishing accessories, musical instruments, weapons, and various utilitarian and recreational items were made. Aerial roots were harvested and plaited together to form tightly stitched *‘ie* (baskets). Ferns and vines were collected and woven into *lei* or tucked into *kapa* (bark cloth) as a scenting agent. Flowers, vines, and fruits were collected for *lei*, natural dyes, and sometimes mixed with other plants and minerals to make medicinal concoctions. The forest itself also holds profound spiritual importance as various plants found in the forest are *kinolau* (embodiments) of named deities. Because of its spiritual significance, the forest was and continues to be revered, especially by those practitioners (i.e. *hula* practitioners, *lei* makers, canoe carvers, *lā‘au lapa‘au* practitioners, etc.) whose customs and practices are highly dependent upon the forest.

The traditional *mo‘olelo* that make explicit reference to Kapāpala, which have been handed down over the ages, carry significant symbolism and insight that must not be disregarded or diminished. These stories are a frank reminder of Pele’s presence on this *‘āina*, her role as both *akua* and *‘aumakua* to the people of Ka‘ū and the neighboring districts of Puna and Kona. Native and foreign writers also reference the many lava flows that affected Kapāpala with that one from 1868, perhaps inflicting the most destruction across the district. These *mo‘olelo* tell us of Pele’s capacity to drive out or exterminate those who dare to defy her power and supremacy including Kamapua‘a, Puna‘aikoa‘e, Waka, and the chief Kapāpala who defiantly surfed her molten lava but was as once swallowed into the pit of Halema‘uma‘u. The *mo‘olelo* of Nānaele, among other things, tells us of an underground cave system spanning between Ka‘ālaiki and Kapāpala that was used as a passageway by the ancient people. Lastly, the *mo‘olelo* concerning the battle between Pele and Waka, a *mo‘o* deity whose form is synonymous with bodies of water, informs us of the presence of freshwater resources in the uplands (i.e. waterholes and springs).

Historical records identifying specific *ali'i* of Kapāpala are limited, however, these records do illustrate a rich lineage of district *ali'i* including those of the famed 'Ī-genealogy whose political power eventually extended outward from Ka'ū into Puna, Hilo, and portions of Hāmākua. The reign of the 'Ī line of chiefs lasted for several hundred years from at least the reign of Keawenuia'umi when he appointed Kumalaenui a 'Umi as a district chief down to Keōuakū'ahu'ula, who stood as Kamehameha I's last rival. We know that during the reign of Lonoikamakahiki, when Kamalālāwalu of Maui attempted to invade Hawai'i Islands, Lonoikamakahiki's brother Pupukeya was residing at Kapāpala. It was Pupukeya who led his vast army through 'Ōhaikea in Kapāpala until they reached Waimea. During Keōuakū'ahu'ula and Kamehameha's long-standing feud, they carried out the battle known as Kaua Kaua'awa or "Battle of the Bitter Rain" in Kapāpala. Lastly, it was at Kapāpala that Keōua lost about 400 of his warriors to an ash fallout while returning home from a battle in Waimea.

Whereas Ka'ū's *ali'i* history tells us of the powerful 'Ī clan and their staunch resistance against the political forces of Kona and Kohala, other historical records inform us of other progenitors of the Ka'ū families who took non-human forms. One such example is Kūa, the famed *manō* who was also an *'aumakua* and protector of the district. Other noted *manō* of Ka'ū included Kealiikaua, Kalani, Kahole[i]akane, Kane, Haloa, Humeke, and Mikololo. In addition to the *manō*, some Ka'ū families traced their lineage to certain plants and animals including the *ipu 'awa'awa* and the *'enuhe*.

From the historical information presented above, we know the upland *koa* forest of Kapāpala was traditionally utilized for *kālaiwa'a* (canoe making), *kia manu* (bird catching), and *māmaki* cultivation. Use of the upland forest for canoe-making is evidenced in Lyman's 1846 visit when he observed canoe-making sheds as well as the testimony provided by Kenoī during the 1873 Boundary Commission hearings in which he described a *piha kauhale kālaiwa'a* near Pu'ūhoakalei. From these narratives, we learn that canoe-making sheds were established in the forest along with settlements for *māmaki* cultivation. The Boundary Commission testimony also identified bird catching in Kapāpala's forest, specifically for the now-extinct *'ō'ō* (*Moho nobilis*) and *mamo* (*Drepanis pacifica*). The capture of other avian resources was also noted including *'ua'u* and *nēnē*, however, according to the Boundary Commission Testimony, these resources were allocated for the people of the neighboring Ka'ala'ala Ahupua'a. The Boundary Commission hearings also described trails along Kapāpala's boundaries as well as the 'Ōhaikea and 'Ainapō trails used during episodic battles. During the Historic Period following the introduction of the market economy, the forest of Kapāpala was exploited for the prized *'iliahi* and *pulu*.

We also learn of some of Kapāpala's *konohiki* including Tapuahi, who was there in 1823 when Ellis made his visit. Another *konohiki*, Kuihelani, was identified by Kaonohi, the *kama'āina* who was born around 1795 and provided testimony in 1873 to settle the boundary of Kapāpala.

By the mid-19th century, during the historic *Māhele 'Āina*, Kapāpala was claimed by the then-reigning monarch, Kamehameha IV as Crown Lands, which suggests the importance of this land to Hawai'i's *ali'i*. There are no known *kuleana* claims for Kapāpala. Although the *Māhele* was meant to provide native tenants with fee-simple parcels of land, it also resulted in the commodification of the land and facilitated the process by which foreign interests could purchase land. However, because of Kapāpala's unique Crown Land status, the king held supreme authority over all land use activities. By 1860, Frederick S. Lyman established the first small ranch in Kapāpala. Lyman's ranch was subsequently acquired by Hilo businessmen, Charles Richardson and William H. Reed who expanded Lyman's ranch by co-leasing the entire Kapāpala Ahupua'a from King Kamehameha IV to form their joint venture, Kapāpala Ranch.

With a lease from the King, Kapāpala Ranch, which extended from the shoreline to the uplands to the summit of Mauna Loa, grew to be one of the largest (next to Kahuku Ranch) and longest operating ranch in Ka'ū. Over the decades, the ranch expanded to include some 200,000 acres (and over the years has decreased in acreage) and managers experimented with a variety of crops and animals in addition to producing meat, cream, butter, wool, and *pulu* which were exported. When Reed married Jane Stobie Shipman in 1868, Reed gained three step-children, one of which, William "Willie" Herbert Shipman, would help Reed manage the day-to-day operations during the early 1870s. The ranch also gained notoriety from the many and sometimes weary visitors who stopped or stayed at the ranch house while making the trek from Kīlauea to Ka'ū. In October of 1876, Reed sold the ranch to Charles R. Bishop for \$75,000 and after just two months, Bishop sold the ranch for \$120,000 to the Hawaiian Agricultural Company (C. Brewer Co.)—a company which Bishop cofounded.

By 1877, the Hawaiian Agricultural Company, whose focus was primarily on sugar production, took ownership of the ranch. They grew sugarcane in isolated pockets on the ranch where soil conditions were most suitable (*makai* of the project area), however, livestock production remained at the heart of the ranch's operations. Throughout the ranch's history, drought conditions—sometimes prolonged—disrupted its operations. By the end of the 19th century, Hawai'i's agricultural sectors along with the government began to recognize the importance of Hawai'i's forest in providing water for household consumption and ranching but more importantly sugar production—which at that time was Hawai'i's

largest economic industry. The combined effects of drought, forest clearing for sugar fields, water diversion, wildfire, along with indiscriminate pasturing were adversely impacting water resources across the islands.

In 1892, the government established the Bureau of Agriculture and Forestry to oversee Hawai‘i’s agricultural industries and forests. The Bureau’s primary focus was on livestock but they also implemented programs to work with private landowners to create forest reserves and control wild goats and cattle. By 1903, following the unlawful overthrow of the Hawaiian Kingdom government in 1893 and the establishment of the Territorial Government in 1900, the territorial legislature with the influence of sugar plantation owners established the Board of Agriculture and Forestry with Ralph S. Hosmer hired as the first Superintendent of Forestry. By 1906, with the urging of the Hawaiian Agricultural Company and other Ka‘ū plantations, some 75,000 acres in eastern Ka‘ū were set aside to create the Ka‘ū Forest Reserve. Three years later, by proclamation, the Ka‘ū Forest Reserve was expanded to include a tract in Kapāpala, whose northeasternmost boundary borders the project area and along which a trail identified in the 1921 and 1924 USGS (see Figures 27 and 28) maps as “forest boundary trail” extends. During this period, Kapāpala Ranch, under the management of Julian “Mauna Kea” Monsarrat, utilized the lower portion of the project area for cattle grazing.

By the 1920s, the ranch’s acreage had shrunk to about 75,000 acres and extended from sea level to about the 6,500-foot elevation. After Monsarrat’s tenure in 1923, management of the ranch was headed by Bradford “Haole” Sumner. Sumner transitioned the ranch’s water system from rainfed to pipelines when he led the construction of a water tunnel in the uplands and installed about 25 miles of pipelines to bring water down to the lower pastures. By October of 1930, by the proclamation of the Governor, 37,416 acres of land in Kapāpala extending above the 5,000 feet elevation and bounding the project area’s *mauka* boundary was established as the Kapāpala Forest Reserve. During this period, 1,151 acres comprising much of the central and lower sections of the project area were part of the ranch’s Yamaoka Paddock No. 1, whereas the upper portion of the project area was within the Ainapo Mauka Paddock.

By 1967, the unpaved road that cuts across the project area in a north-south orientation was built. In 1975, C. Brewer (the successor of the Hawaiian Agricultural Company), was looking to withdraw from the livestock business (and did not renew their lease with the State of Hawai‘i—the agency charged with managing much of Hawai‘i’s Crown Lands) and sold the ranch to Parker Ranch. Operating on a revokable permit issued by the State of Hawai‘i, the sheer size, rugged terrain, and much-needed repairs, motivated Parker Ranch to withdrawn its interest in Kapāpala Ranch. In 1977, John “Gordon” Cran secured a farm loan and added his name to the revokable permit, thus making him the owner of Kapāpala Ranch. Cran managed some 30,000 acres and oversaw much of the day-to-day operations. Around 1989, with the support of Cran, the project area was removed from the ranch’s acreage and in 2009 was established as the Kapāpala Koa Management Area of the Ka‘ū Forest Reserve. By the early 1990s, challenges with the State’s permit renewal process coupled with increasing rent made operating the ranch difficult. To alleviate some of these challenges, Cran’s daughter, Lani, and her husband Bill Petrie worked part-time on the ranch all while holding jobs outside of the ranch. Cran and his wife, Genevieve (Bertlemann) continued to run the daily operations and just before Cran’s passing in 2007, he formed a partnership with his wife and daughter. After Genevieve Cran died in 2016, the ranch passed to Lani and Bill, who continue to uphold her father’s legacy as stewards and owners of Kapāpala Ranch.

IDENTIFICATION OF TRADITIONAL AND CUSTOMARY PRACTICES, VALUED CULTURAL RESOURCES

The information from the culture-historical background information in conjunction with the results of the consultation process revealed the following with respect to traditional and customary practices and valued cultural resources.

Forest Resources and Harvesting of Avian and Plant Resources

Kapāpala’s forest and all of its tangible and intangible elements have been and continue to be recognized as a valued cultural resource. The forests of Kapāpala have for many generations been accessed for a variety of avian and plant resources. The harvesting of native birds for subsistence and artisanal purposes was an important part of certain traditional practices (Gomes 2016). Perhaps, the most famed traditional use of native birds involved the use of their feathers from which spectacular royal insignia including *ahu‘ula* (feathered cape), *mahi‘ole* (feathered helmet), *lei* (garland), *kāhili* (feathered standard), and other adornments were intricately crafted. Although the capture of native birds, including *nēnē*, *‘ua‘u*, *‘ō‘ō*, and *mamo* is no longer practiced, *nēnē* was identified by one of the consulted parties as still occurring on the ranch and likely in the project area. Traditional plant gathering practices that were identified through the historical record included *koa* harvesting for canoes, *‘iliahi*, *māmaki*, and *pulu*. The majority of the consultees also identified *maile* gathering as an ongoing cultural practice that takes place in the project area.

Kālaiwa‘a and Māmaki Cultivation Settlement

The historical records indicate that settlements (*kauhale*) specifically for *kālaiwa‘a* and *māmaki* cultivation were established in the forested areas of Kapāpala. Although the location of such settlements cannot be accurately determined from the available records, we know that there was a *kauhale kālaiwa‘a* at Pu‘uhoakalei near Keauhou. While the forest environment does not lend well to the preservation of organic matter, if stone features were constructed as part of these forest settlements, identifying surface remnants of such settlements through an archaeological survey is possible. Historians who wrote about canoe carving have also noted that sometimes the carving areas were more temporary in nature and were preferably located near a water source.

Trails

Historical maps reviewed as part of this study identified a trail that extends along the southern boundary of the project area and the northeastern boundary of the Ka‘ū Forest Reserve (see Figures 29 and 30). The date in which this trail was established is unclear from the records reviewed in this study. However, an analysis of the historical maps included in this study shows that the boundary of the forest reserve may have been adjusted around the 1920s as early maps define the forest reserve boundary with a relatively straight line, and later maps show the boundary following the curvature of the “forest boundary trail” (see Figure 28). This trail connected with the network of other trails in Kapāpala, including the historic Mauna Loa and ‘Āinapō trails, both of which lie outside of the current project area and were utilized during the Precontact and Historic periods. Given the unusual curvature of the Ka‘ū Forest Reserve boundary, it is hypothesized that this trail may have been built when the boundaries of the forest reserve were formalized or that the forest reserve boundary followed a preexisting trail.

Caves

The *mo‘olelo* of Nānāele identified a cave system that reportedly extended from Ka‘ālaiki to Kapāpala, specifically “a spot back of the Kapāpala stock ranch.” Furthermore, in the battle of Kaua‘awa, upland caves were used as a temporary refuge. Although the cave noted in the story of Nānāele is likely not within the project area, caves, which have historically been used for refuge or temporary shelters may be present in the project area.

Water Resources

Historical *mo‘olelo* namely that one involving Pele, Waka, and Puna‘aikoa‘e as well as historical maps have identified valued water resources in the vicinity of the KKCMA project area. Waka’s (who manifested as a *mo‘o*) passage through Kapāpala informs us of the presence of upland water resources and historical maps have identified several water holes in the vicinity of the project area including “Koiki Waterhole” (see Figure 31) located near the northern boundary in the upper portion of the project area, and another unnamed “Waterhole” further west outside of the project area. Based on the available maps, these two water resources are outside of the KKCMA project area. However, such resources, which have may have not been documented, may be present within the project area.

Ranching

Since the 1860s, ranching has been occurring in Kapāpala and by the turn of the 20th century until the 1900s was occurring in the project area. Although ranching is not considered a traditional cultural practice per se, it is recognized as an important Historic era practice and industry and is a big part of Hawai‘i’s history. Since the establishment of the KKCMA in 1989, ranching activities have ceased, however, ranching persists as an ongoing practice in the vicinity of the KKCMA. One of the consulted parties continues to work and manage Kapāpala Ranch and the remaining consulted parties shared their memories of the ranch or horseback riding in the area.

Hunting

Subsistence hunting was identified by several of the consulted parties as a practice that is ongoing within the KKCMA as well as within the adjacent forest reserves and sometimes illegally on the ranch. Like ranching, hunting feral pigs, as well as other game, whether for subsistence or sport is not considered a traditional cultural practice per se (see Appendix B for Maly et al. (n.d.) for discussion on the traditional role of pigs and the practice of hunting feral swine in modern Hawai‘i). As put forth by Maly et al. (n.d.:4):

The *pua‘a* plays an important role in Hawaiian history; from their early position as a domesticated food source and important cultural symbol, to their more recent role in recreational and subsistence hunting, they have become a part of local culture...As with all resources, proper management and application is the key to maintaining balance.

Game hunting, nonetheless, remains an integral practice to those families who rely on the meat for subsistence purposes.

RECOMMENDATIONS AND CONCLUSION

It is evident from the information presented above that the upland forest of Kapāpala has been utilized since the Precontact and Historic periods for a variety of practices one of which included the harvesting of *koa* for the construction of *koa* canoes. All of the consultees unanimously felt that the sustainable harvest of *koa* from the KKCMA for the construction of *koa* canoes used customarily for fishing, outrigger canoe racing, and voyaging would likely net positive impacts on the customary practice of *koa* canoe making. Furthermore, nearly all of the consulted parties spoke about the importance of responsible human interaction and management with forest resources as a way to mitigate further loss and improve connection and respect for such spaces.

The harvesting of *koa* for the construction of *koa* canoes has for many generations persisted quietly. In speaking with carvers who have the knowledge and capacity to transform a log into a useable canoe, they expressed sincere concern about canoe carving as a dying art with just about a handful who continue to practice. They spoke about the challenges of obtaining a suitable log and having to work with various landowners, all of whom impose different restrictions on the carvers. Because of the difficulties in obtaining a suitable *koa* log, the carving of a canoe is often left to the experts with little room to include upcoming carvers who so very much need experience in working with *koa*. We must remember that Hawai'i's *koa* forest has for hundreds of years sustainably furnished native carvers with the materials needed to make canoes. It was precisely the canoe that allowed early Polynesian voyagers to cross vast oceans and establish Hawai'i as their permanent home. The canoe allowed them to travel from place to place around these islands, engage in inter-island warfare, and procure food from the shallow and deep seas. Its importance in Hawaiian culture cannot be understated. Thus, our actions today, or lack thereof, will play a role in the future of this practice.

While the overall goal of the project is promising for the perpetuation of traditional *koa* canoe-making, the methods and processes by which this project is implemented must be thoughtfully considered. It is in these actions that potential impacts on cultural resources and traditional customary practices can occur—including the practice it is intended to support. Given that this is the first project of this nature in Hawai'i, the State must explore traditional and non-traditional methods of forest management. New partnerships must be forged, existing partnerships improved, and strategies for sustainable funding to manage the KKCMA must be sought. For a project of this nature, DLNR-DOFAW must draw upon traditional and scientific knowledge equitably to strike a balance that will sustain the resources, including *kānaka* on this *ʻāina*. The following recommended actions are intended to prevent or mitigate any potential impacts on the above-identified valued resources and cultural practices.

Dedicated KKCMA Staff

As noted by nearly all of the consulted parties, to properly steward the KKCMA, it is strongly recommended that DLNR-DOFAW seek the appropriate avenues and funding to hire at least one full-time staff member dedicated to managing the KKCMA and other relevant activities. Taking such actions would ensure there is adequate support to facilitate access into the KKCMA, reduce potential impacts to the area's resources and associated practices, and reduce any potential confusion among DLNR-DOFAW and the community.

Archaeological Survey

To identify and protect historic resources that may be located in the KKCMA project area, it is recommended that an archaeological survey be conducted. An archaeological survey of the entire property is preferable, however, such surveys may be conducted incrementally. DLNR-DOFAW must consult with the DLNR-State Historic Preservation Division to determine the proper scope of the survey area. At a minimum, an archaeological survey should be undertaken once a potential harvest area is defined and before any harvesting activities are carried out. This recommended action will ensure any historic resources (i.e. potential settlements, caves, trails, or ranching era resources), potentially located within the harvest area are properly identified, documented, and protective measures are implemented. Areas, where historic resources are identified, should be demarcated on a map and made identifiable in the field. Efforts should be made to preserve in place all historic resources that may exist in the KKCMA project area.

Use of Traditional Place Name

As noted by one of the consulted parties, efforts should be made to utilize the traditional place names. The authors of this study also recommend that Hawaiian environmental zones (*wao*) also be utilized. Such traditional names should be utilized throughout planning documents. If there are plans to erect any sort of auxiliary facility or develop any special program(s) to aid in the management of the KKCMA, it is recommended that the traditional place names be utilized and

incorporated into such efforts. Proper utilization of place names and perhaps even the names of former *konohiki* is one way to ensure the place-based knowledge of Kapāpala is carried forth into the future.

Improve Fencing

Although cattle fencing currently demarcates the perimeter boundary of the project area, it is recommended that DLNR-DOFAW improve fencing to prevent or limit feral pigs from entering the KKCMA. This action will improve the protection of the KKCMA forest and prevent or limit unwarranted destruction to the forest.

Education and Stewardship Opportunities

The development of educational and stewardship opportunities was one of the most prevalent themes that emerged from the consultation process. For a project of this nature, such opportunities could help with both the short and long-term success of the KKCMA by building community support and stewardship capacity. It is recommended that the State:

- Partner with a reputable organization(s) that has the capacity to carry out such activities; that this organization is a Ka‘ū-based organization or at the very least, be well acquainted with the resources and Ka‘ū community.
- Develop an educational plan that promotes both short and long-term cultural and environmental education and stewardship specific to Kapāpala and Ka‘ū.
- Allow for community involvement in educational and stewardship opportunities.
- Strongly encourage or even require *hālau* who receive logs from the KKCMA to participate in such educational and stewardship activities.
- Stewardship activities should consider some elements of silviculture treatments to ensure the *koa* trees growing within or may be replanted within the KKCMA are cultivated in a way that makes them suitable for canoes.

DLNR-DOFAW and the organization may help to seek both internal and external funding to support such efforts.

Reciprocation

As articulated by several of the consulted parties, an appropriate form of reciprocation is strongly recommended. Traditionally, the removal of *koa* from the forest was a significant undertaking that required proper protocols and offerings. Reciprocation can take many forms including strongly encouraging or requiring those *hālau* who receive a *koa* log from the KKCMA to provide some form of give-back. This could include but is not limited to making culturally appropriate offerings, participating in educational opportunities, and encouraging *hālau* to assist with stewardship activities to help care for the forest resources.

Formalize the Existing KKCMA Working Group or Establish Another Working Group

It is recommended that DLNR-DOFAW consider formalizing the existing Working Group or establishing a new working group that would help consistently guide the implementation portion of the project. Such a working group, amongst other things, can help ensure appropriate cultural protocols are being followed and advise on any planned education and stewardship activities. Such a working group could consist of carvers, *kūpuna* and *kama‘āina* of Kapāpala and Ka‘ū, canoe clubs, and other stakeholders.

Repurposing Inadvertently Destroyed or Damaged Vegetation

If during the harvesting process, certain native plant specie(s) are inadvertently destroyed or removed in such a way that the plant may not survive, DLNR-DOFAW should consider 1) gathering seeds or cuttings (if available) from that plant for propagation and replanting; and or 2) identify practitioners or Hawaiian cultural groups who may be able to utilize or repurpose that plant for other cultural uses.

Coordinate Harvesting Efforts

To prevent or limit unnecessary impacts on the valued forest resources, it is recommended that the harvesting of *koa* from the KKCMA be properly coordinated. Thought should be given to seasonal changes and bird nesting seasons. Given the topography of the access roads, which are subject to erosion, especially during the wet months, harvesting should be limited to the dry months to prevent machinery from skidding off the road and potentially causing damage to the forest. Coordinating all harvesting efforts to a particular time of the year will ensure there is minimal disruption to other planned (i.e. education or stewardship activities) or unplanned (subsistence or commercial gathering) activities and will allow the forest to rest and regenerate until the next harvest. Furthermore, when harvesting is to occur, hunting and any other activities in the project area should be temporarily suspended to prevent injury. The timeframe for

harvesting should be developed in such a manner that it does not significantly disrupt other planned or unplanned activities. Ample notice should be posted at the entrance into the KKCMA and any other outlet notifying the public of any temporary suspension and planned harvesting activities.

Conclusion

In summary, the culture-historical background, consultation, and recommendations provided above are intended to ensure the activities associated with the KKCMA project do not adversely impact any of the above-identified valued cultural resources and traditional customary practices. While none of the consulted parties expressed any strong opposition to the proposed project, the concerns, and recommendations offered above are intended to help DLNR-DOFAW remain mindful of the cultural, social, and environmental uniqueness of this *'āina*. Conducting background research, consulting with community members who so willingly gave their time and knowledge, and recommending practical actions to mitigate any potential cultural impacts are done so with the utmost *aloha*, for both the land and the people whose heritage is intimately connected to this landscape. If DLNR-DOFAW assumes ownership of their *kuleana* to implement the KKCMA project, we recommend that it be done so in the same spirit and practice. Failure to consider and implement the above-described recommendations has the potential to adversely impact the above-identified valued cultural resources and traditional customary practices. Likewise, a no-action alternative has the potential for further degradation and loss of the forest resources and the associated traditional customary practices occurring in the project area.

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APPENDIX A. KA WAI OLA PUBLIC NOTICE

**CULTURAL IMPACT ASSESSMENT:
KAPĀPALA KOA CANOE
MANAGEMENT AREA, KA'Ū
DISTRICT, HAWAII ISLAND**

On behalf of the Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW), ASM Affiliates is preparing a Cultural Impact Assessment to inform an Environmental Assessment (EA) being prepared for the Kapāpala Koa Canoe Management Area located on Tax Map Key (TMK) (3) 9-8-001:014, Kapāpala Ahupua'a, Ka'ū District, Hawai'i Island. The primary purpose of this management area is to provide for the sustainable supply of koa (Acacia koa) trees for the construction of traditional koa canoes. Secondary management objectives include native forest and watershed protection, protection of forest bird habitat, collaboration with educational and community groups, and access for certain recreational activities.

ASM is in search of kama'āina (persons who have genealogical connections and or are familiar from childhood with the 'āina) of Kapāpala or practitioners specializing in kālaiwa'a (canoe carving). ASM is seeking information about the area's cultural resources and or cultural uses of the project area; and past and or ongoing cultural practices that have or continue to occur within the project area. ASM is also seeking input regarding strategies to prevent or mitigate potential impacts on culturally valued resources or traditional customary practices. If you have and are willing to share any such information, please contact Lokelani Brandt, lbrandt@asmaffiliates.com, phone (808) 969-6066, mailing address ASM Affiliates 507A E. Lanikaula Street, Hilo, HI 96720. Mahalo.

APPENDIX B. PIGS IN HAWAI‘I, FROM TRADITIONAL TO MODERN (MALY ET AL. N.D.)

Pigs in Hawai‘i, from Traditional to Modern

Kepā Maly, Benton Keali‘i Pang, Charles Pe‘ape‘a Makawalu Burrows

It is well documented that feral pigs ranging through Hawaii’s upland forests today bear little physical or cultural resemblance to the smaller, domesticated pigs brought to the islands by voyaging Polynesians. It remains a popular misconception that pigs are native to Hawaiian forests and that pig hunting was a common practice in ancient Hawai‘i. This paper will briefly compare the traditional role of pigs in Hawaiian culture with the largely western practice of hunting feral swine in modern Hawai‘i today.

Origins and traditional relationships

Pigs are not native to Hawai‘i. The first pigs were brought to the Hawaiian Islands by Polynesians as early as the fourth century A.D.ⁱ Skeletal remains of pigs and recorded traditional knowledge sources indicate that *pua‘a* (the Polynesian pig) was a much smaller animal than the feral pigs of today.ⁱⁱ Historical evidence and genetic studies trace the ancestry of these animals to wild Asiatic swine (*Sus scrofa* subsp. *vittatus*).ⁱⁱⁱ

Originally, *pua‘a* enjoyed a close relationship with their human families and rarely strayed far from the *kauhale* (family compound).^{iv} Well developed taro and sweet potato agriculture in ancient Hawai‘i was incompatible with uncontrolled pigs, and there is every indication that pigs were both highly valued and carefully managed sources of protein. *Pua‘a* were an integrated part of Hawaiian households, and the common presence of *pa pua‘a* (pig pens) reflects the controlled, physically compartmentalized nature of pig management in traditional Hawai‘i.^v

Notwithstanding, small populations of loosely controlled and free-roaming animals existed in ancient times. Traditional and historic evidence indicates that these animals remained largely domesticated, living mainly on the periphery of *kauhale* and extending into lowland forests. They continued to rely largely on the food and shelter provided by the *kauhale*.^{vi} This is because in pre-contact times, native Hawaiian forests were devoid of large alien fruits such as mangos and guava, and major protein sources, such as non-native earthworms, that would eventually support the large feral populations of pigs today. Without such fodder, these early roaming populations would have been chiefly dependant on people for their survival.

Western introductions and spread of feral pigs

In contrast, current feral pigs are largely derived from animals introduced after western contact. Cook, for example, brought European pigs during his first voyage to Hawai‘i, and many other introductions of European and Asian swine followed.^{vii} Over time, the Polynesian *pua‘a* interbred with and were mostly displaced by these larger animals.^{viii}

As feral pig populations grew on all islands, they began ranging more freely in the forests. Concurrent but independent introductions of earthworms and introduced plant species, such as mango and guava, provided reliable protein and carbohydrate food sources and helped expand their range.^{ix} Omnivorous and without any non-human predators, pigs began to thrive in the native forest and successfully established large populations. Within only a few generations, any

escaped domesticated pigs reverted to a feral form, retaining the large body size of European swine, but severing their dependence on human beings.^x

With the advent of large-scale cattle ranching and sugarcane agriculture in the 19th century, much of Hawaii's lowland forests were converted into canefields or pasture, and feral pigs began moving further upslope.^{xi} Expanding development and agriculture throughout the 20th century further accelerated this process, reducing mid-elevation habitat and forcing feral animals into the pristine upland forests. Some areas, like the high elevation forests of the West Maui mountains, remained pig-free until as recently as the 1960s. Today, however, feral pigs are found throughout the main islands, including most of the remote native forests of Kaua'i, O'ahu, Maui, Moloka'i, and Hawai'i.^{xii}

Cultural implications

Clearly, domesticated *pua 'a* carried strong cultural value in traditional Hawai'i. Aside from being an important possession and food source, a oral tradition describes the adventures of *Kamapua'a* (the pig child), a powerful demi-god who ranged over the islands and into the sea.^{xiii} Even the name of the traditional land management system, *ahupua'a*, refers directly to the *pua 'a* and highlights the animal's importance among the variety of resources that were collected and offered during the annual *mahakiki* tributes.^{xiv}

However, pigs were never hunted game for ancient Hawaiians. The Polynesian interaction with these animals was one of near-complete domestication. Despite references to hunting rats with bow and arrow, no historic or traditional knowledge sources describe ancient Hawaiians hunting pigs for either food or recreation.^{xv} Even in the legend of *Kamapua'a* where the demi-god is pursued by man, he is sought so that he might be punished for his mischievous actions, not for sport or sustenance.^{xvi}

To understand the relationship between Hawaiians and pigs further, it is useful to examine the relationship between ancestral Hawaiians and their environment. Far more important than domesticated *pua 'a* were the thousands of native plants and animals who represent the *kinolau* (physical forms) of the *'aumakua* (ancestral deities). Ancient Hawaiians believed they were the familial descendents of the *akua*. The upland forest, or *wao akua* (realm of the gods), was held sacred, considered inhabited by the *kini akua* (myriad gods). As a result, these forests were kept religiously and physically distinct from the lowlands, or *wao kanaka* (the realm of people). In the *wao akua* dwelled such storied deities as Hina-ka-uluhe-nui-hihi-kolo-i-uka (Hina the great tangled mats of uluhe ferns crawling in the uplands), Hina-ulu-'ōhi'a (Hina-'ōhi'a-grove), Lono-i-ka-'owāli'i (Lono-in-the-'owāli'i -fern), Kumu-hea, (the caterpillar god of Ka'ū), Kū-'ōhi'a-Laka (Kū-of-Laka's-'ōhi'a-tree), Kū-pulupulu-i-ka-nahele (Ku-treefern-wool-in-the-forest), and Kū-'ālana-wao (Kū-[of the]-upland-offering), among the myriad *akua*.^{xvii}

As intensely sacred places, the forests of the *wao akua* were not entered except for very specific purposes, and then only by small groups of spiritually and culturally prepared individuals. Following strict traditional protocol, these groups would enter the forest for specific purposes, as to gather medicinal plants, fell carefully selected trees for voyaging canoes, or capture forest birds to harvest ceremonial feathers. In the native Hawaiian experience, human-reared *pua 'a*

were considered denizens of the *wao kanaka* and alien to the sacred upland forests. Until the last 150 years, they were also largely absent from them.

Other ungulate introductions and impacts

Goats were introduced in Hawai'i nearly simultaneously with the European pig, followed shortly thereafter by sheep, cattle, horses and donkeys. Introduction of this working stock accelerated the spread of western agriculture in the islands. This change, along with a growing westernization of traditional concepts of property rights and the decline of the Hawaiian population helped contribute to the collapse of traditional Hawaiian land management systems.^{xviii}

Other non-native ungulates were to follow. Axis deer were introduced on Moloka'i in the mid-19th century and reproduced so rapidly that, by 1898, the population of axis deer on Moloka'i was estimated at 7000 animals and hunters were brought in from California to cull the herd.^{xix} On Moloka'i and elsewhere, Hawai'i residents soon began to

note the deleterious effects of large populations of cattle, pigs, goats, and deer. These introduced animals browsed, trampled, and rooted up sensitive native plant species, converting rich native forest into pasture land or worse. Together with unsustainable *'iliahi* (sandalwood) harvests, this animal-induced degradation of native forests took its toll and predicated the watershed crisis of the late 19th century.

Widespread fencing, feral animal control and forest restoration were undertaken in an attempt to reverse the damage. On June 22, 1878, King Kalākaua himself led a party to the headwaters of Nu'uaniu Stream to plant trees.^{xx} Surprisingly, despite these visionary early control efforts, state-sponsored game animal introduction resumed in the mid-20th century when the Department of Forestry was reorganized to create a game management division. Soon thereafter, mule deer, pronghorn antelope, and mouflon sheep were introduced for recreational hunting. Today there are six introduced species of game mammals.

Modern hunting: Incorporating western traditions

The custom of recreational hunting evolved over the last hundred fifty years as native Hawaiians assimilated western traditions in the context of these introduced game animals. The earliest descriptions of western-style hunting occur in the opening decades of the 19th century, when outings were organized to control wild herds of cattle that threatened agriculture, residences, and forest resources.^{xxi} The practice increased in frequency and in popularity, with island hunters playing a key role in the state's response to the watershed crisis of the late 19th century. These state-sponsored control efforts resulted in the removal of over 170,000 introduced mammals in the first half of the 20th century.

Although hunting is not widely practiced in contemporary Hawaiian society -- only two percent of the state's residents obtain a hunting license -- it is a visible and common occurrence across

Ungulate introductions to Hawai'i (Tomich 1986)

- Polynesian pig – ca 400 AD
- European swine – 1778
- Goat – 1778
- Sheep – 1791
- Cattle – 1793
- Horse – 1803
- Donkey – 1825
- Axis deer – 1868
- Mouflon sheep – 1954
- Pronghorn – 1959*
- Mule deer – 1961

* Now extirpated

the state. Pig hunting, in particular, is a cherished modern practice for island sportsmen, including some whose subsistence depends to greater or lesser extent on wild game. Pig hunting in heavy cover is usually accomplished with the use of dogs, and the required training, feeding and care for these animals can be a difficult and expensive task. The dogs locate, chase, grab, or bay the game, which is then typically dispatched by the hunter with a gun or knife.^{xxii} These techniques are derived directly from western and European pig hunting practices, incorporated over the last 150 years in Hawai'i, and passed down through family generations.

Striking a balance

The *pua'a* plays an important role in Hawaiian history; from their early position as a domesticated food source and important cultural symbol, to their more recent role in recreational and subsistence hunting, they have become part of local culture. As we move forward in conservation, it is important that we understand this historical and cultural context to maintain a proper place for the *pua'a* in modern society. As with all resources, proper management and application is the key to maintaining balance.

Today we face the continued destruction of native forest, and risk losing an irreplaceable natural and cultural resource to uncontrolled feral animals. Feral pigs are widespread in the world, and in no danger of extinction. *Pua'a* were valuable cultural resources, but in ancient times were kept away from the *wao akua*, which held so much more value to Hawaiians than a single species such as a pig. As we strive to strike a balance between protecting native Hawaiian plants and animals and our dwindling native forests and the more recent practice of game hunting, we need to reassert the value represented by the *wao akua* to protect it and the *kini akua* for the future generations.

ⁱ Kirch, 1981, p. XX

ⁱⁱ Personal communication, SG reference

ⁱⁱⁱ Diong, p. 50-51; Clarke et al. p. 9; Giffen (1977)

^{iv} Maly, Kepa. 1998. *Nā Ulu Lā'au Hawai'i* (Hawaiian Forests), Kumu Pono Associates, p. 5.

^v Maly, p. X; Gon; but see "In the pre-European contact era, Polynesian man-pig interaction was essentially a loose one... pigs were never contained by any method. They were 'never confined in sites, but range about in search of food' (Ellis 1831, Vol. I p. 71). The pigs herded with dogs (Cook 1784, Vol. III p. 118) acted as scavengers, and were left unattended to roam freely and without restraint." (Diong p. 70)

^{vi} Diong, p. 73; See also: "Cook observed that pigs were abundant, formed an important part of the natives' culture, and 'were sometimes found wild in the mountains.'" (Diong p. 61)

^{vii} Beaglehole, 1967, p.

^{viii} Tomich, p. 123; Stone, p. 143; Diong, p. 61

^{ix} Stone, C.P. 1990, *Feral Pig (Sus scrofa) Research and Management in Hawaii*, pub info

^x Need citation discussing reversion to feral status

^{xi} Stone, p. 142; Diong

^{xii} Hess?

^{xiii} Kamapua'a lit.

^{xiv} Maly, Kepa. *'Āina a me ke Kai: Hawaiian Land And Ocean Use Practices*, Kumu Pono Associates website: <http://www.kumupono.com/mahele.htm>, accessed 08 March 2007.

^{xv} Maly

^{xvi} Kamapua'a publications by Kahiolo, Charlot, Kame'elcihiwa, akana-Gooch, etc.

^{xvii} Maly, unpublished historical notes, Pukui & Elbert Glossary of Hawaiian Gods 1973.

^{xviii} Osorio 2002 *Dismembering Lahui*.

^{xix} Dorman, *History of Axis Deer in Hawaii*, 1996. University of Hawaii, website:

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^{xx} Cox, Thomas R. *The Birth Of Hawaiian Forestry: The Web Of Influences*, 1991, Hawai'i State Division of Forestry and Wildlife website: <http://www.state.hi.us/dlnr/dofaw/pubs/history.html>, accessed 01 March 2007.

^{xxi} Maly, p. 4

^{xxii} State of Hawai'i, Department of Land and Natural Resources, Division of Forestry and Wildlife. *Technical Report No. 07-0: Review of Methods and Approach for Control of Non-native Ungulates in Hawai'i*, 01 March 2007.