Natural Resource Assessment
Waiʻele, Halepuaʻa, Puna, Hawaiʻi

Ke Aloha ʻAina Foundation, LLC

October 2024

Hala (Pandanus sp.)

1. Introduction

- ***Purpose and Scope***:

The Natural Resource Assessment is being provided for Malama o Puna a 501(c)3 nonprofit who has applied for the stewardship of Waiʻele through the Public Access, Open Space and Natural Resources Preservation Commission (PONC) Program. This commission is part of the County of Hawaiʻi and is responsible for advising on the acquisition and management of lands to preserve and protect natural, cultural, and recreational resources.

Waiʻele is an ancient Hawaiian fishing village. The *ʻili* (land division within an ahupuaʻa) Waiʻele is located in the *ahupuaʻa* (land division in a district) of Halepuaʻa within the *moku* (district) of Puna on the *mokupuni* (island) of Hawaiʻi. The region of Halepuaʻa extends up to the Nanawale Forest reserve which is the watershed that feeds Waiʻele. Uli i ka uli is a concept that shares about the conditions from *mauka* (mountain) to makai (sea). It is said that if the water in the mountains is healthy, then the water at the sea will be healthy and everything in between. *Kanaka maoli* (Indigenous people) believe the health of an ecosystem is directly related to the health of the people. If the environment is healthy, so are the people.

A Natural Resource Assessment (NRA) at Waiʻele was conducted to identify significant cultural and natural resources at Waiʻele. This report highlights the resources that were observed. It also shares *ʻIke Hawaii* (traditional knowledge) and the reader shall take into account the understanding that these cultural and natural resources are directly related to traditional protocols, biocultural practices and stewardship management.

- **Biocultural Practices** refer to the *methods* and *techniques* employed to maintain and use these resources in ways that reflect cultural values and traditions.

Biocultural practices in stewardship involve the integration of cultural traditions, knowledge, and values with the sustainable management and care of natural resources. These practices are rooted in the understanding that the well-being of the environment is closely tied to the cultural identity and practices of the people who interact with it.

Waʻiele, a wahi pana (storied and sacred place), would have likely been a site for various biocultural practices deeply intertwined with Kanaka Maoli lifeways, honoring both the land's ecological vitality and its cultural significance. Here are some practices that might have occurred in Waiʻele:

A. Traditional Plant Gathering (La‘au Lapa‘au)

- Wai‘ele’s native and Polynesian-introduced plants would have been used in traditional Hawaiian medicine, known as la‘au lapa‘au. Plants like kukui (*Aleurites moluccanus*), ‘Ōlena or turmeric (*Curcuma longa*), and other native flora might have been gathered and prepared by kahuna *la‘au lapa‘au* (traditional healers) for various ailments. These practices not only provided medicine but also preserved the knowledge and sustainable gathering methods for healing. There is an abundance of kukui at Wai‘ele.

B. Cultivation and Propagation of Polynesian-Introduced Crops

- Wai‘ele was a place for cultivating key plants brought by Hawaiians, such as Niu (Coconut), ‘Uala (sweet potato), and Ulu (breadfruit). These crops were cultivated using sustainable techniques that preserved soil health and prevented erosion. Terracing, mulching, and water management techniques maintained the landscape’s health and fertility, embodying the practice of *mālama ‘āina* (caring for the land). Traditional sites used for planting are likely found throughout the property.

C. Forest Management and Resource Conservation

- Native birds and plants would have been protected through traditional forest management practices. Kanaka Maoli would selectively gather, prune, and control growth to ensure the vitality of the native forest). Only certain species might have been harvested, ensuring that the forest ecosystem remained balanced and resilient.

D. Spiritual Ceremonies and Cultural Protocols

- As a wahi pana, Wa‘iele may have been a place for ceremonies honoring the akua (deities) and ancestral spirits associated with the land. Ceremonial practices might include offering food, chants (mele), and dances (hula) to acknowledge the area and the ancestors. This biocultural connection deepens the relationship between people and place, reinforcing the idea that the health of the land is directly tied to the well-being of the people.

E. Invasive Species Control and Habitat Restoration

- In Wa‘iele, invasive plant species should be managed by removing non-native growth to protect native and culturally-significant species, such as Hala (Pandanus tectorius), ‘Ekaha (*Asplenium nidus*), Niu (*Cocos nucifera*) and Ulu

(*Artocarpus altilis*). Native Hawaiians managed forest resources sustainably, often planting or encouraging the growth of native and Polynesian-introduced species to keep invasive species at bay. Hau (*Hibiscus tiliaceus*) is not considered an invasive species, yet when not managed it becomes very aggressive. Hau is overgrown and has taken over acres of land that have made the area inaccessible.

F. Use of Wauke (Paper Mulberry) and Other Plants for Crafting and Weaving

- Plants like Wauke (*Broussonetia papyrifera*), used to make kapa (bark cloth), and Hala, used in weaving mats, baskets, and hats, would have been gathered and cultivated. Niu is one of the most commonly used plants in Hawaiian culture, every part of the tree is used. This practice required a close understanding of seasonal cycles and an intimate knowledge of harvesting techniques that ensured the plants' regeneration. Although Wauke was not identified in Waiʻele, it could be a plant of consideration for restoration efforts.

G. Educational Stewardship and Knowledge Sharing (Kuleana)

- Waiʻele would have been a place for teaching younger generations about traditional ecological knowledge, biocultural practices, and the spiritual connections to the land. This passing down of knowledge, known as *kuleana*, ensured that each generation learned to *mālama* (care for) Waiʻele and understood its sacred history, sustaining the continuity of both ecological and cultural integrity.

Waiʻele's role as a wahi pana and of biocultural practice exemplifies the deep connection Kanaka Maoli maintained with the land. Such practices reflect a commitment to both ecological stewardship and cultural responsibility, ensuring the vitality of Waiʻele's unique landscape for generations.

Objectives:

1. Conduct an overview of the natural and cultural resources at Waiʻele
2. Define how these resources are integrated into kanaka maoli and bio-cultural practices
3. Provide recommendations for the management of the cultural and natural resources of Waiʻele

This report outlines the inventory of findings of natural and cultural resources found at Waiʻele and identifies how these resources may have been used. The inventory will share about uses of the resources, how they may have been used traditionally and provide recommendations of land use through a Hawaiian cultural context.

Geographic Overview: Description of Waiʻele's location, climate, topography, and any unique environmental features that influence its ecosystems.

Waiʻele consists of two parcels of land, TMK # 3-1-4-3: 003 and 3-1-4-3: 037 with a total area of 165.3 acres. This lowland moist mesic forest encompasses many groves of Polynesian introduced species that were used by the Kanaka maoli who lived here.

Waiʻele is located on the shoreline of Puna in between Kumukahi and Keonepoko. The area receives approximately 100 inches of rainfall annually with predominant Northeast trade winds. The topography consists mainly of pahoehoe lava and is laden with rich dark soil intermixed with cinder likely from the 1960 Kapoho eruption.

The area is host to many archaeological sites and it is highly recommended to conduct an archaeological inventory of the area. The inventory will share what sites are found in Waiʻele and types of practices that would have occurred there. This will provide invaluable recommendations about how to properly manage the site. At the base of the shoreline, there is an intact *Kūʻula* (fishing shrine). These types of intact sites are not very common anymore and they should be preserved and protected.

This intact ancient Hawaiian fishing village was once occupied by kanaka maoli. The natural resources found in Waiʻele provide a rich history as to what types of land uses occurred there. Recent introductions of alien species has altered the landscape and is a detriment to the overall use of the area. Large alien tree species such as Cecropia (*Cecropia obtusifolia*) are found throughout the area that detract from the natural beauty of the area and have encroached on archaeological sites. The management of the introduced species *hau* near the shoreline has been unmanaged for decades and it has become a species that needs special attention.

2. Ecological Inventory

Introduction

The ecological and site inventory of Waiʻele was conducted with a focus on preserving the integrity of its natural and cultural resources. Given the archaeological and ecological significance of the area, the methodology was designed to minimize disturbance while ensuring thorough documentation of species and features.

Methodology

The ecological inventory was conducted during three site visits by a team of five individuals. Observations were recorded systematically, and care was taken to account for archaeological sites and ecological features. Key methods included:

- **Species Documentation**:
  - Species were recorded at each plot along transect lines. If specific vegetation was dominant in a particular area, it was noted
- **Archaeological Sites**:
  - Significant archaeological features were documented if observed during the survey
- **Mapping and Data Collection**:
  - Avenza maps were utilized to log transect lines, significant features, and species presence

Transect Design

Transects were established with a focus on achieving comprehensive coverage of the property.

- **Orientation**:
  - Transect lines were aligned at 320 degrees and 140 degrees, running parallel to the northern and southern boundaries of the property
- **Spacing**:
  - Transects were spaced 100 meters apart, except for transects seven and eight, which had a 200-meter gap due to dense hau vegetation
- **Plot Design**:
  - Plots extended 10 meters off each transect line

Transect and Plot Details

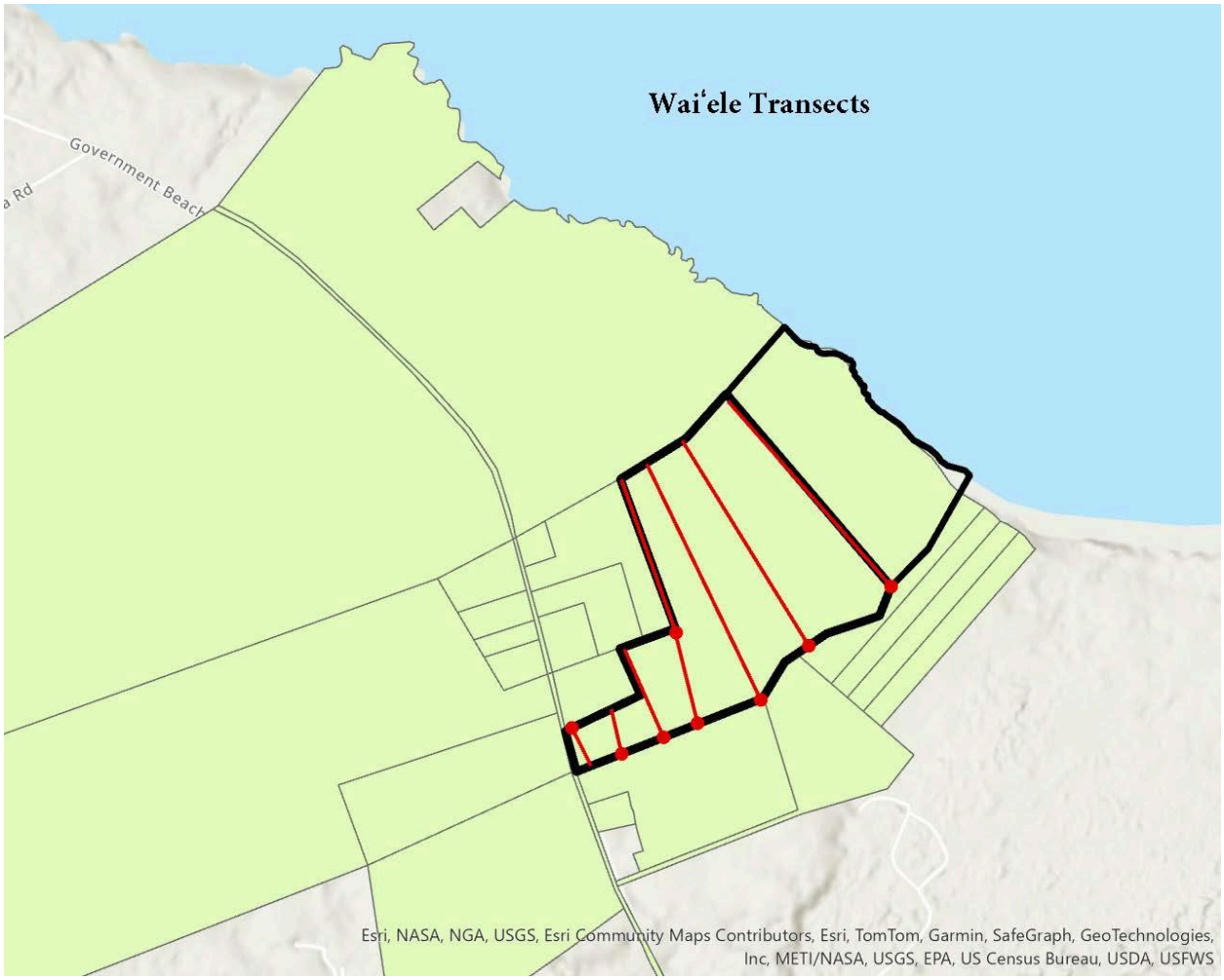
1. **Transect Lines 1–4**:
   - Transects 1 and 2: Each measured 100–125 meters in length with five plots spaced every 25 meters
   - Transects 3 and 4: Each measured 250 meters in length with 11 plots spaced every 25 meters
2. **Transect Lines 5–8**:
   - Transect 5: Plots spaced 50 meters apart, totaling eight plots

    - Transects 6 and 7: Plots spaced 100 meters apart, totaling eight plots each
    - Transect 8: Conducted along the shoreline with plots spaced 25 meters apart, totaling four plots
3. **Hau Thicket**:
    - The area between transects seven and eight consisted of dense hau (*Hibiscus tiliaceus*) vegetation, rendering it inaccessible for surveying

Summary of Effort

- **Transects Completed**: Eight transect lines established
- **Plots Recorded**: A total of 60 plots were surveyed
- **Survey Adjustments**: Transect methodology was modified for transects five through eight to account for ecological and logistical constraints, ensuring accurate data collection

The ecological inventory of Waiʻele was conducted with precision and respect for the natural and cultural significance of the area. The inventory's systematic approach provided a record of species distribution and archaeological features, forming a foundation for future management and conservation efforts.



Map of Transect lines

Flora and Fauna Overview

The ecological survey conducted at Wai'ele provided a comprehensive inventory of the plant and animal species present in the forested area, while also identifying significant archaeological sites and culturally important flora. The forest composition reflects a blend of Polynesian introduced, native, and alien species, with notable biocultural and ecological features observed across the property.

Species Inventory

- **Total Species Recorded**: 46
  - Native Species: 5 (10.9%)
  - Polynesian Introduced Species: 7 (15.2%)

- Alien Species: 34 (73.9%)
- See appendix for detailed information

Fauna Observations

Io (Hawaiian Hawk**,** *Buteo solitarius*): One individual was observed multiple times during site visits, emphasizing the area's ecological significance

Feral Pigs (*Sus scrofa*): While no pigs were directly observed, evidence of ground disturbance indicated their presence in the area

Significant Observations by Transect Lines

Transect Line 1

- Key Features:
  - Large groves of Kukui (*Aleurites moluccanus*) and Hala (*Pandanus tectorius*) at 50 meters
  - Stone wall along the edge of the roadway

Transect Line 2

- Key Features:
  - Dominance of alien species such as Cecropia (*Cecropia obtusifolia*) and guava (*Psidium guajava*)
  - Presence of hala groves throughout the transect

Transect Line 3

- Key Features:
  - Large groves of Ulu (*Artocarpus altilis*), Kukui, Hala, and Mango (*Mangifera indica*) between 50–125 meters
  - Numerous stone walls and structures, particularly along the boundary
  - Ground heavily covered in cinder between Transect Lines 2 and 3

Transect Line 4

- Key Features:
  - Old-growth Mango trees and a large Awapuhi (*Zingiber zerumbet*) patch at the start
  - Extensive Hala and Kukui groves between 50–125 meters
  - First recording of Kakalaioa (*Caesalpinia major*)

- Possible burial sites and other archaeological structures between Plots 1 and 2

Transect Line 5

- Key Features:
  - Alien species such as Cecropia, Macaranga (*Macaranga sp.*), Melochia (*Melochia umbellata*), Gunpowder (*Trema orientalis*), and Waiawi (*Psidium cattleianum*)
  - Multiple sites and walls observed between 50–150 meters
  - Large *Uluniu* (coconut) grove at 300 meters
  - First sighting of the *Io* (Hawaiian hawk).

Transect Line 6

- Key Features:
  - Significant archaeological sites and walls observed at 300–400, 600–700, and 800 meters
  - Large Ulu grove present between 400–800 meters, with extensive Hala groves between 600–800 meters, suggesting a core area of habitation and cultivation
  - Large Bamboo patch along transect line, yet didn‘t fall into a plot (between transect lines 6 & 7)

Transect Line 7

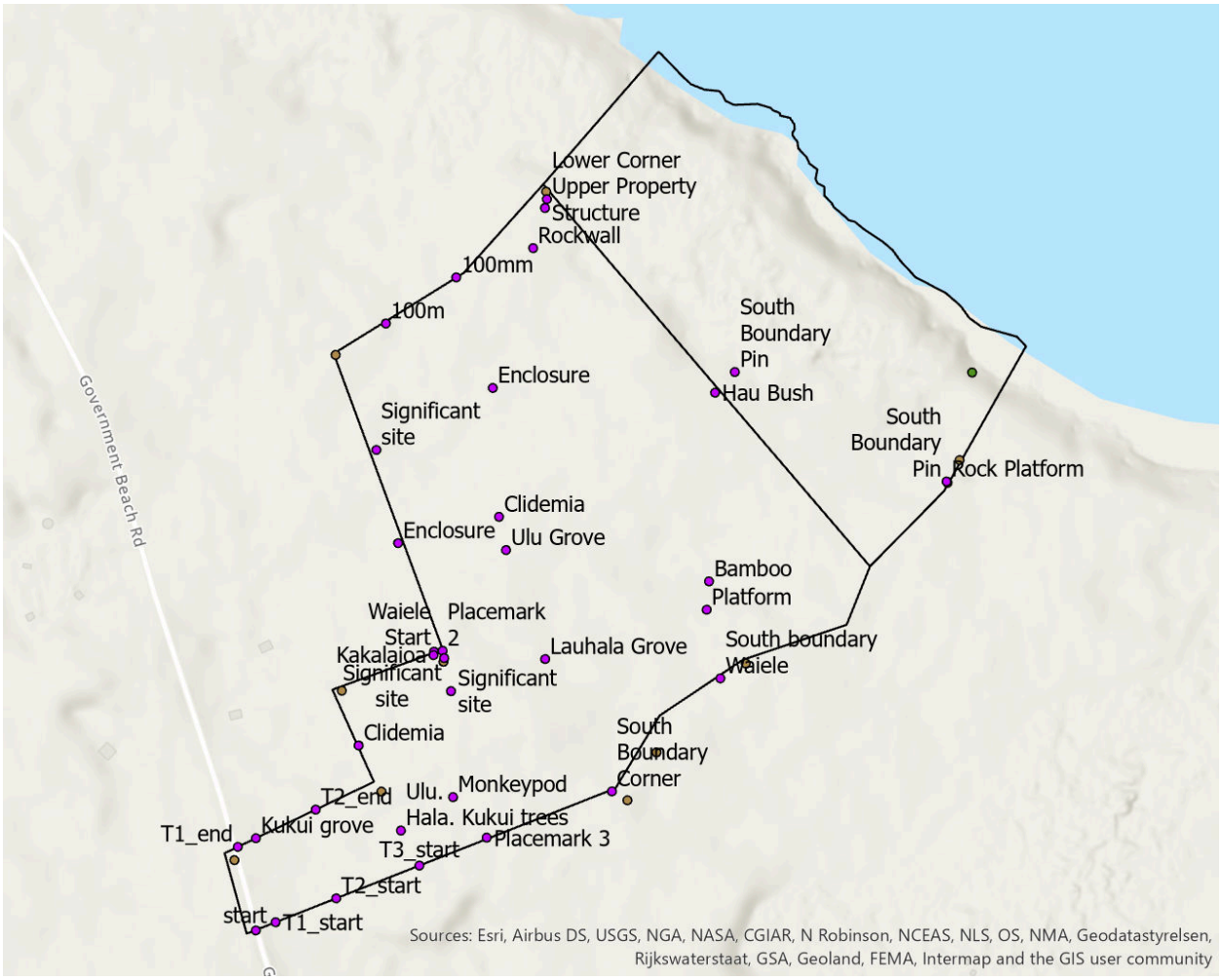
- Key Features:
  - Sites and walls observed between 100–200 meters, with a large Uluniu (Coconut) grove present
  - Significant Rose apple grove at 300 meters
  - Substantial Kukui grove between 500–700 meters.
  - Beginning of Hau establishment.

Between Transect Lines 7 and 8

- Key Features:
  - The Waterstone pathway to the beach is lined with Niu and Mango trees, measuring approximately 200 meters
  - Numerous walls and other structures along the path
  - Hau shrubland rendered certain areas inaccessible

Transect Line 8

- Key Features:
    - Coastal front featuring a large Uluniu grove, False kamani (*Terminalia catappa*), Naupaka (*Scaevola taccada*), Hala, Heliotrope (*Heliotropium foertherianum*), and Blechnum ferns (*Blechnum appendiculatum*)
    - Significant archaeological features, including a large Kūʻula (fishing shrine) and walls
    - Beach laden with water-worn stones consistent with Hānau pōhaku (birthing stones) and tidepools at the shoreline
    - Theses sites were not recorded with the mapping software



Significant features & sites along transect lines

Cultural and Ecological Significance

The flora observed highlights a mix of culturally significant species, including Ulu, hala, kukui, and niu, all integral to the biocultural practices of the area. The archaeological sites, stone walls, and fishing shrine underscore the importance of Waiʻele as a historical and spiritual landscape.

While the inventory focused on identifying significant species and sites, the *Vegetation Analysis and Botanical Survey, Waiʻele* (Rothburn and Stein, 2024) should be consulted for a more detailed account of the area's flora.

Recommendations

- Preservation and restoration of significant sites and old-growth groves
- Management of alien species to protect native and Polynesian-introduced flora
- Continued monitoring of fauna, particularly the *Io* and feral pigs
- Enhanced protection of archaeological features, particularly the *Kūʻula* and stone pathways

Ecosystems and Habitats

Waiʻele, a lowland mesic forest located along the Puna coastline, encompasses a diverse ecological and cultural landscape. The property extends to a bay and marine tide pools at the oceanfront, characterized by waterworn stones typical of the Puna shoreline.

Floral Composition

Waiʻele hosts significant groves of Hala, Kukui, and Ulu, all of which hold cultural importance. Other culturally significant species such as Niu, Noni, Kaʻeʻe, and Green ti are prevalent across the property.

- The ʻEkaha fern was observed consistently across almost all transects, indicating its widespread presence
- Mango trees, though not native or canoe plants, dominate large areas of the canopy and are valued for their wood
- The lower section of the property, about 200–300 meters from the shoreline, features an extensive thicket of Hau

Invasive Species

Invasive trees pose a significant threat to the forest's health:

- **Large invasive trees**: Cecropia, Gunpowder, Melochia and Macaranga
- **Other invasives**: Rose apple (*Syzygium jambos*), Banyan (*Ficus sp.*), and Koster's curse (*Clidemia hirta*) in the lower sections of the forest. These require urgent removal to prevent further spread

Overall, Wai'ele is predominantly an alien species forest interspersed with Polynesian introduced and native species.

Water Resources

- **Known Freshwater Sources**:
  A lineal descendant shared knowledge of a freshwater well near the lower section of the property. While the well was not located during this inventory, it may be identified in future archaeological surveys
- **Other Water Features**:
  No rivers, streams, or ponds were observed on the property

Soil and Land Use

Soil Characteristics

- **Lava Substrate**:
  The underlying substrate is smooth pāhoehoe lava, dated to AD 1200–1550 (Sherrod et al., 2021)
- **Surface Layer**:
  Fertile loamy and muck soil intermixed with cinder covers the area, supporting diverse vegetation
- **Erosion Risks**:
  The beachfront shows potential for erosion due to seasonal wave action and swells. Soil erosion is affected by large alien species growing in the forest. Feral pigs also play a factor in the degradation of the soil. It is likely that flooding from heavy rains contributes to soil erosion.

Land Use Patterns

- **Past and Present Uses**:
  While past land use patterns require further research, the archaeological inventory will provide guidance for appropriate future activities
- **Conservation and Agriculture**:
  - Coastal areas and significant archaeological sites should be prioritized for conservation efforts

- The upper sections of Waiʻele are suitable for agricultural use, particularly for cultivating culturally significant species such as Kukui, Ulu, Hala, and Niu

Recommendations

1. **Conservation and Restoration**:
   - Preserve and restore groves of Hala, Kukui, Ulu, and other culturally significant species
   - Remove invasive species such as Cecropia, Gunpowder, Macaranga, Melochia, and Koster‘s curse to protect native habitats
2. **Archaeological Mapping**:
   - Conduct a comprehensive survey to identify and map significant sites, ensuring land use plans align with cultural preservation goals
3. **Agricultural Development**:
   - Encourage the cultivation of culturally valuable crops in upper sections to support sustainable and culturally respectful land use
4. **Water Resource Exploration**:
   - Investigate and document potential freshwater sources, such as the descendant-reported well, to support future conservation and habitation efforts

3. Cultural and Historical Resources

- **Cultural Significance**

Waiele, as a culturally and ecologically significant site, and hosted a variety of biocultural practices that reflect the deep connection between kanaka maoli and their environment. These practices blend cultural traditions with sustainable resource management, supporting both the spiritual and physical needs of the community. Below are some examples of biocultural practices likely to have occurred at Waiele:

1. Agriculture and Food Cultivation

- **‘Ulu Orchards**: Breadfruit trees were likely cultivated as a staple food source. These trees were traditionally grown in agroforestry systems alongside other culturally significant plants like Kalo or taro (*Calocasia esculenta*) and Niu
- **Polyculture Farming**: Hawaiian agricultural systems often utilized Kalo patches (wet or dry loʻi) and diversified upland plantings with

Mai‘a or banana (*Musa pudica*), ‘Uala, and Kukui in integrated systems
- **Shifting Cultivation Practices**: In some forested areas, *ka‘a ‘āina* (shifting cultivation) may have occurred, where small patches were cleared for planting and later left to regenerate

2. Gathering and Crafting

- **Hala (Pandanus) Weaving**: Leaves from Hala trees were gathered and processed for weaving *moena* (mats), *‘ie* (sails), baskets and other cultural items. Gathering practices would have been guided by protocols that respected the tree’s health
- **Kukui Nut Harvesting**: Kukui nuts were collected for oil, which was used for light, medicine, and food preparation. The tree’s bark and leaves were also used for dyes and traditional remedies
- **Niu (Coconut) Harvesting**: Niu provided materials for food, drink, fibers, and tools, such as cups and ropes, contributing to the daily life and ceremonies of the community

3. Forest Stewardship

- **Maintaining Native and Polynesian-Introduced Plants**: Kanaka maoli likely tended to areas with culturally important plants like Ka‘e‘e (a vine with ceremonial uses) and ‘ēkaha (bird’s nest fern) to ensure their abundance for rituals and practical uses
- **Selective Forest Clearing**: Clearing forested areas for habitation or agriculture was done with care, using traditional tools like *ko‘i* (adzes) while preserving trees and plants that were ecologically or spiritually important
- **Planting Practices for Biodiversity**: Kanaka maoli would likely outplant significant species, including native trees (Alahe‘e, Lama, and ‘Ōhi‘a) to maintain biodiversity and reinforce the land’s resilience

4. Coastal and Marine Practices

- **Tide Pool Harvesting**: Tide pools along Wa‘iele’s coastline would have been a source of *limu* (seaweed), small fish, and crustaceans. Harvesting practices were likely guided by the *kaulana mahina* (lunar calendar), which dictated the best times for gathering to ensure resource sustainability

- **Fishing Practices with Cultural Protocols**: Surrounding coastal areas might have supported *koʻa* (fishing shrines) and specific rules about when and how fish could be caught. These practices ensured healthy fish stocks and maintained balance in the ecosystem

5. Cultural and Spiritual Practices

- **Ceremonial Use of Plants and Stones**: Many plants in Waiʻele, such as Hala, Kukui, and Kaʻeʻe, have ceremonial significance, being used in blessings, lei-making, and offerings at heiau (temples). Stones along the coastline may have been incorporated into *koʻa* or used in tool-making
- **Sacred Protocols at Wahi Pana (Storied Places)**: Waʻiele's designation as a *wahi pana* suggests that rituals, storytelling, and mele (chants) were likely practiced here to honor its sacred nature and maintain the spiritual health of the land

6. Invasive Species Management and Ecological Maintenance

- **Traditional Land Clearing Techniques**: Fire and stone-wall building was employed to manage the land and create boundaries for cultivated areas, limiting the spread of invasive plants
- **Targeted Gathering of Problematic Species**: Plants, such as hau a fast-growing species, would have been harvested for materials or removed to maintain the health of native ecosystems

7. Water Resource Management

- **Mālama Wai (Caring for Water):** Springs, streams, and wetland areas would have been carefully managed to ensure clean water for agricultural and domestic use. Features like terraced walls may have been present, with channels to divert water sources. Uli i ka uli, healthy water in the mountains, means healthy water in between and at the ocean
- **Tide Pool Protection**: The coastline's tide pools likely required ongoing stewardship to protect their integrity from overuse or natural erosion

8. Community-Based Stewardship

- **Transfer of Intergenerational Knowledge**: *Kūpuna* (elders) teach younger generations about the significance of plants, gathering and

planting practices and traditions, lunar cycles and harvesting and ceremonial protocols which fosters a strong sense of *kuleana* (responsibility) for the land
- **Ahupua‘a-Based Management**: Waiele is part of a larger ahupua‘a system, the resources were shared and managed collaboratively from the mountains (*mauka*) to the sea (*makai*). Such systems balanced resource use and conservation.

9. Seasonal and Lunar-Based Practices

- **Lunar Calendar Alignment**: Many practices, such as planting, fishing, and harvesting, were tied to the Hawaiian lunar calendar, ensuring activities aligned with natural cycles for maximum abundance and sustainability
- **Seasonal Resource Management**: Seasonal protocols may have limited access to certain resources, allowing ecosystems to replenish and recover during specific times of the year

By reviving and adapting these traditional biocultural practices, Wai‘ele can become a living classroom and an example of how cultural heritage and ecological stewardship work together. Through thoughtful, community-led efforts, Wa‘iele can continue to thrive as both a *wahi pana* and a resource-rich ecosystem.

● Historical significance

Wai‘ele, a *wahi pana* (sacred and storied place), holds deep historical significance rooted in the cultural, spiritual, and ecological practices of the kanaka maoli. Its location, natural resources, and archaeological features provide insights into traditional Hawaiian lifeways and the adaptive strategies of its people in Puna’s unique environment.

1. Cultural and Spiritual Importance

- **Wahi Pana**: Wai‘ele is not just a physical space; it served as a place where kanaka maoli honored their connection to the land and the deities associated with natural elements, particularly Kū (god of war and fishing) and Lono (god of agriculture and peace)
- **Ceremonial Practices**: The presence of a *kū‘ula* (fishing shrine) along the coastline highlights Wai‘ele’s role in spiritual practices, particularly in invoking success in fishing. Offerings and rituals

would have been conducted here to maintain harmony between people and the ocean
- **Seasonal and Lunar Observances**: Wai‘ele would have been a site where people observed the changing seasons and moon cycles to guide planting, harvesting, and ceremonial activities

2. Subsistence and Resource Use

Wai‘ele’s landscape was integral to traditional subsistence practices:

- **Agriculture**: The rocky terrain of Puna made it ideal for cultivating staple crops like ‘Uala and Ulu. Agricultural mounds and groves of Ulu reflect a history of careful land stewardship
- **Fishing and Coastal Activities**: Wai‘ele’s proximity to the ocean supported fishing, gathering of marine resources, and the construction of paths like the beachfront stone pathway to access the shoreline
- **Gathering, Crafting, Medicine**: The abundance of culturally significant plants, such as Hala, Kukui, Noni, and Niu, supported a range of activities, including medicine, weaving, lei-making, and crafting tools

3. Archaeological Legacy

Wai‘ele is rich in archaeological sites that provide a window into the lives of its early inhabitants:

- **Kū‘ula Shrine**: A fishing shrine dedicated to Kū underscores the site’s role in ensuring abundance from the sea
- **Stone Pathways**: The large beach stone path suggests organized access to the ocean for fishing and/or trade
- **Other Sites**: Additional archaeological features, such as agricultural terraces and habitation sites, share that this was a once-thriving community connected to both land and sea. The beach hosts significant rocks that are found in sizes from small to large along the shore. It is likely that there are hānau (birthing) rocks or rocks that give birth to others.

4. Connection to Broader Hawaiian History

Waiʻele is part of the larger narrative of Puna's historical significance:

- **Adaptation to Environment**: The region's volcanic soil and rugged coastline required ingenuity and adaptability, reflected in the traditional agricultural practices and resource use at Waiʻele
- **Trade and Exchange**: While Kalo (taro) was more commonly grown in upland areas, evidence suggests trade relationships between Waiʻele and mauka (upland) regions, highlighting its role in a broader network of resource exchange
- **Impact of Colonization**: Over time, changes in land use, the introduction of invasive species, and disruptions to traditional practices have impacted Waiʻele, making its preservation a critical effort to honor and restore Hawaiian heritage

5. Ecological and Historical Resilience

The abundance of native and Polynesian-introduced plants at Waiʻele speaks to the ecological harmony maintained by its early stewards. This resilience underscores the importance of Waiʻele as a model of sustainable living, rooted in a reciprocal relationship between people and the land.

Waiʻele stands as a testament to the ingenuity, spirituality, and resilience of the kanaka maoli. Its rich history, marked by traditional practices, sacred sites, and ecological stewardship, offers invaluable lessons for contemporary conservation and cultural revitalization. Preserving Waiʻele ensures that future generations can continue to honor and learn from its profound historical and cultural legacy.

- **Traditional Practices**

  Sustainable Resource Use

  Kanaka maoli engaged in diverse practices that integrated their daily lives with the environment, ensuring a harmonious relationship between people and the land (*ʻāina*). Waiʻele's resources were used for:

  - **Farming**: Staple crops such as Ulu and ʻUala were cultivated. Agricultural mounds in the rocky terrain were likely utilized for planting ʻUala, a crop well-suited to Puna's rugged landscape. Ulu

was also a common source of poi, a staple food in the area, and the groves of Ulu at Waiʻele suggest its prominence
- **Fishing and Gathering**: The beachfront area was central to fishing activities, supported by the presence of the *kūʻula* dedicated to Kū, the fishing god. Gathering of marine resources and harvesting of *limu* would have complemented the diet
- **Crafting and Medicine**: Trees such as Kukui, Hala, Noni, and Hau provided materials for crafting tools, lei-making, and medicine. Kukui was particularly versatile, used for lighting, food, dyeing fishnets, and making lei. Ti leaves were used in rituals, wrapping food, and as coverings for structures
- **Spiritual Practices**: Ceremonial offerings (*hoʻokupu*) to deities, as well as rituals connected to fishing, farming, and seasonal cycles, would have taken place in Waiʻele. The presence of sacred sites underscores the spiritual importance of this area

Plant and Resource Diversity

Waiʻele's landscape features groves of culturally significant plants, including Hala, Ulu, Niu, Kukui, Noni, and Hau. The overabundance of Hau indicates its widespread use in crafting, such as for cordage and structures. Although Maiʻa was not observed during the survey, it likely grew in the area, serving as a significant food source and contributing to *imu* (underground oven) preparation and mulching.

Archaeological Features

Waiʻele is home to many archaeological sites, including:

- **Kūʻula Shrine**: A beachfront structure dedicated to Kū, used to honor and ensure successful fishing endeavors
- **Beach Stone Path**: A large stone path located along the southeastern boundary, used to access the ocean
- **Many other sites include**: walls, house sites, enclosures, agricultural mounds and more

A comprehensive archaeological survey will identify these sites in depth. These features are culturally significant and should be preserved. Restoration efforts must ensure these sites are undisturbed and retain their historical and spiritual integrity.

Seasonal and Lunar Cycles

Traditional practices at Waiʻele followed the Hawaiian lunar calendar and its two distinct seasons:

- **Kau (Dry Season)**:
  - **Timeframe**: May to October.
  - **Associated Deity**: Kū, the god of war, farming, and fishing.
  - **Activities**: Planting and preparing the land for cultivation occurred during Kau. The dry conditions allowed for intensive farming and resource gathering.
- **Hoʻoilo (Wet Season)**:
  - **Timeframe**: November to April.
  - **Associated Deity**: Lono, the god of agriculture, peace, and harvest.
  - **Activities**: Makahiki ceremonies celebrate abundance and gratitude. This was a time of peace, during which war was forbidden, and the best harvests were offered to Lono.

The changing of seasons was marked by the rising of the constellation Makaliʻi (Pleiades) in November, signaling the start of the Makahiki season.

Waiʻele represents a vital connection to the traditional knowledge and practices of kanaka maoli. By honoring the cultural and spiritual importance of the land and its resources, restoration efforts can ensure Waiʻele remains a thriving ecosystem and a testament to Hawaiian heritage. Preservation of its sacred sites and integration of traditional practices will serve as a model for sustainable and culturally aware natural resource management.

Tidepool at the shoreline of Waiʻele

4. **Environmental Pressures and Threats**

Waiʻele faces numerous environmental pressures and threats. These pressures stem from invasive species and human activities, both of which have negatively impacted the area's natural resources, ecosystems, and cultural integrity. This report provides an analysis of these threats and recommendations for their management and mitigation.

Invasive Species

- **Identification and Impact Assessment**

  Invasive species pose one of the greatest threats to Waiʻele's ecological health. Key species of concern include:

1. **Invasive Plant Species**
    - **Large-Scale Invasives**:
        - Cecropia, Macaranga, Melochia, and Gunpowder dominate large areas of the forest, reducing native biodiversity and these species need immediate attention
    - **Other Detrimental Plants**:
        - Banyan, Rose apple, and Koster's curse were observed and are contributing to ecosystem degradation. Focusing on the removal of these species is advised to prevent further spread
2. **Invasive Animal Species**
    - **Queensland Longhorn Beetle** (*Acalolepta aesthetica*)
        - Documented in the forest (Rathbun & Stein, 2024), this beetle is particularly harmful to culturally significant plants such as Ulu and Kukui, which serve as host plants. Controlling this beetle is crucial to preserve these species
    - **Feral Pigs** (*Sus scrofa*)
        - Though no pigs were directly encountered during the survey, evidence of their presence was observed. Feral pigs disrupt native ecosystems by:
            - Consuming native plants and spreading invasive seeds
            - Digging and uprooting culturally significant flora, causing soil erosion and compaction
    - **Little Fire Ants (LFA)** (*Wasmannia auropunctata*)
        - Present at Waiʻele (Rathbun & Stein, 2024), these ants disrupt ecosystems by altering habitats and threatening flora and fauna. LFA also poses a threat to humans that will be conducting work in Waiʻele. Current control efforts cover parts of Waiʻele, but the extensive 165-acre property makes comprehensive management challenging

Management Recommendations

An invasive species management plan should:

- Address the control of species like Macaranga, Cecropia, and Gunpowder while protecting native vegetation and groundwater
- Implement biocontrol and chemical treatments cautiously to avoid harming the ecosystem

Assessment of Human Activities and the Impacts

Human activities have significantly altered Wai‘ele’s landscape and ecosystems. These activities include:

1. **Agricultural Practices**
    - Historic agriculture likely contributed to habitat fragmentation. The introduction of invasive crops and techniques incompatible with traditional stewardship has altered soil health and plant communities
2. **Tourism and Recreation**
    - **Ocean Access and Forest Use**
        - Activities such as fishing, gathering, and spiritual practices are culturally significant but must be balanced with conservation needs
        - Recreation of Wai‘ele is not monitored and a plan for regulated access should be developed
    - **Negative Impacts**:
        - Evidence of all-terrain vehicle (ATV) trails, rubbish left behind, and forest access for unsustainable Kukui gathering indicate human-induced degradation
3. **Community and Conservation Efforts**
    - Activities such as beach clean-ups and cultural ceremonies help preserve Wai‘ele’s cultural and environmental integrity. However, without clear guidelines and education, these efforts can inadvertently contribute to habitat disruption

Recommendations

- **Education and Outreach**:
    - Develop community programs to teach visitors and residents about Wai‘ele’s cultural and ecological significance
- **Regulated Access**:
    - Establish designated access points and trails for ocean and forest activities to minimize ecological disruption
- **Cultural Integration**:
    - Partner with local communities to incorporate traditional ecological knowledge (TEK) into land management practices.

Wai‘ele faces substantial pressures from invasive species and human activities that threaten its natural resources and cultural heritage. Through targeted

invasive species management and regulated human activity, Wai‘ele can be restored and protected. Balancing ecological restoration with cultural practices will ensure Wai‘ele remains a thriving ecosystem and a site of spiritual and cultural significance for future generations.

This report underscores the urgency of addressing these challenges and calls for collaborative efforts between conservationists, cultural practitioners, and the local community to ensure the sustainability of Wai‘ele.

- **Analysis of land-use changes and their effects on natural habitats**

  Wai‘ele has undergone considerable land-use changes over time. These transformations, shaped by shifts in cultural practices, colonization, urbanization, and invasive species proliferation, have had significant impacts on its natural habitats.

  Historical Land-Use Changes

  1. **Traditional Hawaiian Practices (Pre-Contact Era)**
     - **Sustainable Stewardship**: Early kanaka maoli (Native Hawaiians) managed Wai‘ele using techniques that maintained ecological balance. Agriculture, fishing, and gathering were conducted in harmony with the seasons, lunar calendar, and local ecosystems. Crops like ‘uala and Ulu were cultivated, while coastal resources were harvested sustainably
     - **Habitat Preservation**: Native and Hawaiian-culturally significant forests of Hala, Kukui, and Niu were maintained, and native undergrowth provided habitat for endemic species. This careful land stewardship ensured Wai‘ele’s ecological integrity
  2. **Post-Contact Era (Colonial and Plantation Influence)**
     - **Introduction of Invasive Species**: The arrival of Europeans and Americans brought invasive plants (*Macaranga sp.*, *Schinus terebinthifolia*, *Cecropia obtusifolia*) and animals (feral pigs, rats, and cattle), disrupting native habitats
     - **Land Conversion**: Portions of Wai‘ele and surrounding areas were likely altered for plantation agriculture or grazing, leading to soil erosion, deforestation, and displacement of native species
     - **Decline in Traditional Practices**: The suppression of Hawaiian culture and resource management systems led to the abandonment of sustainable practices that had protected the land

3. **Modern Developments (20th–21st Century)**
    - **Urbanization and Fragmentation**: Increased development in Puna, including roads, housing, and tourism infrastructure, has fragmented ecosystems, reducing habitat connectivity for native species
    - **Overgrowth of Invasives**: Without active management, invasive plants like *Macaranga tanarius*, *Melochia umbellata*, and *Passiflora laurifolia* have outcompeted native vegetation, altering the composition and structure of Waiʻele's ecosystems

Effects on Natural Habitats

1. **Loss of Native Forests**
    - **Deforestation**: Conversion of land for agriculture, grazing, and development has resulted in the loss of native trees such as Kukui and Hala, reducing critical habitats for endemic species
    - **Altered Forest Composition**: Invasive plant species now dominate many areas, reducing biodiversity and the availability of traditional resources
2. **Soil Erosion and Degradation**
    - Clearing of vegetation and the overuse of land have led to soil erosion, particularly on Waiʻele's rocky coastal areas, impacting plant regrowth
    - Feral pigs are known to have negative impacts on soil erosion and degrade the forests understory
3. **Impacts on Coastal Ecosystems**
    - **Disturbance of Tide Pools**: Increased human activity and runoff have altered coastal habitats, affecting marine life that depends on tide pools
    - **Increased Vulnerability to Climate Change**: Habitat degradation has reduced the coastline's resilience to sea level rise and storm surges
4. **Displacement of Native Fauna**
    - **Loss of Habitat for Native Birds and Insects**: Native forests once provided food and shelter for species like *ʻapapane* and *ʻōpeʻapeʻa* (Hawaiian hoary bat). Habitat loss has contributed to population declines
    - **Spread of Predators and Competitors**: The introduction of feral pigs, rats, and mongoose has placed additional pressure on native fauna, particularly ground-nesting birds and endemic invertebrates

Recommendations for Mitigating Effects

1. **Restoration of Native Habitats**
    - Replant native and Polynesian-introduced species, such as Ulu, Hala, and Kukui, Niu, Noni to restore Waiʻele's ecological and cultural balance
2. **Control of Invasive Species**
    - Implement management strategies such as targeted removal of invasive plants like *Macaranga sp.* and *Cecropia*
3. **Soil and Coastal Protection**
    - Use traditional Hawaiian techniques, such as planting *ti* and other stabilizing plants, to prevent erosion and protect coastal areas.
    - Monitor and maintain tide pools to preserve their ecological function
4. **Community Engagement**
    - Foster partnerships with local Hawaiian communities to incorporate traditional ecological knowledge (TEK) into land management
    - Encourage cultural practices, such as forest gathering, hula and fishing rituals, that promote stewardship and connection to the land
5. **Long-Term Monitoring**
    - Establish regular assessments of invasive species, habitat health, and resource use to guide adaptive management efforts

The land-use changes at Waiʻele reflect a shift from sustainable, culturally integrated practices to extractive and invasive processes. Restoring Waiʻele requires a balance of ecological science and traditional Hawaiian knowledge to heal the land, honor its cultural significance, and ensure its resilience for future generations. Through proactive management, Waiʻele can once again thrive as a living landscape that supports both natural ecosystems and cultural heritage.

5. Conservation and Management Recommendations

Recommendations for Preservation and Restoration

1. **Preservation of Archaeological Sites**
    - Conduct an archaeological survey to identify the sites at Waiʻele. Protect and maintain the kūʻula shrine, stone paths, walls, house sites, and other significant structures. Avoid activities that may alter or detract from their cultural significance.

2. **Restoration of Native Plants**
    - Promote the outplanting of native and Polynesian-introduced species such as Ulu, Kukui, Ohia‘ai and Mai‘a while managing the overgrowth of Hau and invasive plants
    - Identify methods of protection in areas where rare and endangered species are present
    - Remove invasive species such as *Cecropia, Gunpowder, Macaranga, Banyan, Koster‘s curse*
3. **Cultural Revitalization**
    - Incorporate traditional farming and fishing practices into management strategies to reconnect the community with cultural heritage
    - Encourage educational programs and ceremonies that honor traditional Hawaiian knowledge and practices
4. **Priority Areas for Conservation**
    - Identification of key areas that require immediate conservation efforts, such as habitats of endangered species or culturally significant sites
5. **Sustainable Practices**
    - Recommendations for sustainable land and resource management practices that align with both environmental preservation and community needs
        1. Manage agricultural crops such as Ulu, Kukui, Niu, and Mango
        2. Plant Native and Hawaiian culturally-significant plant species that are consistent with the archaeological landscape
6. **Restoration Efforts**
    - Suggested strategies for ecological restoration of degraded areas, such as reforestation, invasive species removal, or wetland restoration
    - Inventory archaeological sites and preserve or restore areas per the decisions of the lineal descendants of the area
7. **Community Involvement**
    - Develop plans for engaging the local community in conservation efforts, including education, volunteer programs, and traditional knowledge integration

- **Baseline Data Establishment**:
    - Creation of a baseline for ongoing monitoring of natural resources, including indicators for ecosystem health, species populations, and water

quality. Use the botanical survey and natural resources assessment as a basis to identify priority areas and methods of management

- **Monitoring Programs**:
    - Design of long-term monitoring programs to track changes in the environment, the effectiveness of conservation efforts, and emerging threats

6. Adaptive Management Approach

- Recommendations for an adaptive management approach that allows for flexible responses to new information or changing conditions. Use the Wai‘ele Steering committee to guide this process

Outline of Adaptive Management for Wai‘ele

1. Introduction to Adaptive Management

- Define adaptive management as a structured, iterative process of robust decision-making in the face of uncertainty
- Emphasize its relevance for addressing the dynamic ecological and cultural challenges at Wai‘ele

2. Core Principles of Adaptive Management

- **Learning by Doing**: Treating management actions as experiments to refine future strategies
- **Flexibility**: Adjusting actions based on new data, ecological feedback, and cultural input
- **Stakeholder Involvement**: Engaging community members, cultural practitioners, scientists, and policymakers in all stages of planning and implementation.

3. Key Components of the Adaptive Management Plan

A. Assessment and Baseline Data Collection

- Conduct comprehensive inventories of flora, fauna, archaeological sites, and land use patterns.
- Monitor invasive species and environmental conditions (e.g., rainfall, erosion, soil health).
- Document cultural practices and historical narratives tied to Wai‘ele.

B. Goal Setting

- Define clear, measurable objectives for ecological restoration and cultural preservation.
    - Examples: Reduce invasive plant cover by 50% within 5 years; replant 10 acres with native and culturally significant species.

C. Implementation of Initial Management Actions

- Launch initial projects based on baseline data and input from stakeholders:
    - Invasive species control (mechanical removal, biocontrol, fencing).
    - Restoration planting with culturally significant species like hala, ulu, and kukui.
    - Preservation efforts for archaeological sites and coastal erosion mitigation.

D. Monitoring and Evaluation

- Establish a robust monitoring framework to assess the effectiveness of actions:
    - Track changes in species composition, water quality, and soil stability.
    - Use GPS mapping to track invasive species removal and restoration planting progress.
- Regularly collect and analyze ecological and cultural data.

E. Adjustments and Revisions

- Use monitoring data to identify successes, challenges, and unforeseen impacts.
- Adapt strategies to address new threats, opportunities, or knowledge:
    - Example: If invasive species control methods harm native plants, modify techniques.
    - Example: Expand cultural engagement efforts if feedback suggests greater community involvement is needed.

F. Stakeholder Engagement and Feedback Loop

- Host regular meetings with lineal descendants, cultural practitioners, scientists, and local stakeholders.
- Encourage feedback on management actions and incorporate cultural insights into decision-making.

4. Recommendations for Adaptive Management at Waiʻele

- **Integrate Cultural Practices**: Align ecological restoration with traditional knowledge and known biocultural practices
- **Foster Research Partnerships**: Collaborate with universities and conservation organizations to refine management practices
- **Ensure Flexibility in Funding and Resources**: Develop grant proposals and partnerships to allow adjustments as priorities shift
- **Implement Education Programs**: Train volunteers and stakeholders on adaptive management principles

7. Conclusion

- **Summary of Key Findings**:
  - Overview of the most critical natural resources, threats, and conservation priorities identified in the assessment.

Critical Natural Resources

- **Culturally Significant Plant Species**:
  Waiʻele hosts groves of hala (*Pandanus tectorius*), kukui (*Aleurites moluccanus*), ulu (*Artocarpus altilis*), and niu (coconut), as well as other significant species like noni (*Morinda citrifolia*), green ti (*Cordyline fruticosa*), and the ʻekaha fern (*Asplenium nidus*). These plants are vital to traditional Hawaiian biocultural practices and provide essential resources for food, medicine, and crafts
- **Marine and Coastal Features**:
  The property includes a bay with tide pools, a shoreline of waterworn stones, and significant archaeological features, such as habitation sites, walls, structures and a Kūʻula fishing shrine. These elements are critical to cultural heritage and ecological balance
- **Freshwater and Soil Resources**:
  Fertile loamy and cinder-rich soils across the property offer potential for agricultural use. While no freshwater sources were observed during the survey, a well reported by descendants may exist

Threats to Natural Resources

- **Invasive Species**:
    - **Flora**: Cecropia, gunpowder, melochia, macaranga, rose apple, and Koster‘s curse dominate parts of the forest, threatening native and culturally significant plants
    - **Fauna**: Feral pigs and invasive insects, such as the Queensland longhorn beetle and Little Fire Ant (LFA), pose risks to forest integrity and ecosystem health
- **Human Activities**:
    - Evidence of resource gathering, trail use, and rubbish left behind by visitors has disrupted the forest's balance
    - Unmanaged access to the beach and archaeological sites risks damaging these culturally and ecologically significant areas
- **Coastal Erosion**:
  The beachfront is at risk of erosion due to wave action and seasonal swells, potentially impacting the shoreline ecosystem and archaeological features

Conservation Priorities

1. **Restoration and Preservation**:
    - Protect and restore groves of Hala,Kukui, Niu, and Ulu while addressing invasive species management
    - Preserve significant archaeological sites, including stone walls, fishing shrines, and burial structures
2. **Invasive Species Management**:
    - Implement strategies to control and remove invasive trees (cecropia, gunpowder, etc.) and shrubs (Koster‘s curse)
    - Monitor and manage threats posed by the Queensland longhorn beetle, Little Fire Ant, and feral pigs
3. **Sustainable Land Use**:
    - Dedicate coastal areas and significant archaeological zones to conservation efforts
    - Develop sustainable agricultural practices in upper sections, focusing on native and Polynesian-introduced species
4. **Community and Cultural Engagement**
    - Collaborate with lineal descendants and cultural practitioners to ensure management plans align with traditional practices
    - Promote community education and stewardship to reduce human impact on natural and cultural resources

This summary highlights Waiʻele's ecological and cultural importance while addressing key threats and outlining actionable priorities for conservation and sustainable management.

- **Call to Action**

Waiʻele is a place of immense ecological, cultural, and historical significance that requires our collective effort to protect, restore, and honor its natural and cultural heritage. The findings of this assessment highlight the urgent need for coordinated action to address threats, preserve native ecosystems, and uphold the traditional biocultural practices that have defined Waiʻele for generations.

We call upon stakeholders, including community members, cultural practitioners, conservation organizations, and government agencies, to take part in safeguarding Waiʻele's unique resources. Together, we can ensure that this land continues to provide for future generations while maintaining its integrity as a place of cultural and ecological harmony.

Immediate Actions Needed

1. **Invasive Species Management**:
   Develop and implement a targeted plan to remove invasive plants and animals, protecting Waiʻele's native and culturally significant species.
2. **Preservation of Archaeological Sites**:
   Map, document, and restore archaeological sites while ensuring their protection from human and environmental impacts.
3. **Restoration of Ecosystems**:
   Focus on replanting and fostering the growth of hala, kukui, ulu, and other culturally significant plants, supporting traditional practices and ecological health.
4. **Community Engagement**:
   Build partnerships with lineal descendants and cultural practitioners to guide management decisions and foster a sense of shared responsibility.

How You Can Contribute

- **Volunteer**: Join restoration efforts, invasive species removal initiatives, and cultural site preservation projects.
- **Advocate**: Support policies and programs that prioritize conservation and cultural preservation at Waiʻele.
- **Educate**: Share knowledge about Waiʻele's importance with others to inspire collective stewardship.

- **Collaborate**: Work with local organizations, schools, and cultural groups to create a sustainable future for Waiʻele.

A Commitment to the Future

The preservation of Waiʻele is not just a task—it is a kuleana (responsibility) that we all share. By acting now, we honor the legacy of the land, its people, and its traditions, ensuring that Waiʻele thrives as a symbol of balance and harmony for generations to come.

Let us come together to mālama ʻāina (care for the land) and uphold the spirit of Waiʻele as a place of resilience, abundance, and deep cultural connection.

Role of the Waiʻele Steering Committee in Implementing the Natural Resources Assessment

1. Oversight and Governance

- Provide leadership and guidance in aligning the natural resource assessment with Waiʻele's broader conservation and cultural goals.
- Act as a decision-making body to ensure priorities are set based on community values, ecological needs, and historical significance.
- Establish clear objectives and timelines for implementing recommendations from the assessment.

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2. Stakeholder Coordination

- Serve as a liaison between key stakeholders, including:
    - Lineal descendants and cultural practitioners.
    - Environmental scientists and ecologists.
    - Local government and conservation organizations.
    - Volunteers and community members.
- Facilitate ongoing communication to integrate diverse perspectives into management actions.

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3. Implementation of Recommendations

- Oversee the execution of the recommendations outlined in the natural resource assessment, including:

    - **Invasive Species Control**: Approve and monitor removal strategies for invasive plants and animals.
    - **Habitat Restoration**: Guide efforts to reintroduce and nurture native and culturally significant species.
    - **Cultural Site Preservation**: Ensure culturally significant sites are protected and restored in alignment with traditional values.

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4. Adaptive Management Leadership

- Use an adaptive management framework to guide decision-making:
    - Evaluate the effectiveness of implemented actions through regular progress reports.
    - Adjust strategies based on ecological monitoring, community feedback, and emerging challenges.
- Develop and refine long-term conservation goals as new data or opportunities arise.

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5. Community Engagement and Education

- Organize outreach efforts to educate the public about Waiʻele's natural and cultural significance.
- Encourage active participation in conservation efforts through volunteer programs and community events.
- Create opportunities for knowledge-sharing sessions that integrate traditional Hawaiian practices with modern ecological science.

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6. Funding and Resource Mobilization

- Identify and pursue funding opportunities to support conservation and restoration activities.
- Ensure resources are allocated efficiently and transparently to address key priorities.

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7. Reporting and Accountability

- Regularly report progress to stakeholders and the community through updates, public meetings, and published materials.
- Uphold transparency and accountability in decision-making and resource management.

The Wai‘ele Steering Committee will act as the backbone of this effort, ensuring that conservation practices honor the cultural and ecological integrity of Wai‘ele while fostering community involvement and sustainable stewardship.

Special Mahalo

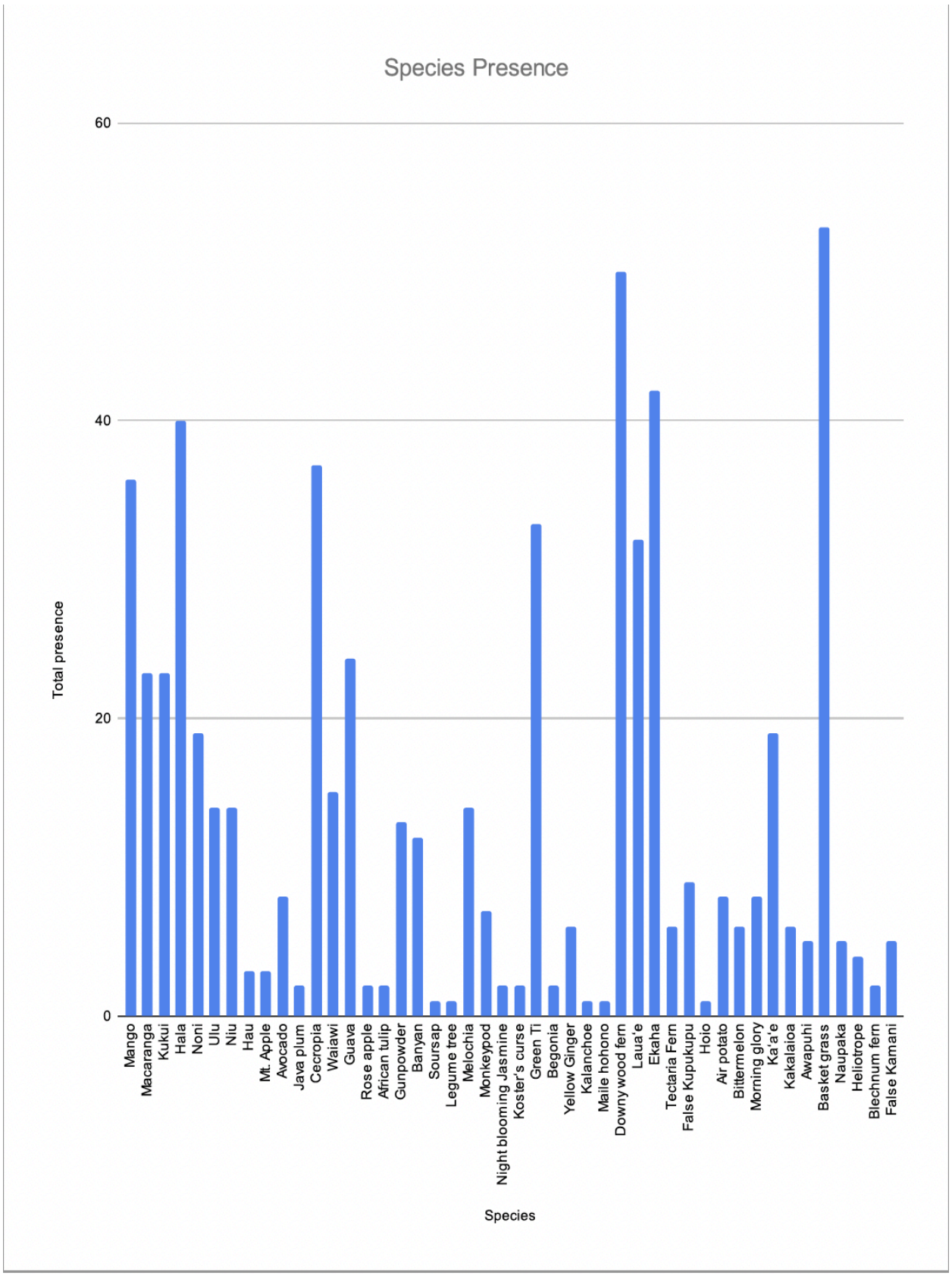
Ke Aloha ‘Aina Foundation, LLC would like to thank Fred Aiona, Makani Gregg and Michael Kyser Jr. for their work they contributed to this project. The area of Wai‘ele is special to many ‘ohana of this region. The ecology and archaeology of Wai‘ele that our group encountered is significant and these natural and cultural resources need to be protected, enhanced and managed for the generations to come. We hope that the information provided will help to guide the management decisions for Wai‘ele that will allow for the biocultural practices that were once thriving in this village to be revived once again.

7. Appendices

Rathburn, John, William Stein (2024). *Vegetation Analysis and Botanical Survey, Wai‘ele, Hawai‘i*, *Technical report*.

Sherrod, David R., John M. Sinton, Sarah E. Watkins, and Kelly M. Brunt (2021). *Geologic map of the State of Hawaii.* USGS Numbered Series Scientific Investigations Map 3143. USGS Publications Warehouse and Volcano Science Center, doi: 10.3133/sim3143.

Flora Species representation			
Species		**Total species count**	**Percentage**
Mango	*Magnifera indica*	36	5.80%
Macaranga	*Macaranga sp.*	23	3.70%
Kukui	*Aleurites molucanna*	23	3.70%
Hala	*Pandanus tectorius*	40	6.44%
Noni	*Morinda citrifolia*	19	3.06%
Ulu	*Artocarpus altilis*	14	2.25%
Niu	*Cocos nucifera*	14	2.25%
Hau	*Hibiscus tilieacus*	3	0.48%
Mt. Apple	*Syzygium malaccense*	3	0.48%
Avocado	*Persea sp.*	8	1.29%
Java plum	*Syzygium cumini*	2	0.32%
Cecropia	*Cecropia obtusifolia*	37	5.96%
Waiawi	*Psidium cattelianum*	15	2.42%
Guava	*Psidium guajava*	24	3.86%
Rose apple	*Syzygium jambos*	2	0.32%
African tulip	*Spathodea campanulata*	2	0.32%
Gunpowder	*Trema orientalis*	13	2.09%
Banyan	*Ficus benghalensis*	12	1.93%
Jackfruit	*Artocarpus heterophyllus*	1	0.16%
Legume tree	*Sesbania ?*	1	0.16%
Melochia	*Melochia ubmellata*	14	2.25%
Monkeypod	*Samanea saman*	7	1.13%
Night blooming Jasmine	*Cestrum nocturnum*	2	0.32%
Koster's curse	*Clidemia hirta*	2	0.32%
Green Ti	*Cordyline sp.*	33	5.31%
Begonia	*Begonia sp.*	2	0.32%
Yellow Ginger	*Hedychium falvescens*	6	0.97%
Kalanchoe	*Kalanchoe pinnata*	1	0.16%
Maile hohono	*Ageratum conyzoides*	1	0.16%
Downy wood fern	*Christella denata*	50	8.05%
Laua'e	*Phymatosorus scolopendria*	32	5.15%
Ekaha	*Asplenium nidus*	42	6.76%
Tectaria Fern	*Tectaria*	6	0.97%
False Kupukupu	*Nephrolepis sp.*	9	1.45%
Hoio	*Diplazium esculentum*	1	0.16%
Air potato	*Dioscorea bulbifera*	8	1.29%
Bittermelon	*Mormordica charantia*	6	0.97%
Morning glory	*Ipomoea sp.*	8	1.29%
Ka'a'e	*Mucuna gigantea*	19	3.06%
Kakalaioa	*Caesalpinea bonduc*	6	0.97%
Awapuhi	*ZIngiber zerumbet*	5	0.81%
Basket grass	*Osplimenus hirtellus*	53	8.53%
Naupaka	*Scaevola sericea*	5	0.81%
Heliotrope	*Heliotropium arboreum*	4	0.64%
Blechnum fern	*Blechnum sp.*	2	0.32%
False Kamani	*Termanlia catappa*	5	0.81%
Total		621	


Species Presence
60
40
20
0
Total presence
Mango
Macaranga
Kukui
Hala
Noni
Ulu
Niu
Hau
Mt. Apple
Avocado
Java plum
Cecropia
Waiawi
Guava
Rose apple
African tulip
Gunpowder
Banyan
Soursap
Legume tree
Melochia
Monkeypod
Night blooming Jasmine
Koster's curse
Green TI
Begonia
Yellow Ginger
Kalanchoe
Maile hohono
Downy wood fern
Laua'e
Ekaha
Tectaria Fern
False Kupukupu
Holo
Air potato
Bittermelon
Morning glory
Ka'a'e
Kakalaioa
Awapuhi
Basket grass
Naupaka
Heliotrope
Blechnum fern
False Kamani
Species