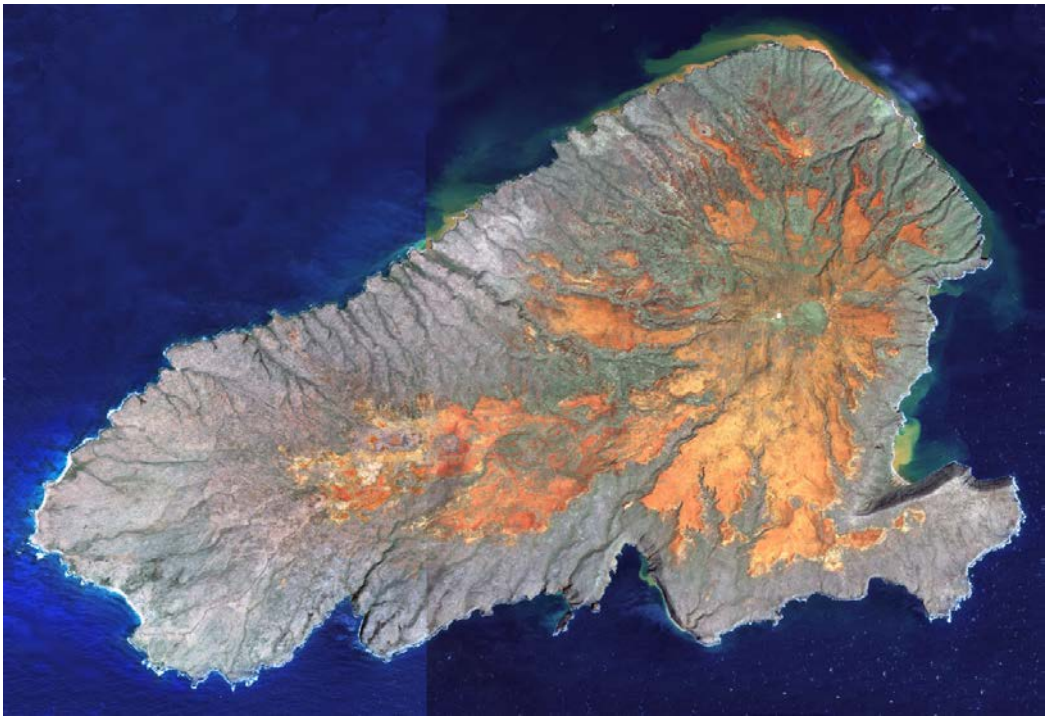
KAHO‘OLAWE ISLAND RESERVE BIOSECURITY IMPLEMENTATION PLAN



Fire Ant (*Wasmannia auropunctata*) G. Brilmyer

Ship Rat (*Rattus rattus*)

Prepared by
LYMAN L. ABBOTT, JAMES C. BRUCH AND PAUL K. HIGASHINO
VER. 11 JULY 2018

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Contributors: Lyman L. Abbott[1], James C. Bruch[1], Paul K. Higashino[1], Dean Tokishi[1], Chad Hanson[2], Pete McClelland[3], Forest Starr[4] and Kim Starr[4] and James Stanford[5].

[1]Kahoʻolawe Island Reserve Commission, [2]Island Conservation, [3]Pete McClleland Environmental Services, [4]Starr Environmental, LLC, [5]USFWS, Pacific Islands Fish and Wildife Office.

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CAPS - Cooperative Agricultural Pest Survey
CISR – Center for Invasive Species Research
CGAPS - Coordinating Group on Alien Pest Species
DAR - Department of Aquatic Resources
DBEDT - Department of Business and Economic Development and Tourism
DLNR – Department of Land and Natural Resources
DOFAW - Department of Forestry and Wildlife
DOT – Department of Transportation
ED/RR – Early Detection/Rapid Response
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act
HDOA – Hawaiʻi Department of Agriculture
HEAR - Hawaiʻi Ecosystems At Risk
HIOSH - Hawaii Occupational Safety and Health
HISC - Hawaiʻi Invasive Species Council.
HPWRA - Hawaiʻi Pacific Weed Risk Assessment
IAS - Invasive Alien Species
IPM – Integrated Pest Management
KIR - Kahoʻolawe Island Reserve.
KIRC - Kahoʻolawe Island Reserve Commission.
LFA - Little Fire Ant (*Wasmannia auropunctata*)
OSHA - Occupational Safety and Health Administration
PIA – Pacific Invasive Ant
PKO - Protect Kahoʻolawe Ohana
PPE - Personal Protective Equipment
RBP- Regional Biosecurity Plan for Micronesia and Hawaiʻi
RCRA - Resource Conservation and Recovery Act
UH – University of Hawaiʻi
USDOA - United States Department of Agriculture
USDOD - Unites States Department of Defense
USDOI - United States Department of Interior
UXO – Unexploded ordnance
WPS - Worker Protection Standards

EXECUTIVE SUMMARY

Hawaiʻi receives on average 15 new introductions of non-native species annually, which is the most of any state in the United States. An invasive alien species (IAS) is defined as a species that is non-native (alien) to the ecosystem under consideration, and whose introduction causes, or is likely to cause economic or environmental harm, or harm to human health. This Biosecurity Plan for the Kahoʻolawe Island Reserve (KIR) was written for a Hawaiʻi Invasive Species Council (HISC) grant entitled "Biosecurity Implementation Plan for the Island of Kahoʻolawe". It details Pre-Border, Border and Post-Border biosecurity detection and highlights IAS pathways and vectors. A KIR Biosecurity Advisory Committee comprised of personnel from the Kahoʻolawe Island Reserve Commission (KIRC) and Protect Kahoʻolawe Ohana (PKO) guides this document and established protocols and ensures the objective and actions are met. This Biosecurity Plan has one objective of keeping new Invasive Alien Species (IAS) from entering the KIR and three (3) actions using an Early Detection/Rapid Response (ED/RR) approach to obtain the objective. The three ED/RR actions are Prevention, Detection and Response and are crucial to a successful Biosecurity Plan preventing new IAS from entering the KIR. Prevention is key and does not allow IAS to enter the KIR. Detection consists of keen observations and monitoring from KIRC Staff and Volunteers, PKO, and Passenger/Cargo Transport Companies. Education and engagement is an essential component of all three actions. Rapid response includes Quarantine and Eradication which occurs on site and is an immediate mitigation of IAS with the Rapid Response Kit.

The island of Kahoʻolawe, the smallest of eight Main Hawaiian Islands, is under the jurisdiction of the State of Hawaiʻi and the KIRC. The KIRC is currently mandated to manage all activities occurring on island including land use and public access, which is only permitted in conjunction with restoration activities and cultural practices of the Native Hawaiian people. The island was a US Navy bombing range between 1941 and 1990 and the island was left littered with thousands of unexploded ordnance (UXO) of almost every type used in warfare at the time. When the Title to the island was returned to the State of Hawaiʻi by the Navy in 1994, the US Navy completed a partial clearance of UXO in November 2003 (Parsons-UXB Clearance Project), after which the State gained full control of access to the island. Land Based biosecurity involves checking all supplies, equipment, personal gear and ceremonial offerings used during cultural practices. These must be carefully inspected before bringing any plant material to island. Baseline botanical surveys have been established on Maui at the Kihei Boathouse property as well as several main ports of entry on Kahoʻolawe. Results of floral and faunal (vertebrate and arthropod) surveys on Maui and Kahoʻolawe are included in this Plan. Protocols for plant nurseries on Maui are established as well as methods for control and eradication of existing IAS. Ocean based biosecurity protocols outline responsibilities of captains and boaters entering into Zones A and B of the KIR, and lists invasive seaweed species not in the KIR.

I. BIOSECURITY (PROBLEM / NEED)

Need for Biosecurity

IAS in the United States cause major environmental damage and losses adding up to more than $138 billion per year (Pimental et al., 1999). **Biosecurity refers to measures that are taken to stop the spread or introduction of IAS to animal and plant life, and is the set of measures taken to manage the risk from IAS to the economy, environment, and health and lifestyle of the people.**

Global and Pacific Island Impacts

An IAS is a non-native organism (plant animal, fungus, bacteria) that can establish a population with the potential to spread and cause harm. IAS that are plants and animals can represent serious threats to the survival of native organisms and natural communities (KICC, 1992a). Their introduction causes or is likely to cause, economic or environmental harm, or harm to human health.

IAS account for more than $130 billion in annual losses in the United States (CISR, 2017). IAS in new regions can pose a significant invasion threats to human health, agriculture, biodiversity and natural ecosystems. Species and community outcomes tend to decline following invasions, especially those for plants (Pysek et al., 2012). Pysek (2012) also mentions the impact of invasive plant species on resident species, communities and ecosystems reducing species richness and abundance of native biota and decreasing local species diversity. IAS decrease the distinctiveness of biological communities.

Potential harm from IAS may cause disease, predation, competition, habitat destruction, or hybridizing with local species. Examples of harm from disease and its effect on human health is the Dengue and Zika virus spread by the *Aedes* mosquito. Habitat destruction from Miconia (*M. calvescens*) has been documented in Tahiti and has spread into Hawaiʻi. Competition may be observed in the Barn Owl (*Tyto alba*) affecting the availability of food resources for the native Pueo (*Asio flammeus sandwichensis*). Habitat destruction is exemplified by ungulates, (goats) eating native vegetation and impacting coastal and near shore ocean resources. Hybridization can take place between the native Koloa Duck (*Anas wyvilliana*) and introduced Mallard Duck (*Anas platyrhynchos*).

Impact to the Hawaiian Islands and Kahoʻolawe

Hawaiʻi (Figure 1) receives an average of 15 new introductions of non-native (alien) species on an annual basis.

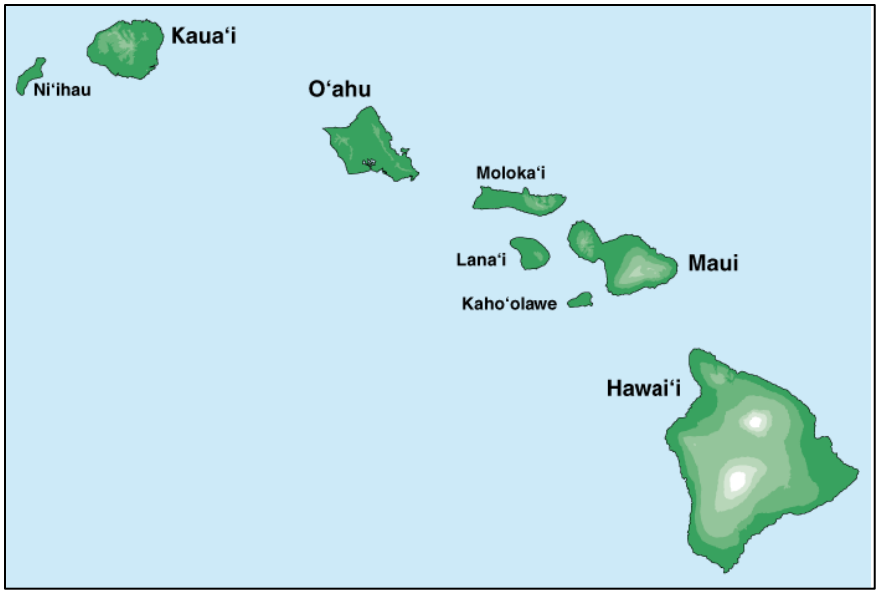

Figure 1 State of Hawaii

KIR Biosecurity Plan Objective and Actions

The transfer of IAS within Hawaiʻi is real, ongoing, and an increasing problem that must be addressed (US NAVY, 2015) and IAS in Hawai'i's natural areas is as critical now as it was in 1992 (Stone, 1992). Therefore one (1) objective and three (3) actions in an Early Detection/Rapid Response (ED/RR) format have been adopted to address this problem.

Using the ED/RR format, there is one objective of the KIR Biosecurity Plan.

- **KEEP IAS FROM ENTERING THE KIR**.

The three actions to accomplish this objective are;

- **Prevention**
- **Detection**
- **Response**

Prevention

Due to the issues with locating, identifying and eradicating IAS once they are on island, (including cost and feasibility of removal), the emphasis of the plan/focus of resources should be on preventing IAS getting to the island rather than trying to detect and eradicate them once they are present. Prevention is the most operationally efficient and cost effective way to prevent IAS establishing, especially for rodents, invertebrates and reptiles (a management action occurs at the Kihei Boathouse). Animal IAS are often cryptic, hard

to detect, relatively mobile and have the reproductive ability to reach unmanageable levels before they are detected.

Awareness and understanding is key to the importance of the Biosecurity Plan and have long term impacts and/or consequences if it is not implemented. It will be the objective of all personnel entering the KIR to implement this adaptive process. Prevention of IAS is key, from getting into Kahoʻolawe Island Reserve (KIR) by ocean vessel or air. (Pre and Post-launch check will be conducted using IAS Inspection Form and quarantine self-check sheet).

Education and engagement of the public and staff is a key component to a successful Biosecurity Plan. Pertinent Information should be disseminated to all staff and volunteers of the KIRC, PKO, and other companies involved in transport of cargo and people to and from Kahoʻolawe (Helicopter, ocean transport). The main message is that IAS are detrimental to native ecosystems and prevention is the most cost effective and efficient approach to control them. Information should be included in orientations and safety briefings regarding prevention, remaining vigilant, and keeping channels of communication open to report biosecurity risks.

Detection

Pre-Border Detection – A record of remedial actions taken with an IAS prior to entering the transportation network to Kaho`olawe should be kept and entered into a KIR Biosecurity Inspection database. Any IAS quarantined and eradicated should be noted on the IAS Encounter Form. End results will include heightened engagement in IAS recognition to improve biosecurity activities.

Border Detection - Remedial actions taken with an IAS after entering the transportation network to Kaho`olawe points of entry are a last defense. End results will include education of personnel in the vector and pathway of the IAS and entry point on Kahoʻolawe. If a rat is observed on a vessel, the Captain shall turn around and go back to Maui or its home island eg. Molokaʻi (California Islands Biosecurity Program, 2013). Do not throw the rat overboard as they can swim in the ocean and potentially reach land.

Post-Border Detection - Remedial actions taken with an IAS on Kahoʻolawe should be recorded and then monitored for a sufficient duration to ensure it has not become established at the entry point. End results include quarantine and/or eradication of the IAS contained with the IAS rapid response kit. All occurrences will be documented on the IAS Biosecurity Inspection Form and entered into the KIR Biosecurity Inspection database.

With early detection, removing recent plant introductions may be possible. However, the options for response to many animal incursions are very limited. Mobile animals are especially problematic. In the time it takes to determine their current localities, they may have spread even further. Once there is an incursion, a social and political reaction for response and eradication should be anticipated. If Pre-Border, Border, and Post-Border

biosecurity detection is not successful, Kahoʻolawe has the potential habitat for sustaining populations of high risk species.

Response to IAS on Kahoʻolawe and Preventing Re-introductions

This requires an appropriate standard of biosecurity to prevent re-invasions. The high economic cost of undertaking most eradications and the impracticality of eradicating many species once they are established, along with the impact that new species may have on ecological and cultural values makes it crucial to ensure that additional IAS do not invade the island or that any species which is able to be eradicated does not re-establish on Kahoʻolawe. This requires an appropriate standard of biosecurity to prevent re-invasions.

Response actions will be initiated when an IAS is detected at any one of the ports of departure and/or on Kaho'olawe. During Response, quarantine the IAS in the most efficient and expedient manner to mitigate the potential introduction. Eliminate an IAS threat immediately on site.

To achieve the objective of keeping new IAS from entering the Kahoʻolawe Island Reserve, these three actions in the ED/RR format need to be learned and performed by all personnel involved entering Kahoʻolawe and supporting logistical operations. Education and engagement and adequate time management needs to be considered in thoroughly performing these three actions.

Kahoʻolawe Base Camp

Located in Honokanaiʻa on the South western side of Kahoʻolawe, the KIRC field base camp has a significant amount of infrastructure (buildings, vehicles) and is usually serviced using the KIRC vessel ʻŌhua which is the landing craft.

Biosecurity Threats to Kahoʻolawe

Since historical times Kahoʻolawe has been increasingly susceptible to IAS introductions. Vitousek (1988) states the accidental or intentional introduction of IAS is one of the most serious threats facing island ecosystems. Although feral ungulates have been eradicated, predatory mammals still occupy the island and include the invasive Polynesian Rat (*Rattus exulans*), mice (*Mus musculus*) and feral cats (*Felis catus*). Endemic species on islands are highly susceptible to local extinction, especially if they are exposed to IAS such as feral cats (Koch, et al, 2016) and ground nests of Pue`o on Kaho`olawe have not been observed. Examples of IAS present in Hawaiʻi with the greatest potential to threaten the ecology of Kahoʻolawe are listed in Table 1.

	Common Name	**Taxa**	**Form**
1	Mongoose	*Herpestes auropunctatus*	Mammal
2	Rat	*Rattus rattus, R. norvegicus*	Mammal
3	Little Fire Ant	*Wasmannia auropunctata*	Ant

	Common Name	Taxa	Form
4	Gorilla Ogo	*Graciliaria salicornia*	Seaweed

Table 1 Examples of IAS present in Hawaiʻi with the greatest potential to threaten the Biosecurity of Kahoʻolawe

Mongoose (US DOA, 2010) and rats (Hathaway and Fisher, 2010) are well known to have severe effects on ecosystems they invade. These animals have been observed at the Kihei Boathouse. The Little Fire Ant was first observed in March, 1999 on Hawaiʻi Island by a resident of Hawaiian Paradise Park in the Puna District and submitted to the Hawaiʻi Department of Agriculture (Conant et al. 2007). There have been recent outbreaks on Maui and they can cause blindness in pets and severely disrupt human activities (Hawaiʻi Ant Lab, 2016). To avoid establishing Little Fire Ant in new areas of Hawaiʻi, Vanderwoude (2008) states knowingly moving material and equipment infested with Little Fire Ant is an offense under Statute (HRS 150A) and Rule (HAR Chapter 4-72).

Failure to abide by the biosecurity protocols addressed in this Biosecurity Plan could allow the introduction of any one of these organisms, and would cause a huge negative impact to the ecological balance of Kahoʻolawe, due to the nature of the animals and limitations of eradication tools and resources currently available. For example, on June 21, 2016, a few white footed ants (*Technomyrmex difficilis*) were inadvertently brought to the kitchen of the KIRC office in Wailuku, Maui on individual bananas and taro (*Colocasia esculenta*) corms. While already present of Kahoʻolawe and a medium threat level (http://idtools.org/id/ants/pia/), this is an example of how easily new invasive ants species could be introduced to Kahoʻolawe without knowing they were present in the edible food items presented to KIRC Staff. A series of Biosecurity signs have been posted at the boathouse entrance as a reminder to people entering the premises to be vigilant.

At the Kihei Boathouse, landscape plants such as Mexican fan palm (*Washingtonia robusta*) from neighboring urban housing and Hotels present a threat and should be evaluated. Also, landscaping materials around these structures might allow Little Fire Ant to arrive in the vicinity of the Boathouse.

Types of Rodents and IAS Plant Seeds

It is important to note that each species brings with it different and often cumulative impacts. While the Polynesian Rat (*R. exulans*) is already present on Kahoʻolawe, any Black Rat would likely have a greater impact as they are good climbers and so are more likely to affect tree nesting birds. The Norway Rat is much larger and can have a greater impact on ground nesting birds. The seeds of many plants are difficult to differentiate. Therefore, it is an important Pre-Border Biosecurity detection to minimize unplanned transfers of IAS plant seeds rather than try and differentiate between species.

Alien Aquatic Organisms

Alien aquatic organisms are species that pose a serious problem in Hawaiʻi, and are a significant threat to people as well as to native ecosystems (State of Hawaiʻi, 2003). Up

to 346 alien marine algae and invertebrate species are currently established in Hawaiʻi State waters (DLNR, 2017) and IAS may consume, outcompete or hybridize with local native species which can result in a loss of biodiversity and ecosystem alteration (Abbott 2001, Vitousek et al., 1997). From HRS 187A 6.5, "*the department or its agents may seize, confiscate, or destroy, as a public nuisance, any fish or other aquatic life found in any waters of the State and whose importation is prohibited or restricted pursuant to rules of the department of agriculture*." Table 2 lists the three invasive fish species found in the KIR that prey on native fish species.

	Taxa	**Common Name**
1	*Lutjanus kasmira*	Taʻape
2	*Lutjanus fulvas*	Toʻau
3	*Cephalophalus argus*	Roi

Table 2 Three invasive fish found in the KIR

Nearly 50 years has passed since the introduction of roi and taʻape, and they spread rapidly (DAR, 2003). In 2015, over 700 pounds of these three fish were removed from Honokanaiʻa Bay in support of a KIRC Hawaiʻi Community Foundation grant.

Table 3 lists the algal taxa that are present in the KIR. This list is compiled from the KIRC Ocean Management Plan (Dames and Moore, 1997).

	Algae in the Kahoʻolawe Island Reserve		
No	**Taxa**	**Hawaiian Name**	**Color**
1	*Codium reediae*	ʻaʻalaʻula (wawaeʻiole)	Green
2	*Ahnfeltia concinna*	ʻakiʻaki	Red
3	*Dictyota sp.*	alani	Brown
4	*Grateloupia filicina*	huluhuluwaena	Red
5	*Sargassum echinocarpum*	limu kala	Brown
6	*Laurencia succisa*	lipeʻepeʻe	Red
7	*Dictyopteris plagiogramma*	lipoa	Brown
8	*Gracilaria coronopifolia*	manauea	Red
9	*Laurencia nidifica*	maneʻoneʻo	
10	*Porphyra sp.*	paheʻe	Green
11	*Ulva fasciata*	palahalaha	Green
12	*Codium edule*	wawaeʻiole	Green

Table 3 Algal taxa in the KIR

Table 4 lists the algal taxa not observed in the KIR. “Cryptogenic” is unclear whether the species is native or introduced.

	IAS Algae not in the Kahoʻolawe Island Reserve		
No	**Taxa**	**Common Name**	**Comment**
1	*Acanthophora spicifera*	Prickly Seaweed	
2	*Avrainvillea amadelpha*	Leather Mudweed	Cryptogenic[1]

	IAS Algae not in the Kahoʻolawe Island Reserve		
No	**Taxa**	**Common Name**	**Comment**
3	*Cladophora sericea*[2]	Green Slime Weed	
4	*Dappaphycus spp.*	Smothering Seaweed	
5	*Dictyosphaeria cavernosa*[2]	Green Bubble Algae	
6	*Gracilaria salicornia*	Gorilla Seaweed	Cryptogenic[1]
7	*Hypnea musciformis*	Hookweed	
8	*Nemacystus decipiens*		Cryptogenic[1]
9	*Wrangalia bicuspidata*		Cryptogenic[1]

Table 4 IAS Algal taxa not observed in the KIR

[1]DAR, 2003.

[2]Personal Communication, D. Tokishi, Ocean Resources Specialist, KIRC

Also, *Eucheuma sp., Kappaphycus sp.* and *Ulva reticulata* are introduced seaweeds in Hawaiʻi (Gulko, 1998), and once they establish a foothold and grow atop coral beds, they are very difficult to eradicate. The smothering seaweeds (*Kappaphycus sp.*) have the ability to overgrow and kill corals. Green Slime Weed, (*Cladophora sericea*) and Green Bubble Algae (*Dictyosphaeria cavernosa*) would also be undesirable introductions into the Reserve. Figure 2 is a Department of Aquatic Resources (DAR) sign that was posted on a KIRC gate at the Kihei Boat Ramp in February, 2016 for other boaters to observe.

Figure 2 DAR sign posted at Kihei Boat Ramp February, 2016

II. INTRODUCTION AND BACKGROUND

Natural History

The island of Kahoʻolawe is a single shield volcano and is 1.03 million years old. It is located 11.2 km (7 mi.) southwest of the island of Maui. Kahoʻolawe is 17 km (10.6 mi.) long, 11 km (7 mi.) wide and 11,520 ha (28,800A) in size (45 mi^2). Its highest peak reaches 450 m (1477 ft.). Kahoʻolawe consists of eroded uplands of exposed, unfertile hardpan with severe gullying, drainage basins lined with predominantly alien dry shrub land vegetation, and ephemeral streams, which discharge sediment laden waters into a variety of marine environments, including coral reef ecosystems. Temperatures on the island range from 19ºC to 31ºC (66 °F to 88°F) and there are 24 watersheds. Average rainfall is 60 cm/yr. (25 in/yr.) and streams are ephemeral. Kona (southerly) storms generally bring the heaviest rainfall from November to March. Wind speeds range from 8 to 50 km/h (5 to 31 mph) with occasionally higher gusts.

Kahoʻolawe is comprised of mainly of dry forest and coastal habitat. Hawaiian Dry Forests are ranked 10th of the 21 most endangered ecosystems in the United States. This is based upon decline in original area since European settlement, present area, and imminence of threat and number of federally listed endangered and threatened species (Noss and Peters, 1995). Although much of the habitat is denuded, the island is home to rare and endangered species such as the Hawaiian Hoary Bat (*Lasirurus cinereus semotus*), Band-rumped storm petrel (*Oceanodroma castro*) and also is an important site for Hawaiian monk seal (*Neomonchus schauinslandi)* pupping. Endangered plants naturally occurring on Kahoʻolawe include the ʻOhai (*Sesbania tomentosa*) and akoko (*Chamaesyce celastroides var. amplectans*). Endangered insects include two yellow faced bees (*Hylaeus spp.*) and the Blackburn Sphinx Moth (*Manduca blackburni*).

Land Use and Land Owners

Kahoʻolawe is under the jurisdiction of the State of Hawaiʻi, and the KIRC is currently mandated to manage all activities occurring on the island. This includes land use and public access, which is only permitted in conjunction with restoration activities and cultural practices of the Native Hawaiian people. The KIRC was established by the Hawaiʻi State Legislature in 1993 to manage the Kahoʻolawe Island Reserve while it is held in trust for a future Native Hawaiian sovereign entity. The KIRC establishes policies and usage of the island and its surrounding waters through comprehensive restoration and monitoring programs. Its Cultural Program integrates a Native Hawaiian cultural perspective into all programs and activities. The organization is managed by a seven-member Commission and a committed staff.

The PKO are important stewards of the island and operate a base camp in Hakioawa on the northeast coast of the island. The PKO Vision & Mission statement is as follows; VISION: Aloha ʻĀina, love of the land MISSION: To perpetuate Aloha ʻĀina throughout our islands through cultural, educational, and spiritual activities that heal and revitalize the cultural and natural resources on Kanaloa-Kahoʻolawe.

The majority of Kaho‘olawe is currently off limits due to the presence of UXO. Therefore, restoration activities and cultural access have only been allowed in areas defined as Tier I (where there has been UXO surface clearance only) and Tier II (where clearance was completed to 4 feet depth).

The entire island of Kaho‘olawe is listed on the National Register of Historic Places, and contains over 3000 archaeological features and 544 archaeological sites. Pre-contact settlement of Kaho’olawe began around the year AD1000 when small communities flourished around the coastline (KICC, 1993). Severe loss of vegetation and significant soil erosion started with the introduction of goats (*Capris hirca*) in 1793. In 1880, at the beginning of the Ranching Period, Mouflon sheep (*Ovis musimon*) and cattle (*Bos taurus*) were also introduced and numbered 900 and 12,000 animals respectively in 1890 (Appendix A).

The goat population reached approximately 50,000 animals at its peak (KIRC, 1998) and goats were subsequently eradicated by 1993. This period of grazing left an island with a severely denuded landscape and areas exposed to high winds and rain with no vegetation cover. The island became a US Navy bombing range between 1941 and 1990. Explosions on the soil left barren from grazing, accelerated the pattern of erosion on the plateaus and high grounds on the island, leaving an exposed hardpan and very little topsoil to promote vegetation growth. In addition, the island was left littered with thousands of UXO of almost every type used in warfare at the time. When the Title to the island was returned to the State of Hawai‘i by the US Navy in 1994, they completed a partial clearance of UXO (Figure 3) in April 2004 (Parsons-UXB Clearance Project), after which the State gained full control of access to the island.

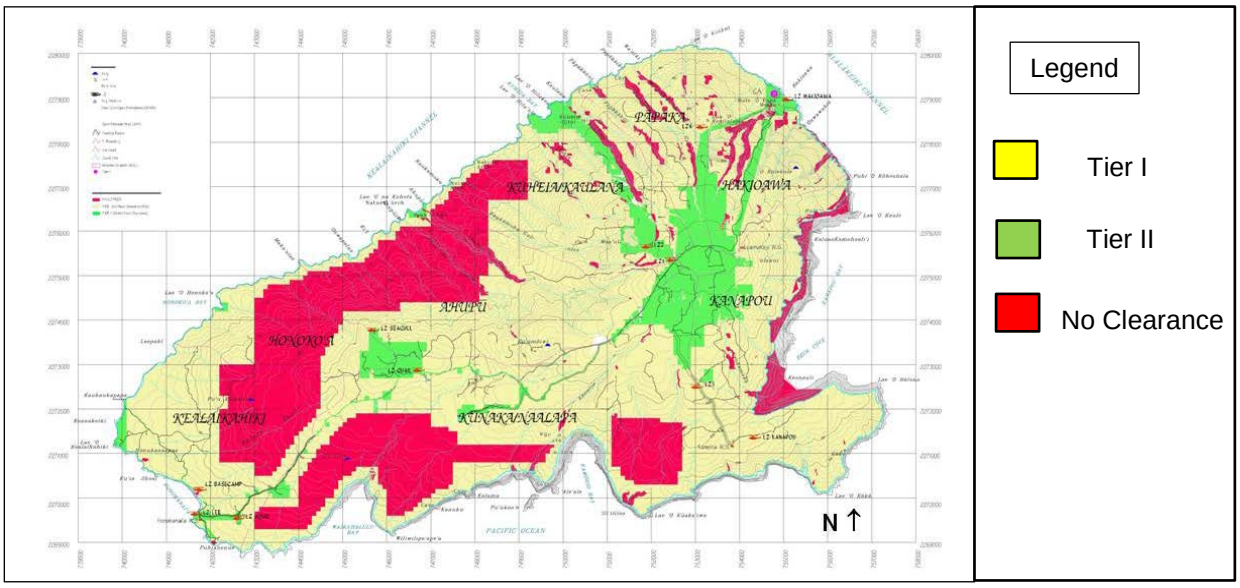

Figure 3 Final Clearance Map of Kaho‘olawe

Protect Kahoʻolawe Ohana (PKO)

A crucial partner in implementing any effective biosecurity for Kahoʻolawe is the PKO, an independent group working to re-establish the native Hawaiian cultural link with the island. The base on the northeastern side of the island in Hakioawa is used for monthly visits to the island for cultural purposes including utilizing volunteer groups for restoration purposes.

The PKO is the most important partner with the KIRC and has shown a good level of biosecurity in logistics and procedures leading up to and during an access (Pete McClelland Environmental Services, 2017). For example, all food was packaged in plastic bags shortly after purchase. For both the KIRC and the PKO, the transport of plant material does pose a significant risk which must be managed, and actions should include;

- Include all current biosecurity practices in this Biosecurity Plan
- Audit on the ground practices in this Biosecurity Plan
- Alter the practices and/or Biosecurity Plan so that they are consistent
- Share Knowledge and Experience through KIR Biosecurity Advisory Committee

KIRC Management Support

There is a high level of support at all levels in the KIRC management for biosecurity for Kahoʻolawe (McClelland, 2017). This support generates compliance from KIRC and PKO personnel and makes biosecurity part of the organizational ethos.

Vectors and Pathways

Vectors are means of travel for an IAS to get to Kahoʻolawe. Pathways are departure locations and entry points with biosecurity risks of IAS on Kahoʻolawe. These pathway locations and their associated vectors are listed in Table 5.

Vector	**Departure Location**	**Entry Point on Kahoʻolawe**
Helicopter	Kahului Heliport, Puʻu Nene Airfield	LZ Base Camp, LZ Quail LZ-1
Boat	Kihei Boat Ramp, Maʻalaea, Lahaina, Kaunakakai, Kaneohe	Honokanaiʻa, Honokoʻa, Kuheʻeia, Hakioawa, Kanapou
Wind	Maui Nui (Maui, Molokaʻi, Lanaʻi)	Kahoʻolawe
People	All of the above	All of the above
Personnel Gear	All of the above	All of the above

Table 5 Vector, Departure Location and Entry Points on Kahoʻolawe for IAS

If resources allow, all reasonable and manageable vectors and pathways will be covered by this Biosecurity Plan, and will be considered equally but not necessarily be

given the same priority for resources, if the risks differ between them. Risk being defined as likelihood times impact.

Biosecurity risks from locations of departure (boat harbors and air fields) on Maui and entry points on Kahoʻolawe are illustrated in Figure 4.

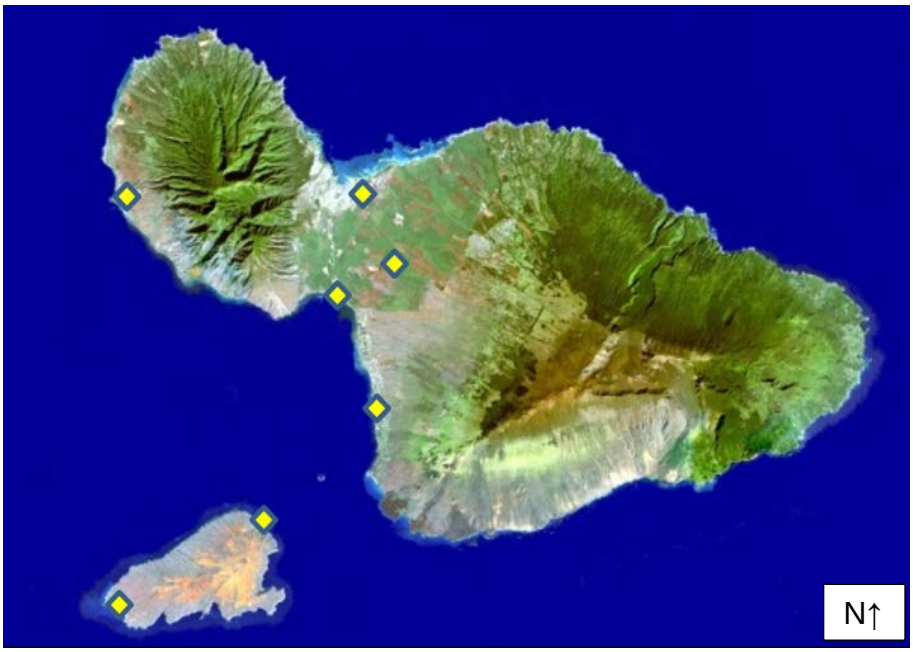

Figure 4 Biosecurity risks form Locations of Departure on Maui and Entry Points on Kahoʻolawe

The island has two main entry points at Hakioawa with PKO and Honokanaiʻa with the KIRC. If Post-Border inspections in these entry points reveal an IAS, the Pre-Border and Border protocols on Maui (and other islands) were not successfully implemented. In case of an IAS introduction in either one of these entry points, the Post-Border protocols described in this Biosecurity Plan for Kahoʻolawe should be implemented.

There are six (6) different methods for accessing Kahoʻolawe.

1.) KIRC access via ʻŌhua
2.) KIRC Access via a different vessel (NOAA, Charter)
3.) PKO Access via charter vessels
4.) Helicopter access including supply
5.) Other vessels and groups including canoe clubs
6.) Larger vessels for Construction Projects involving a large amount of equipment and supplies.

Other vessels that transport personnel to and from Kahoʻolawe include PKO vessels, catamarans from Lahaina and Maʻalaea, and occasionally, double hulled canoes (Figure 5) escort fishing boats and outrigger canoes from local Canoe Clubs.

Figure 5 Double-hulled canoes such as the Hokuleʻa will visit Honokanaiʻa bay for ceremony.

The transport of passengers, materials and supplies for cultural protocols and vegetation restoration presents a high risk that any rodents present on Maui (or source island) will eventually reach Kahoʻolawe (Parkes, 2009). Due diligence from all parties is required to maintain a significant biosecurity barrier from rodents reaching Kahoʻolawe. Only through education and engagement**,** introduced through volunteer orientations and pre-trip briefings, will ensure that rodents do not breach biosecurity measures and make it onto the island. In addition to volunteer briefings, a biosecurity tab was created on the KIRC website.

Kihei Boathouse Property

Acquired in 1999 for future use as an office/information center, Boathouse/storage facility, and native Hawaiian plant nursery (Executive Order No. 3963) an 8.2 acre parcel was used to build a Boathouse for the KIRC vessel Hakilo. It is now developing a Hale Hoʻoulu Mea Kanu (Plant Nursery) and Kalamalama (Education center), in a "Building Bridges Between Kahoʻolawe and Kihei" Project granted through the Kūkulu Ola (*Build Life*): Living Hawaiian Culture grant program from the Hawaiʻi Community Foundation and Hawaiʻi Tourism Authority, Atherton Family Foundation and Alu Like, Inc.'s Native Hawaiian Career and Technical Education Program. The Kihei Nursery is under development and may be providing native flora to Kahoʻolawe. The Boathouse is the main point of departure and supports the operations of the current KIRC vessel ʻŌhua to transport materials and passengers to Kahoʻolawe. Figure 6 illustrates the approximate boundary of the 8.2 acre Kihei Boathouse property (and Kihei Boathouse and Nursery in Yellow) located at 2780 S. Kihei Rd., Kihei, HI 96753.

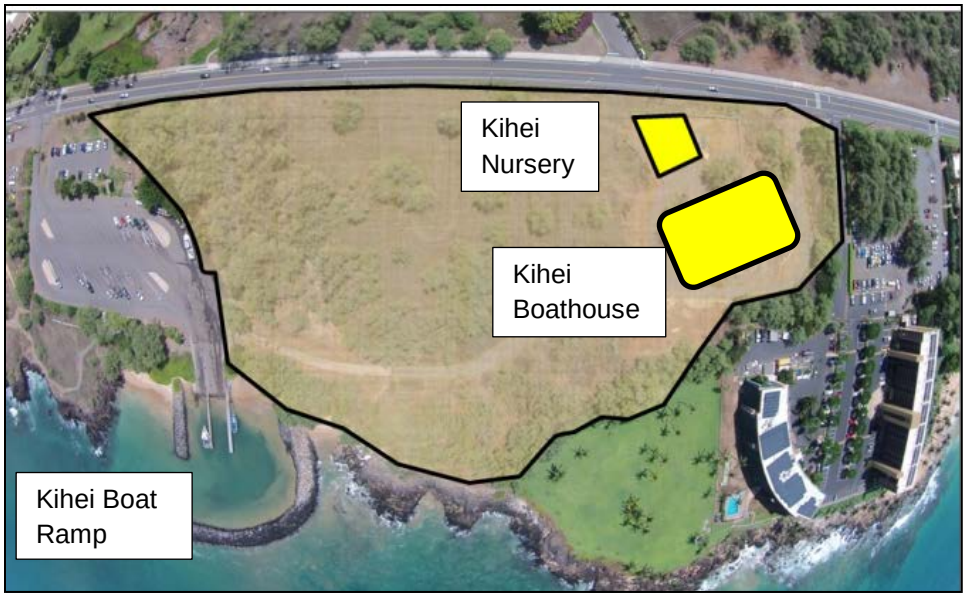

Figure 6 Eight acre Kihei Boathouse property and adjacent public boat ramp

Figure 7 illustrates the Kihei Boathouse and surrounding dry Kiawe (*P. pallida*) forest habitat.

Figure 7 Kihei Boathouse and surrounding urban habitat

Figure 8 illustrates clutter along the Boathouse fence line where rodenticide bait has consistent uptake. The discovery of Giant African Snails (*Achatina fulica*) also demonstrates that there is abundant cover and moisture in this area providing habitat for additional IAS.

Figure 8 Clutter along the Boathouse fence line

Biosecurity Planning Concepts

In order to be effective a Biosecurity Plan must be;

- Affordable
- Sustainable
- Effective
- Achievable
- Acceptable/Justifiable
- Enforceable
- Understandable
- Supportable

The Biosecurity Plan should be fully implemented with the available financial and personnel resources and remain logistically achievable within the available resources and time frames. The KIRC must be able to resource the establishment of the proposed on-going protocols and systems, and to purchase equipment and develop educational material. While it is not necessary all protocols and standards clearly stated in the Biosecurity Plan occur at one time, any proposed phase-in must also be appropriately audited and reviewed. If biosecurity measures are proving to be ineffective, the actions could target only higher risk species or specific vectors and pathways. The Biosecurity Plan should state what is able to be achieved and highlight any facets that will be implemented later if and when resources become available. This will allow auditing of the procedures that are supposed to be in place at the given time.

The objective and actions of the Biosecurity Plan should be supported by visitors, partners, and staff. In order for them to be fully engaged it should be readily understandable and clearly stated and disseminated in a thorough and timely manner. If the requirements of the Biosecurity Plan are too arduous and impractical to comply with,

and personnel do not become engaged and accept the necessity of the protocols, visitors on access and staff will circumvent the biosecurity process. Therefore, the Biosecurity Plan should be kept as simple as possible while still covering all the required detail. Once biosecurity protocols become established as standard practice and part of the management, the requirements may become more stringent.

Acceptance and support of the Biosecurity actions by personnel is one of the overall desired outcomes. However, it is highly likely that some individuals will not fully engage with what is required. Also, due to time constraints, biosecurity protocols may fail to be the priority they should be. Therefore, a Biosecurity Officer responsible for the implementation of the Biosecurity Plan will also have the ability to perform periodic checks of personal gear, equipment, off-highway vehicles, vessels, barges, helicopters, vectors and pathways. Examples of non-compliance should be used as an educational tool for the group and future orientations.

The Biosecurity Plan should have support and priority at all levels within the KIRC Staff and the Commission, especially at management level. Staff should feel like they have management support, so they will not be inclined to step up and make any hard decisions necessary to maintain the set standards for biosecurity, even if it is inconvenient or at a financial cost. If staff believes that set biosecurity standards are supported by management they will not be inclined to do what is easiest/cheapest possibly at the expense of biosecurity. In order to maintain the set biosecurity standards, it is quite possible that an access would need to be postponed, or at least containers of equipment and supply not taken to island delaying work programs. This has an operational/ financial cost but all personnel must see that cost as secondary to maintaining the standards.

This Biosecurity Plan provides background information that will assist with the various aspects of biosecurity, but does not record in detail the current level of biosecurity in place that is happening in the field regarding the biosecurity process undertaken by KIRC staff and the PKO. While the level of biosecurity are currently good (McClelland Environmental Services, 2017), and there is a high standard of biosecurity built into the normal operations of servicing the island, there will be opportunities to make improvements. The KIRC staff and the PKO need to always be aware of the impacts of IAS and consequently the importance of biosecurity to protect the island from additional IAS.

The first and most important step in improving biosecurity for Kahoʻolawe is to document what actions are currently taking place. Documenting what is currently being done allows these processes to be standardized allowing for logistical differences between groups across all visitors and accesses and reviewed formally and informally to look for possible improvements as new opportunities, technology and resources are identified. It allows for on-going audits of the processes to ensure that the agreed standards are being followed.

All groups will be treated equally so no one feels like they are being singled out. The KIRC will lead by example and not be hypocritical by not following their rules. This Biosecurity Plan states here that “Everyone and Every Group Should Be Treated Equally”

and what the KIRC is doing can be readily shown to all parties, partners and funders. The ability to enforce strict biosecurity (comprehensive inspection of all equipment and supplies) is limited so improving biosecurity requires education and engagement with acceptance from all visitors.

Hawaii Interagency Biosecurity Plan (HIBP) 2017-2027

The HIBP 2017-2027 addresses the most critical biosecurity gaps in the State and provides a coordinated, interagency path for actions to be taken by government agencies and partners. It increases support for local agriculture, protection for our environment, and safeguards for the health and lifestyle of Hawaiʻi's people. The HIBP was created for a stronger IAS policy, infrastructure and capacity by 2027. The Biosecurity Vision is for Hawaiʻi's people, visitors, economy, agriculture, and natural environment to be protected from the impacts of IAS. Achieving this will require hard work, policy development, and financial commitment (HIBP, 2016). Five (of the ten) highlights in the HIBP (2016) which are the keys to a successful Biosecurity Plan align with the KIR Plan and are as follows.

- Inspection facilities – Well-lit secure containment area for inspection, quarantine, treatment, and pest destruction capabilities and refrigerated area for produce.
- Emergency response capacity – Interagency Plans, protocols, and funding in place for timely and effective response to new pest incursions.
- Enhanced control of established pests – Adequate field staff at HDOA, DLNR, DOH, and UH to control established IAS, improved laboratories to support effective biocontrol.
- Minimized interisland spread – Increased staff and inspections for interisland goods, support to local farms and nurseries through certification programs and import substitution programs.
- Educated and engaged supportive community- Targeted outreach to different stakeholder groups to increase awareness through education and engagement in biosecurity programs.

Although Hawaiʻi is the most isolated archipelago in the world, IAS impact our local economy, environment, human health and our quality of life. In Hawaiʻi, $378 million will be requested by the HDOA over a ten year time span for IAS (HIBP, 2016). Federal agencies such as the USDOA, US Customs and Border Protection and the USFWS play a key role in Hawaiʻi's biosecurity and they regulate foreign imports and provide technical and funding support to state and private landowners to manage IAS (HIBP, 2016). The USDA Animal and Plant Inspections Service, US Department of Homeland Security and Customs and Border Protection are responsible for intercepting pests from foreign points of origin.

From the executive summary of the HIBP, Red Fire Ants are predicted to cost Hawaiʻi $211 million per year, and the Brown Tree Snake could cause upward of 2.14 billion per year in economic damages (HIBP, 2016). In 2001, the Hawaii legislature stated that the invasion of Hawaiʻi by IAS is the greatest threat to the economy, natural environment and

health and lifestyle of the people (HIBP, 2016). Hawaiʻi's flora has one of the highest rates on endemism in the world, with an estimated 10,000 endemic species (HISC, 2015) and it's IAS problem is also the most severe of any state (HISC, 2004). The resulting uncontrolled population growth and spread causes economic or environmental problems (CISR, 2016). Governor Ige has a Sustainable Hawaiʻi Initiative (**http://governor.hawaii.gov/sustainable-hawaii-initiative/**) which includes strengthening our waters, land and food for Hawaii's communities and includes the HIBP.

Hawaiʻi Invasive Species Council (HISC)

Established in 2003 by the Hawaiʻi State Legislature, the Hawaiʻi Invasive Species Council (HISC) is a State interdepartmental collaboration that was formed in response to a Legislative Reference Bureau report (Ikuma et al., 2002). A Senate concurrent resolution (No.45 H.D.1, 2001) directed the Legislative Reference Bureau to conduct a study on policy recommendations and funding options for a comprehensive IAS protection and control program for the State of Hawaiʻi. Gaps were identified in IAS management statewide, exposing the risks to Hawaiʻi's Biodiversity (a measure of the variety of organisms present in different ecosystems). A highlight from the report states

"*The alien invasive species problem in Hawaii is both serious and daunting. The damage that invasive species cause and may potentially cause affects the State's health and safety, as well as its economic and environmental well-being*." Also "*invasive species pose a constant and costly threat to Hawaiʻi's native ecosystems functions, biodiversity, watersheds, industries including tourism, agriculture, aquaculture, shipping, public health and the quality of life of residents and visitors*" (http://dlnr.hawaii.gov/hisc/info/).

The HISC was authorized by Chapter 194, Hawaiʻi Revised Statutes (HRS-194) and was created to provide policy level direction, coordination, and planning among state departments, federal agencies. Also, to develop international and local initiatives for the control and eradication of harmful IAS infestations throughout the State, and for preventing the introduction of other IAS that may be potentially harmful.

The HISC is co-chaired by the Department of Land and Natural Resources (DLNR) and the Hawaiʻi Department of Agriculture (HDOA) and includes the members from the University of Hawaiʻi (UH), the Hawaiian Department of Business and Economic Development and Tourism (DBEDT), the Hawaiʻi Department of Health (DOH) and the Hawaii Department of Transportation (DOT). The HISC is composed of five working groups chaired by member agencies dealing with prevention, established pest management, public awareness, research and technology and natural resources. The HISC seeks to maintain a comprehensive overview of issues and supports state wide IAS prevention, early detection and control programs in the effort to provide a testing ground for innovation in methods and capacity to address IAS which can be adopted permanently by other funded agencies.

In addition, the leaders of the following Departments and organizations are non-voting participants in HISC meetings for interagency dialogue: State Senators and

Representatives, Additional state agencies, County Mayors, Federal agency representatives from the US Departments of the Interior (US DOI), US Department of Agriculture (US DOA), and the US Department of Defense (US DOD). Hawaiʻi Ecosystems at Risk (HEAR, 2016) assists with identifying IAS for plants and animals in Hawaiʻi. Finally, the Coordinating Group on Alien Pest Species (CGAPS) is a statewide partnership of agencies and organizations working together to promote policy and procedural change to close the gaps in Hawaiʻi's biosecurity. The Vision statement from HISC's Strategic Plan for 2015-2020 protects Hawaiʻi's unique natural environment from the impact of IAS.

The HDOA which is the only agency with a mandated biosecurity program, and the DLNR which is empowered by the HIBP, are the two primary state agencies responsible for biosecurity, but received less than 0.4% and 1% respectively of the $13.7 billion state operating budget in FY 16-17 (HIBP, 2016). State agencies such as the DOH and UH, as well as Federal agencies including the United States Department of Agriculture (USDOA) and the United State Fish and Wildlife Service (USFWS), also play a role in Hawaiʻi's biosecurity.

Cultural Protocols and Ceremonial Offerings

It is recommended that individuals thoroughly inspect and clean by hand all items to be transported to KIR and when feasible soaking/cleaning items in saltwater and/or freezing. All items for transport will be inspected by trained staff prior to entry into the transportation system and debarkation. Items which may pose an unacceptable risk of transporting pest to island will be refused transport.

Recommendations include thoroughly inspecting and cleaning by hand or soaking and cleaning in saltwater or, if appropriate, freezing. Any IAS observed must be removed from the item before transporting to island.

All plant matter (ti, ferns, banana, breadfruit, sweet potato, coconuts) must be inspected for any animals, invertebrates (especially ants), scale, moss or fungus that might be transported to island.

Chapter 6K Hawaiʻi Revised Statutes [§6K-3] states that, "The Kahoʻolawe island reserve shall be used solely and exclusively for the following purposes; Preservation and practice of all rights customarily and traditionally exercised by Native Hawaiians for cultural, spiritual, and subsistence purposes". The KIRC has pledged to provide for the meaningful and safe use of Kahoʻolawe for the purpose of the traditional and cultural practices of the Hawaiian people (KICC 1993, KIRC 1995). Several cultural ceremonies are performed annually on Kahoʻolawe including Makahiki, the Rain Ceremony (Ka Holo i ka lani) and monthly volunteer trips by both the KIRC and the PKO. It is imperative ceremonial offerings (hoʻokupu) in Figure 9, as well as individual field gear are thoroughly inspected by PKO access leaders and/or KIRC staff for IAS before they are brought to Kahoʻolawe.

Figure 9 Hoʻokupu on Kahoʻolawe

Kahoʻolawe Island Reserve (KIR) Biosecurity Advisory Committee

Managing IAS on Kahoʻolawe involves prevention of pest establishment and controlling those already there (Broome, 2007). To establish protocols for the KIRC Biosecurity Plan, a KIR Biosecurity Advisory Committee has been formed to guide the document and established protocols, and ensure the one objective and three action items are met. The members name, title, and affiliation are as follows (Table 6).

KIR Biosecurity Advisory Committee			
Member Name	**Title**	**Affiliation**	**Comments**
Mike Nahoʻopiʻi	Executive Director	KIRC	Executive Director
Paul Higashino	Natural Resource Specialist V	KIRC	Program Manager
James Bruch	Natural Resources Specialist III	KIRC	Restoration
Lyman L. Abbott	Natural Resources Specialist III	KIRC	Restoration
Dean Tokishi	Ocean Resource Specialist III	KIRC	Program Manager
Lopaka White	Natural Resources Specialist II	KIRC	Boat Captain
Grant Thompson	Kahoʻolawe Island Reserve Specialist III	KIRC	Boat Captain/Kihei Boathouse
TBD	Biosecurity Specialist	HISC/HDOA/DLNR	
TBD	Access Leaders	PKO	
TBD	Access Leaders	PKO	

Table 6 Members of the KIR Biosecurity Advisory Committee

The first meeting of the KIR Biosecurity Advisory Committee took place in April, 2017. An additional biosecurity specialist from the HISC, HDOA or DLNR would be beneficial.

Current management issues and actions are presented during regular KIRC Staff Meetings. Biosecurity issues are then shared with the PKO.

Biosecurity for Parsons-UXB Clearance Project (1998 - 2003)

Biosecurity measures during the Parsons UXB Clearance Project, for IAS vectors included inspecting personnel boots, socks, pants and hats. Prior to boarding aircraft, daily self-inspection as well as Natural Resource Specialists observing personnel foot gear and back packs occurred. Equipment, containers and transportation vehicles (helicopters) were also inspected. Large barge inspections took place on Oʻahu and small barge inspections on Maui.

III. CURRENT OPERATIONS

Volunteer Orientation and Biosecurity Protocols

The first step of anyone who accesses Kahoʻolawe is the mandatory volunteer orientation which occurs before the trip. Access begins at the orientation. This occurs on the home island of the group or individual and covers expectations and behaviors of the volunteer while on Kahoʻolawe. During orientation, volunteers are provided with details regarding their role in supporting KIR biosecurity standards. For IAS, this addresses **Prevention, Detection and Response** and includes pictures of key detrimental organisms that can severely impact the ecology of the island (Figure 10).

Figure 10 A slide from the KIRC volunteer orientation presentation on Biosecurity

KIRC and PKO Websites

Biosecurity standards are provided on the KIRC (www.kahoolawe.hawaii.gov/home) and PKO (www.protectkahoolaweohana.org) websites. They are also available as needed for volunteers on arrival at the location of departure. The Biosecurity page stresses the importance of protecting the KIR from IAS using the three actions of

Prevention, **Detection** and **Response**. The PowerPoint presentation is available on the KIRC Website on the Biosecurity page.

Biosecurity Signs

A simplified 1 page KIR Biosecurity Sign (Appendix B) for the KIRC and PKO has been created to present a visual image in volunteer orientations at the Kihei Boathouse, where personnel congregate before the island access, and on Kahoʻolawe as reminder of biosecurity protocols. They were designed to be conspicuous, and to remind people how to inspect their personal equipment before going to Kahoʻolawe.

Biosecurity signage is posted at the KIRC Boathouse in Kihei (Figure 11).

Figure 11 KIR Biosecurity signage and information to address the objective and three actions

The concrete slab is a Biosecurity Checkpoint (Pre-loading/loading quarantine area) to inspect incoming materials to be stored at the Boathouse, and outgoing materials to Kahoʻolawe. Volunteers and visitors place their bags and equipment on this slab for IAS **Detection** before it is loaded onto the KIRC vessel.

Protocol for the Prevention of IAS Introduction

In addition to the updated KIRC Biosecurity tab with information for visitors, volunteers and researchers at http://kahoolawe.hawaii.gov/biosecurity.shtml The KIRC website lists the following information for Biosecurity Procedures;

"Control of introduced plants and animals and restoration of native plants and animals are principal goals of the KIRC to restore Kahoʻolawe. New accidental entries to the

*island add to an already extensive list of alien species, resource management workers, with increased urgency, call for stricter control measures to prevent alien ingress (*prevent introducing unwanted IAS) *into natural areas. Every person is a possible vector (transmitter or carrier) of alien species. Taking preventative measures to hinder the introduction of alien invasive species to Kahoʻolawe is crucial to preserving the native environment.*

These measures include:

- *Inspecting all clothing, gear, and equipment before coming to Kahoʻolawe. Field pests include weed, seeds, and insects. Thoroughly clean footwear, socks, pant legs, jackets, rain gear, tools, packs, and other containers.*
- *Thoroughly wash and dry all swim clothes and gear. Dip snorkel and fins in a light bleach solution prior to your Kahoʻolawe access. Invasive algae are just as dangerous as terrestrial weeds.*
- *Become acquainted with Hawaiʻi's invasive species, their status, and locales. Learn which are localized to your area and be alert for those established on other islands or natural areas.*
- *Keep localized infestations from becoming established on other islands or in other preserves. Avoid spreading pests from your home that your destination may not have, and vice versa, by inspecting and cleaning.*"

This information and a Quarantine Self-Check Sheet (Appendix C) guides the volunteer through a list of personal and cultural items to inspect for IAS before the trip. The form can be completed as the person packs their gear, and then signed. This will reinforce the observation of seeds (and other unwanted items) in their preparation, and make them accountable for their actions even if no further inspection takes place. The signed checklist could become a part of the overall access and volunteer registration process. Having all personnel, regardless of whether they are staff, regular visitors or volunteers complete the form reinforces the priority that everyone (KIRC and PKO, canoe clubs) is treated the same.

Land Based Biosecurity and Standard Operating Protocols

Land Based Biosecurity will implement the ED/RR approach using the three actions to achieve the objective. A quarantine self-check sheet will be made available to the staff and volunteers to fill out before a trip to island.

The transport of personnel and equipment to and from Kahoʻolawe is performed by the KIRC vessel ʻŌhua (Figure 12). It is a 39 foot ALMAR® with twin Cummins diesel engines.

Figure 12 KIRC vessel ʻŌhua at Kihei Boathouse

Recommended Actions

The KIRC has identified priority target fauna and flora species (mongoose, rats, ants, Khaki weed, puncture vine) at the Kihei Boathouse property to be managed for quarantine and possible eradication.

The ʻŌhua is a primary vessel and vector (carrier of IAS) to Kahoʻolawe, so it is imperative observant eyes support the action of **Prevention, Detection and Response** of any IAS in the cargo. This is key. When loading in the early morning hours, it is important to have bright lights in the Boathouse and on board to visually inspect the gear so that is free from any ants, insects or rodents. Sticky Traps should be collected and disposed of properly. Education for all personnel involved should be included as follow up once the IAS Quarantine Form is completed and updates made to this Biosecurity Plan as appropriate.

KIRC staff will thoroughly inspect and load equipment (stored in the Boathouse in plastic bins) onto the deck of the vessel and then transport to Kahoʻolawe. All stored lumber (foreground in Figure 12) must be inspected for IAS before loading onto the vessel for transport to Kahoʻolawe. Ideally lumber should not be stored on the ground as ants can nest in the wood stack (Figure 13).

Figure 13 Ant nest in stored lumber at Kihei Boathouse

All cardboard and boxes sitting in or outside the Boathouse must be inspected for IAS before loading onto ʻŌhua. Also, reduced clutter, use of metal trash bins, control of water supplies and properly discarded food will help eliminate resources for rodents. It should be realized exclusion of IAS from property and storage units is never permanent and must be maintained on a continual basis (Hoddenbach, 2005). The ʻŌhua should not have anything hanging off the side of the vessel such as lines or webbing. Ladders should not be stored leaning against the vessel in which rats or mongoose could crawl up and into the holds. Rats have been known to be able to jump 4 feet high. Using a "Rapid Response" approach, if there is a **Detection** of IAS, they need to be quarantined immediately in proper containment (glass jar, plastic vile). Figure 14 illustrates an inspection of bananas.

Figure 14 An example of inspecting supplies for IAS before departure to Kahoʻolawe

<u>IAS Rapid Response Kit</u>

The IAS Rapid Response Kits will be on vessels, locations of departure and entry points to Kahoʻolawe. This includes the ʻŌhua, the Kihei Boathouse and Honokanaiʻa Base Camp. The PKO will be provided with one kit for accesses to Hakioawa.

IAS Rapid Response Kit Contents

The IAS Rapid Response Kits should consist of insecticides, sticky traps, collection jars and vials (Figure 15) and other appropriate equipment (aspirator) to capture and dispatch organisms. This will ensure a “Rapid Response” to Quarantine the IAS threat.

Figure 15 IAS Rapid Response Kit

Appropriately stocked and readily accessible kits will help improve Rapid Response to a variety of potential IAS.

IAS Encounter Form

The IAS Encounter Form will be used to document the ED\RR (including Quarantine and Eradication) actions taken for dispatch and identification of the IAS. With **Response**, the date, time and location of the Quarantine action will be filled out on the IAS Encounter Form. Also take a picture of the organism, list what organisms were observed, disposition (captured, stored, escaped), number of organisms encountered, type of cargo/equipment it was associated with, and how encounter occurred (during inspection, loading, in transit). Other information such as who was involved should be documented if possible. If eradication of the IAS occurs on site (on a vessel, departure location or entry point), it should be accomplished with the IAS Rapid Response Kit. The IAS Encounter Form is available in Appendix D.

Kihei Boathouse Rodent Control

To control rodents at the Kihei Boathouse, Contrac® all-weather Blox® rodenticide is currently used (Figure 16) and recorded in the Rodent Control Log (Appendix E).

Figure 16 Contrac® Blox® bait

The active ingredient is Bromadiolone 0.005% which is less toxic to non-target animals in primary and secondary poisoning Target pests: Norway rats (*R. norvegicus*), Roof rats (*R. rattus*).

Contrac® bait blocks are a multi-edged, single feeding Rat and Mouse bait. It is formulated with an optimal blend of food grade ingredients and low wax to yield a highly palatable, weatherable bait that is very attractive to rodents. The Blox® is placed in a tamper resistant Protecta® Bait station (Figure 17) to keep non-target animals such as dogs and cats from the bait.

Figure 17 Protecta® Rodenticide Bait Station

The number grams of bait maintained within bait stations will follow the manufactures recommendation on the product label. Stations will be placed at densities according to specifications from the manufacturer. To control for mice and rats permanent bait boxes are spaced out at roughly 25 meters apart including 2 inside the boathouse (Figure 18).

Figure 18 Location and numbers of labeled bait stations at Kihei Boathouse and Nursery

Boxes are kept stocked with 8-16 oz. of fresh bait in accordance with the "Contrac® Specimen Label". In addition, on Kahoʻolawe bait boxes are located at the Honokanaiʻa and Hakioawa Base Camp to control seasonal rodent irruptions that impact sanitization of the base camps. Rodent stations are serviced in accordance with the "Contrac® Specimen Label" and recorded with a Rodent Control Log. If rodent activity is noted traps are also set out.

Kihei Boathouse and Nursery Ant/Arthropod Control

Controlling the spread of invasive invertebrates is crucial and ants are notoriously difficult to control around structures. They can cause huge ecological damage when they are introduced to new locations (Vanderwoude, 2008). The KIRC is currently using the ant bait (Amdro®) and barrier (Talstar®). The ants present in the Kihei Nursery typically nest in clutter and utilize the growing medium for potted plants. Using a general insecticide may not always be available for the treatment of plants, field gear, supplies and equipment. Also, some pests may not be affected by the general treatment. Therefore, to minimize the risk of incursions, the KIRC is using the comprehensive and adaptive strategy of the ED/RR approach.

Ant Bait Treatments for the Kihei Boathouse

Several ant bait treatment products are available and have been tested by the Hawaiʻi Ant Group (Table 7) with the Pacific Cooperative Studies Unit of the University of Hawaiʻi.

	Name	Description	Comment
1	[1]Amdro®	Ant Bait, Consistently Effective	Very popular
2	Probait®	Consistent Performer	Similar to Amdro®
3	[1]Maxforce Complete®	Extremely Effective	Expensive
4	Extinguish Plus®	Not as Effective	Moderately attractive
5	Advion Fire Ant Bait®	Professional Use Only	Inconsistent Results
6	[1]Tango®	Concentrate	Forms a gel
7	[1]Talstar®	Barrier Protection	Requires a sprayer

Table 7 Types of Ant Baits

[1] Recommended Use at Kihei Boathouse and Nursery.

The Hawaiʻi Ant Group was formed to develop a better understanding of ants and their impacts in Hawaiʻi as well as facilitate and exchange of information, monitor and report new introductions and increase public awareness. Amdro®, MaxForce Complete®, Tango® and Talstar® may all be used at the Kihei Boathouse. Appendix F lists the proper techniques and precautions for using the Amdro® bait. Dry days are better than wet ones to apply bait. It is important to treat the entire property and systematically apply the bait to each section. It is also very important to apply bait treatments 2 weeks before barrier treatments. Ant species recorded in Hawaiʻi and Kahoʻolawe are listed in Appendix G.

Two methods are used at the Kihei Boathouse and Nursery for ant/arthropod control; Bait Treatments and Barrier Treatments.

Bait Treatments

Insect baits are very different from contact sprays or liquids. Baits have a lower toxicity so that they don't kill the insect outright, and they are disguised as attractive food, encouraging the worker to share the pesticide with the rest of the colony, including queens and developing larvae. There are two different types of action for the recommended Little Fire Ant products: *toxicant* and *growth regulation*. While both bait treatment and barrier treatment may be applied with a spreader, it is important to have two labeled spreaders to keep them separate.

Barrier Treatments

Ant barrier treatments are insecticides that are sprayed or sprinkled around areas where ants are to be excluded. They should not be mixed with bait treatments and should be applied to wet soil or when rain is expected, making a wide band 3 - 6 feet wide. Granular barrier treatments are easiest to apply because there is no mixing required. It is important to apply the barrier treatment two weeks after the bait treatment so the ants taking the bait poison back to the colony will not be killed. Any ants that come into contact with the chemical will die. Barrier treatments usually have a residual activity and can be effective for months. Figure 19 illustrates the area in the Kihei Boathouse and Nursery for ant and other insect pests barrier protection using 1% Talstar P (Bifenthrin) in water. Usage is recorded in the Pesticide Use Log (Appendix H).

Figure 19 Granular Bait Treatment (orange) and Ant barrier treatment (blue) at the Kihei Boathouse and Nursery.

Co-operative Agricultural Pest Survey (CAPS)

The CAPS are performed in cooperation with the USDA Animal and Plant Health Inspection Service (APHIS), to detect high risk pests before they have a chance to cause significant damage. This ensures that new introductions of harmful plant pests and diseases are detected as soon as possible. In January, June, September and December of 2016, four CAPS were completed at the Kihei Boathouse and Nursery primarily to detect the presence of Little Fire Ant. The Little Fire Ant is a common ant species located throughout northern and central South America, the West Indies, the warmer portions of Mexico and the Southeastern United States (http://entnemdept.ufl.edu). The CAPS procedures for conducting standardized surveillance and monitoring for exotic ants (and Little Fire Ant) at Hawaiian Points of Entry are as follows;

- Targets are Little Fire Ant and Red Imported Fire Ants (*Solenopsis invicta*) not yet in Hawaiʻi, and other invasive ant species.

- Surveillance of ants is accomplished by placing vials (Biolab® 60cc) baited with attractive food items in a grid pattern over the entire area to be surveyed, and collecting the vials after 30-60 minutes exposure.
- While baits are in the field, any ants foraging nearby will be attracted to the baits and these can be sealed inside the vials and identified in the laboratory.
- Procedures that specifically target Little Fire Ants or Red Imported Fire Ants for delimiting, monitoring and general surveillance are different.

For follow up surveys, work out the area to cover and obtain a map or aerial image of the site. Plan to do the survey every three months during clear weather when rain is not expected. Each team should be made up of three (3) people and one team should be able to place and collect around 200-400 vials in a day. When preparing baits, make approximately 100 per person working in the survey. Different ants are attracted to different food types so a mixture of bait types is used. It is best to make only enough bait for a days' work. This way the baits will be fresh and attractive to ants (ants are not interested in old baits). If possible, make them up the day before and store in a refrigerator overnight. Two types of bait (protein and sugar) are made and laid out in alternate fashion in the field. Use vials with different colors for each bait type and keep in separate bags. When placing the vials, keep in the shade if possible, pointed away from the prevailing wind, and angle downward to keep any potential rainwater out. If it begins to rain, it is good to collect the vials already out. Protein balls contain a smear of peanut butter on the inner side of the bait container and a small cube of luncheon meat inside the vial. The sugar baits contain a smear of light colored jelly or jam (no seeds, lumps or rinds) on the inner side of each bait container.

The aim of the survey is to thoroughly sample the ants at the site. This is done by placing baits approximately spaced in a grid pattern appropriate for each survey type. For example sections that are concrete or asphalt (bitumen) do not need to be sampled. Potential ant habitats are listed in Table 8 and it is important that all these are sampled.

	Potential Habitat for Ants	
	Location	**Comments**
1	Tree Trunks	visual inspection and bait at base if appropriate
2	Flowers	
3	Shrubs and poles	
4	Building edges and foundations	
5	Concrete slab edges	
6	Cracked concrete	
7	Disturbed sites	
8	Drains and culverts	
9	Electrical generators and fittings	
10	Exposed rocks	
11	Fence palings	
12	Grass areas	

	Potential Habitat for Ants	
	Location	**Comments**
13	Verges	
14	Hot water pipes and heaters	
15	Isolated weeds	
16	Logs	
17	Loose gravel	
18	Low vegetation	Including grass
19	Plant pot bases	
20	Road margins	
21	Rubbish piles	
22	Shiny surfaces	
23	Soil	
24	Tree crotches and hollows	
25	Vertical Surfaces	
26	Weed and plant re-growth	
27	Wooden Structures	
28	Underneath stones or concrete rubble	

Table 8 Potential habitat for ants for CAPS

Ant Taxa Observed at Kihei Boathouse and Nursery

Table 9 lists the eight (8) ant taxa found during the four 2016 surveys at the Kihei Boathouse and Nursery in accordance with CAPS protocols.

	Kihei Boathouse - June 15, 2016	**Present on Kahoʻolawe 2016**		
	Taxa	**Yes**	**No**	**RISK (PIA)**
1	*Anoplolepis gracilipes*	X		Medium
2	*Brachymyrmex obscurior*	X (2018)		NA
3	*Cardiocondyla obscurior*		**X**	Low
4	*Camponotus variegatus*	X		TBD
5	*Monomorium bicolor (destructor)*	X		Medium
6	*Ochetellus glaber*	X		Low
7	*Paratrechina longicornis*	X		High
8	*Tetramorium simillimum*	X		Medium
9	*Pheidole megacephala*	X		Medium

Table 9 Ant taxa found at Kihei Boathouse and Nursery during 4 CAPS in 2016

Also listed is whether or not it has been observed on Kahoʻolawe and the Pacific Invasive Ant (PIA) Risk Assessment. This information serves as a baseline of ants present in 2016. If follow up surveys detect a new ant species, the baseline data will improve Pre-Border Biosecurity for Kahoʻolawe. Starr Environmental has been assisting

the KIRC staff acquiring the data with ant identification on Kahoʻolawe and at the Kihei Boathouse property.

The Carpenter Ant (*Camponotus variegatus*) was not initially observed at the Kihei Boathouse property during the surveys, although it was then observed April 15, 2016 and collected April 22, 2016. This may be due to the nocturnal behavior of this particular ant species

.

Figure 20 illustrates the locations of the sweet and protein baits during the CAPS.

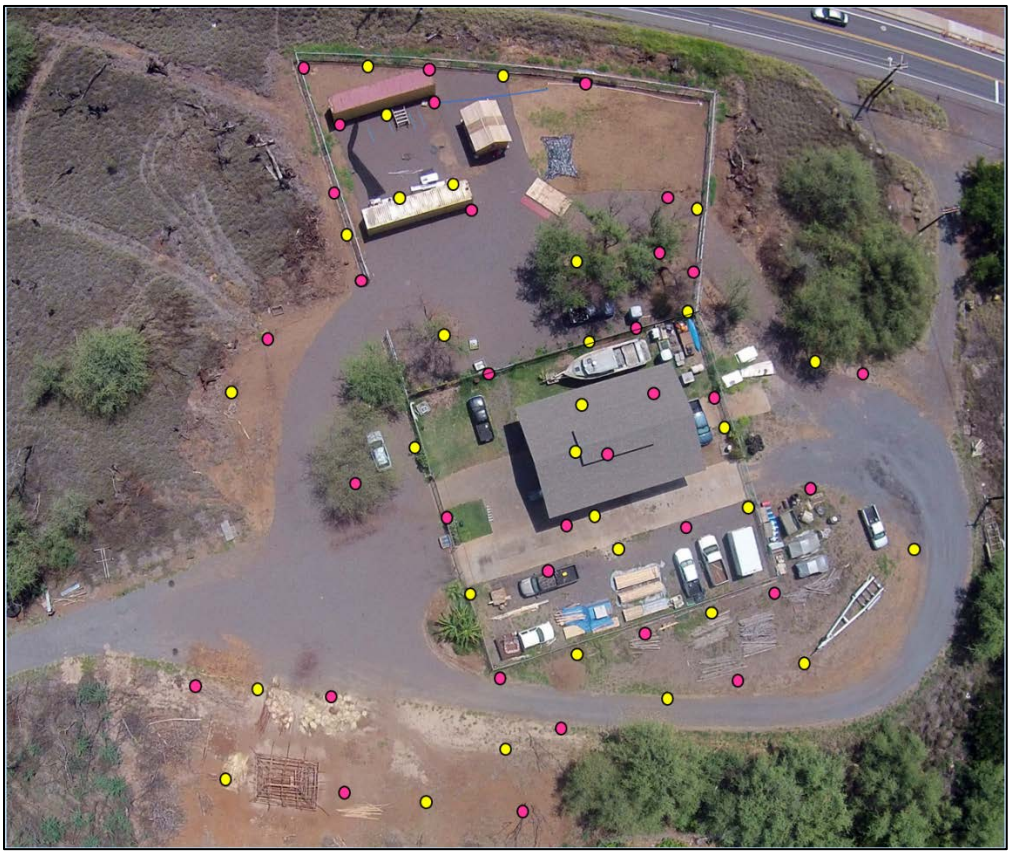

Figure 20 CAPS stations at the Kihei Boathouse and Nursery (Protein and Sugar Baits).

IAS Plant Control at the Kihei Property

Table 10 lists fifty (50) botanical species observed at or near the Kihei property in January, 2016.

Taxa	**Taxa**
Abutilon incanum	*Ipomoea pes-caprae ssp brasiliensis*
Abutilon menziesii (E)	*Jacquemontia ovalifolia*
Alocasia sp.	*Leucaena leucocephala*
Aloe vera	*Macroptilium lathyroides*
Alternanthera pungens	*Malvastrum coromandelianum*
Amaranthus spinosus	*Merremia aegyptia*
Bonamia menziesii (E)	*Musa x paradisiaca*
Bothriochloa pertusa	*Panandus tectorius*
Cenchrus ciliaris	*Panicum maximum (Megathyrsus maximus)*
Chloris barbata	*Paspalum conjugatum*
Cordyline fruticosa	*Pluchea indica*
Cynodon dacytlon	*Prosopis pallida*
Cyperus sp.	*Ricinus communis*
Desmanthus pernambucanus	*Samanea saman*
Digitaria insularis	*Schefflera actinophylla*
Dodonaea viscosa	*Sida fallax*
Eluesine indica	*Sporobolus africanus*
Erigeron bonariensis	*Synedrella nodifolia*
Euphorbia hirta	*Tribulus terrestris*
Ficus sp.	*Tridax procumbens*
Gossypium tomentosum	*Trifolium sp.*
Heliotropium curvassavicum	*Verbesina encelioides*
Hibiscus clayii	*Vitex rotundifolia*
Indigofera spicata	*Waltheria indica*
Indigofera suffruticosa	*Washingtonia robusta*

Table 10 Botanical Survey of Kihei Boathouse Property, January 2016
E = Federally Endangered

Priority Target Species are highlighted in yellow. Also observed in 2017 on the Kihei Boathouse property was a Shower Tree (*Cassia sp.*), Lions Tail (*Leonotis leonurus*), Obscure Morning Glory (*Ipomoea obscura*) and Sunflowers (*Helianthus annuus*).

Since 2015, Puncture Vine (*Tribulus terrestris*) and Khaki Weed (*Alternanthera pungens*) have been manually removed from the Kihei Boathouse and Nursery or treated with herbicide. These have been designated as Priority Target Species for eradication by the KIRC. They continue to be monitored and removed when observed to prevent an IAS introduction to Kahoʻolawe. Puncture vine became a pest problem at the Boathouse area in the first half of 2016 (Figure 21).

Figure 21 Seed (nutlet) and flower of Puncture Vine (*T. terrestris*)

Puncture Vine was treated with RoundUp® (2% in water), collected and bagged. However, the seeds are viable for years and both Puncture Vine and Khaki Weed need to be managed on the property area for an extended time. Priority Target Species need to be reevaluated by the KIR Biosecurity Advisory Committee on an annual basis.

Obtaining controls quickly from vendors is important and a few are listed here:

BEI Hawaii
300 Pakana St. Wailuku, HI 96793 (808) 244-3761, Insecticides, Pesticides, Bait Boxes

Del's Feed and Farm Supply
326 Hanamanu St. Kahului, HI 96732 (808) 873-0101, Pest Traps

GoodNature
http://www.goodnature.co.nz/products/, A24 Traps

Simplot
400 Lehuakona St. Kahului, HI 96732 (808) 877-6636, Pesticides

Kahoʻolawe Island Reserve (KIR)

Protocols for Ocean Based Biosecurity will be strictly enforced to prevent the spread of unwanted algae in the shallow water benthic habitat of Zones A and B in the KIR (Figure 22).

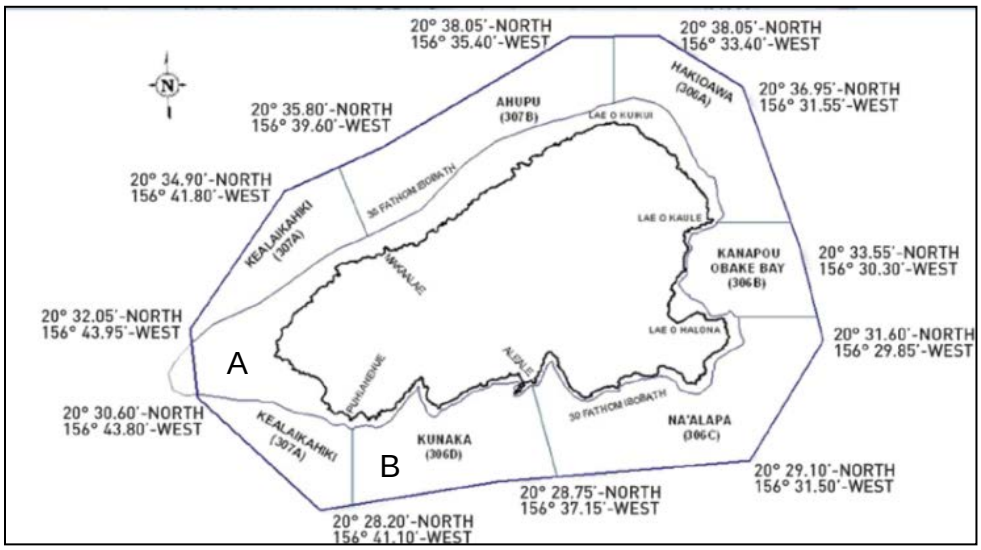

Figure 22 Boundaries of Zone A and B in the KIR

The KIR (defined as the submerged lands and waters within two nautical miles of the island) is divided into two zones; Zones A and B.

Zone A**:** Includes the island of Kahoʻolawe and all the submerged lands and waters between the shoreline of Kahoʻolawe and the 30-fathom (180 ft.) depth which surrounds Kahoʻolawe (HAR13-261). Unauthorized entry into Zone A is prohibited at all times except in case of emergency.

Zone B**:** All waters and submerged lands between the 30-fathom (180 ft.) depth surrounding Kahoʻolawe and two nautical miles from the shoreline of the island. Unauthorized entry into Zone B is prohibited at all times except for trolling as authorized by KIRC on the days stipulated by the Permitted Trolling Schedule or in case of emergency. Trollers must remain underway, making way at all times while in Zone B.

Standard Operating Protocols for the Transportation of Plants into the KIR

Plant Nurseries on Maui

KIRC has had a standard for IAS in place when ordering and receiving plants since 1998, and they are to be free of nematodes, slugs, ants, and other insects. All plants will be grown on either raised benches, weed cloth or plastics covered ground, cement slab or in a certified nursery. Plants will be grown in a sterile medium. No compost will be used

that contains sewage sludge. Upon delivery, all plants will be free of IAS, fungal or other diseases, and any other type of organism that may be harmful to the restoration efforts on Kahoʻolawe. If the shipment does not meet these standards, the plants will be rejected and placed in a quarantined area. Once notified it is the responsibility of the vendor to remove the plants from the Kihei Boathouse designated quarantined area within 24 hours.

All plants will be inspected at the Kihei Boathouse for IAS by the KIRC personnel prior to shipment to island. Grasses, shrubs and trees should be delivered to the boathouse as close to the access as possible (the day before) to minimize the risk of IAS. Plants in containers will be checked again just before loading onto the vessel and all plants should be visually inspected before they are loaded. Once plants are cleared they will be signed off with a date and time, 24 hours or less before the vessel leaves for Kahoʻolawe.

Nurseries and Farms supplying plants to the Kihei Boathouse property need to be a registered facility with the KIRC and acknowledge they will deliver IAS free material in agreement with the KIRC plant protocols (Appendix I) in this Biosecurity Plan. Also, they will provide a docket of the common plant name, taxa (*Genus species*) and variety if known, and location the plant is from.

Hoʻolawa Farms in Haiku specializes in Hawaiʻi's endemic and indigenous plants and supply over 100 species for landscaping and ecological restoration. Maui Nui Botanical Gardens in Kahului is dedicated to the protection of Maui Nui's rich native plants and cultural heritage. Finally, Native Nursery, LLC in Kula is committed to providing the highest quality plant material for statewide reforestation. Plant materials from these nurseries on Maui will be visually inspected at the Nursery and before packing and shipping to Kahoʻolawe. Three potential sources of IAS will be from these Nursery facilities. The KIRC restoration department has given these three Nursery facilities the protocols for the condition of the plant deliveries.

The horticultural industry is a vector of alien snails and slugs in Hawai`i. An Amber snail (*Succinea tenella)* was found during a survey on plants destined for the Kaho`olawe restoration effort (Robert H. Cowie, University of Hawai`i, Personal Communication, November, 2017). Cowie et al., (2008) stated limited quarantine measures for small species of snails have not prevented their inadvertent spread and predation and extinction of Pacific and other island snail species is suspected by Rosy Wolf Snail (*Euglandina rosea*).

Transportation of Cultural Material

KIRC and PKO entry points present one of the greatest biosecurity risks identified. The transport of cultural plant material, including banana stumps (with soil), ti leaves, fern and forest materials for lei to Kahoʻolawe for ceremonial purposes has the high potential to introduce everything from seeds and invertebrates to geckos and rodents. It is important to establish a Pre-Border process that will minimize this risk. This can include immersion of materials in salt water or treatment with an insecticide (pyrethroids).

Rooted plants in soil present a major risk for both invertebrates and pathogens. Therefore, no soil is allowed for transport and plants. If needed, plants can be re-potted with a sterile soil (Perlite) at the Kihei Nursery prior to their transport to island.

Integrated Pest Management

Integrated Pest Management (IPM) is a strategy that prevents pest damage with minimum adverse impact on human health (MDAR, 2010) and refers to diseases, insects, mites, slugs, snails, nematodes and weeds. In the IPM approach, the grower uses their knowledge of pest biology to take actions that reduce pest establishment and increases in populations. IPM uses monitoring techniques and combinations of biological, mechanical, chemical, environmental and physical control. Pesticides are utilized only if monitoring stipulates they are needed. If pesticides are chosen, they are applied that avoids disrupting other IPM methods.

Limit the amount of pesticides stored. The storage area should be properly labeled with signs that say "Pesticide Storage Area". A list of product being stored should be posted on the outside of the storage facility. A shelf life for pesticides longer than two years is unpredictable, so pesticides can be labeled with the date purchased. Containers should be kept off the ground to prevent the accumulation of water in or under the containers. Separation of pesticides by hazard and function is essential. Flammable product should be stored separately in a fire proof cabinet away from non-flammable materials, dry pesticides should be stored away from wet. Fungicides, herbicides and insecticides should be stored in separate locations of the storage area to prevent cross contamination and accidental misuse. Safety is the key element in pesticide storage. Accidents involving pesticide spills or leakages have serious health and environmental consequences. It is important the storage facility be locked and access limited only to those personnel who are properly trained in the use of pesticides.

"*To protect seeds and cuttings from pests the area should be closed in with secure shade cloth walls (or stainless steel screen mesh). It helps to have the entire propagation area closed. Native plants do not respond well to harsh insecticides, use botanical insecticides as much as possible. The most damaging pests to cultivated native Hawaiian plants are the introduced insects, aphids, mealybugs, mites, scale, thrips* (DLNR, 2013)*, whiteflies, nematodes and ants. The new growth is for sucking insects. They produce honeydew, which in turn is harvested by ants to feed their nest mates. Keeping a consistent and regular application regime is important part of keeping the pests under control*" (Lilleeng-Rosenberger, 2005).

Kihei Nursery

The Kihei Nursery is a State of Hawaiʻi run facility and therefore needs to be managed according to State of Hawaiʻi and US Federal regulations and pesticide storage and ant bait and barrier protocols are required. The US EPA Workers Protection Standard and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) apply (Appendix J). Strict

biosecurity will be implemented according to this Biosecurity Plan and the Kihei Nursery Facility Manager will keep it on site for all personnel working at the Kihei Nursery to read.

Construction began on the Kihei Nursery in 2016, and will need constant monitoring for any IAS that may become established during propagation of native plants. A separate document entitled "KIRC Kihei Nursery Management Plan", has been developed and discusses in detail how to safely administer and store pesticides, and prevent IAS from entering the KIR. Some of the Kihei Nursery protocol information is presented here. The Kihei Nursery (Figure 23) is currently being used for propagation of plants around the Kihei Boathouse property and for training staff, interns and volunteers until biosecure SOP's are in place.

Figure 23 Work Area and Tables at the Kihei Nursery in 2017

The Sunshine Mix #4 (right) attracts ants when opened and will be placed into garbage cans and sealed with a secure lid. Weed cloth will be laid down beneath the plant tables (Figure 24) and potted plants moved up and off the ground. Hoses should not be left lying on the ground.

Figure 24 Weed cloth beneath coarse gravel under Kihei Nursery tables

Management of pest ants in the Kihei Nursery will reference Vanderwoude (2008) when they are observed. Vanderwoude identifies three ways ants can enter a plant nursery system, 1.) Purchase of infested plants, 2.) Potting media or other items, ants traveling on cars and trucks driven by staff and personnel and 3.) Ants spreading from a neighboring property. To protect plant stock two products may be utilized. Sevin® is a soil drench and foliar spray. It provides short term control provided the foliage and medium is thoroughly treated. Talstar Pro® is used at 1 oz. per gallon of water and can be used pot drench or for barrier treatments. Standard procedure is to always were PPE and also be sure other personnel are kept away from the sprayed plants until they are dry.

Ocean Based Biosecurity

Ocean Based Biosecurity will implement the three actions (**Prevention, Detection and Response**) to achieve the objective of keeping IAS from reaching the KIR. Individual boat operators are responsible for implementing the biosecurity protocols presented in this Biosecurity Plan.

Furthermore from section 7 of the KIRC form for Permitted Trolling in Zone B, it now states; *Prevention of Invasive Alien Species (IAS). The permittee will be held accountable to prevent any invasive alien species, plant or animal (i.e. invasive algae, barnacles, etc.) into the Reserve in regard to the marine environment.* ***It is the responsibility of the vessel operator to ensure vessel hulls are free of any IAS.***

Virkron® for Hull Fouling and Anchors

The most common pathway for the introduction of non-native marine species is from hull biofouling (HIBP, 2016). Virkron® Aquatic (hydrogen peroxide) is highly effective against many strains of virus, bacteria, and fungi and also fish pathogens. It should be

used in conjunction with hot water (>40°C) for hulls and anchors. Wear a face shield and chemical splash goggles to avoid contact to face when spraying the mixture. Applicator should wear a Tyvek style full body suit. Also, a dust mask should be worn when handling the powder form. It is available from Western Chemical (800) 283-5292. Figure 25 illustrates personnel from NOAA pressure washing the hull of their vessel (Kohola).

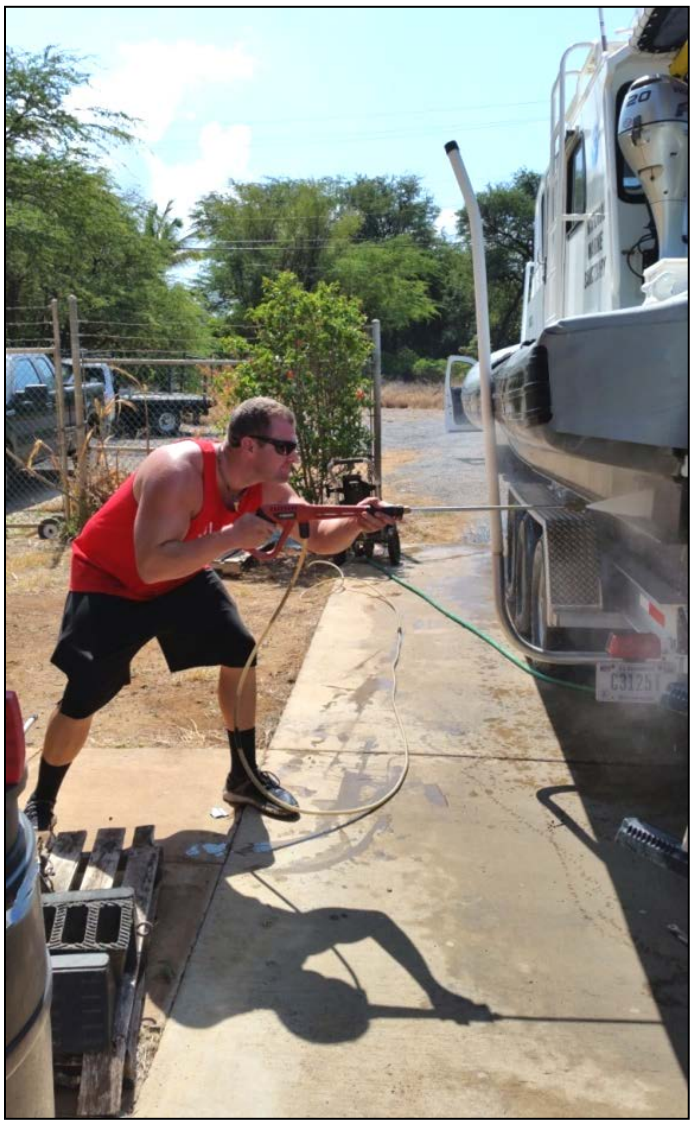

Figure 25 Pressure washing hull of NOAA vessel

Vessel biofouling is the attachment of organisms to wetted areas of a ship or boat, usually below the waterline; this can include the hull, propeller, bilge keel, keel coolers, thruster, inlet gratings, anodes, sea chests. The DLNR has a web site under Aquatic Invasive Species for additional information for ballast water and biofouling (http://dlnr.hawaii.gov/ais/ballastwaterbiofouling/biofouling/).

Dive Gear

All skin diving and scuba gear needs to be inspected and disinfected before using in Kahoʻolawe waters. The process should be disseminated to personnel before coming to island as sometimes tabi's, fins and masks are needed to swim into the beach at Honokanaiʻa during large surf. Wipes with ammonium chloride (Clorox® or Lysol®) should be used to clean and remove any organic matter and all dear should be soaked in a 3-10% solution of Clorox® for a minimum 10 minutes. They should be rinsed with fresh water and hung to dry. Any scientific equipment used to study the ocean environment needs to be clear of any foreign organisms before using in the KIR including dive bags, spears, measuring tapes, and camera housings.

Personal Gear

Another weak link in biosecurity for all groups is personal gear for both the staff and volunteers. While the KIRC and PKO procedures to reduce the risk of IAS via the supply pathway are in place, more attention needs to be given to personal gear. Levels of inspection may include every item and bag, but this is sometimes impractical. Therefore, greater ownership has to be put onto the individual staff member and volunteer, to eliminate the IAS pathway on personal gear (boots, backpacks, clothing, fins and snorkel gear). This involves simple procedures everyone can follow, and reminding people as early as possible what is expected, so that biosecurity procedures become a normal part of the access of Kahoʻolawe. A quarantine self-check sheet is available in Appendix C.

Early Morning Inspection Conditions

Managing and ensuring all equipment is clean in the early morning hours in the dark is problematic, but reinforcing the need to clean and inspect all gear is an important first step. New bright LED lights at the boathouse have been installed (with a spotlight pointed onto the deck of ʻŌhua) so that loading the vessel in the hours before sunrise can still detect an IAS. Personnel dropped off at the Kihei Boat Ramp early in the morning of an access should place their gear on asphalt or cement and not on the far side near bushes growing below the boat wash area.

Canoe club members coming from Maui must be sure to inspect their gear carefully so they are not bringing IAS with them as they pack up their tents, sleeping bags and campsites before they launch for Kahoʻolawe.

Contractor Specific Biosecurity

Biosecurity is essential to ensure that pest incursions to Kahoʻolawe are prevented. If and when they do occur, they must be managed appropriately and in a timely manner. While this Biosecurity Plan may not effectively manage and target all the aspects of a specific project, a Biosecurity Sub-Plan may address future non-standard operations specific to Independent Contractors. In the event that an island access will need a separate Sub-Plan to address the needs of a separate project, it can define the concerns

related to that operation. Biosecurity Sub-Plans should be drafted before the contract is authorized and completed in conjunction with the contractor to ensure it is practical and achievable. The Biosecurity Sub-Plan can be generated to include how biosecurity affects the group and what they have to do to meet the standards set in place.

Capital Improvement Project (CIP)

A major refurbishment of the Base Camp including the installation of a solar power system is planned for 2017/2018 which will involve the transport of a large amount of equipment, supplies and additional personnel. Short of producing a separate biosecurity sub-plan for this CIP project, all personnel should be well briefed on the biosecurity protocols expected to be implemented during this CIP project on Kahoʻolawe.

Ala Loa Construction

The Ala Loa is a coastal trail that will eventually circumnavigate the entire shoreline area of Kahoʻolawe for cultural practices. Since 2003, several miles have been built from Honukanaenae to Lae o Paki and from Hakioawa to Kuheʻeia. Chainsaws, mechanical loppers and any other equipment brought in from Maui (or other islands) need to be inspected and completely cleaned of debris and sediment before bringing them to Kahoʻolawe to work on the Ala Loa. If not addressed, seeds from IAS can remain imbedded in the equipment, and become established on Kahoʻolawe from a different island. Biosecurity protocols apply to all other supplies that accompany cultural personnel and individuals and need to be thoroughly inspected. It is critical to have a supply of response equipment on site including detection devices, traps for animals, sprays and spray gear for plants.

IV IAS PRESENT ON KAHOʻOLAWE

Kahoʻolawe Botanical Surveys and Results

Several botanical surveys have occurred in the past on Kahoʻolawe (US Navy 1979, DOFAW 1980, Gon and Chun 1992, Herbst et al., 1994, the Parsons-UXB Clearance Project from 1998 to 2004, and visiting botanists). In addition, four (4) botanical surveys were performed on Kahoʻolawe in December, 2015 to update previous inventory and are listed in Appendix K. HPWRA scores will serve as baseline data for future IAS introductions, not only in these four primary points of entry (Base Camp, LZ Quail, LZ1, Hakioawa), but also potentially for all of Kahoʻolawe.

Moodley et al., (2014) state the outcome of alien plant introductions is often considered invasive or non-invasive. Table 11 lists twenty three (23) site specific IAS present on Kahoʻolawe with Hawai'i Pacific Weed Risk Assessment (HPWRA) Scores (HPWRA, 2016). Higher number is a higher risk.

Entry	Family	Taxa	Common Name	HPWRA Score	RISK Status
1	Verbenaceae	*Lantana camara*	Lantana (wild type)	32	High
2	Poaceae	[1]*Cenchrus setaceum*	Fountain grass	26	High
3	Poaceae	*Cynodon dactylon*	Bermuda grass	22	High
4	Asteraceae	*Verbesina encelioides*	Golden crown-beard	21	High
5	Poaceae	*Digitaria insularis*	Sour grass	20	High
6	Poaceae	*Chloris barbata*	Swollen fingergrass	20	High
7	Poaceae	*Cenchrus ciliaris*	Buffelgrass, Laredo buffelgrass	19	High
8	Fabaceae	*Prosopis sp.*	Mesquite (Kiawe)	19	High
9	Poaceae	*Megathyrsus maximus*	Guinea grass	17	High
10	Fabaceae	*Neonotonia wightii*	Glycine, perennial soybean	16	High
11	Fabaceae	*Acacia mearnsii*	Black wattle	15	High
12	Fabaceae	*Leucaena leucocephala*	Leucaena (Koa Haole)	15	High
13	Solanaceae	*Nicotiana glauca*	Tree tobacco	15	High
14	Fabaceae	*Vachellia farnesiana*	Sweet acacia, Klu	14	High
15	Asteraceae	*Heterotheca grandiflora*	Telegraph weed	14	High
16	Poaceae	*Tragus berteronianus*	African bur grass, small carrot seed grass	13	High
17	Amaranthaceae	*Atriplex semibaccata*	Australian saltbush	13	High
18	Asparagaceae	*Agave americana*	American century plant	12	High
19	Fabaceae	*Acacia confusa*	Formosan koa	10	High
20	Bataceae	*Batis maritima*	Pickleweed, saltwort	9	High
21	Asteraceae	*Zinnia peruviana*	Field zinnia, wild zinnia	5	Evaluate
22	Proteaceae	*Grevillea robusta*	Silk oak	5	Evaluate
23	Myrtaceae	*Eucalyptus robusta*	Swamp mahogany	3	Low

Table 11 IAS present on Kahoʻolawe

[1]Syn. *Pennisetum setaceum* (Chemiquay et al., 2010)

IAS Observed on the Four Botanical Surveys

Using the HPWRA scoring order in Table 11, some of the IAS flora that were observed in the four botanical surveys are discussed: (32) Lantana (*L. camara*) only grows as a shrub less than 1m due to low precipitation levels and does not present the problem on Kahoʻolawe it does on other wetter islands. (19) Buffel grass (*C. ciliaris*) was introduced in 1970's (KIRC, 1998) and is an African grass tolerant and adapted to fire and is also allelopathic. (19) Kiawe (*P. pallida*) introduced in 1918 (KICC, 1993) is nearly ubiquitous on the island and responds to cutting (chainsaw) the stump down to ground level and treating with Garlon. It is a phreatophyte (a deep-rooted plant that obtains a significant portion of the water that it needs from the phreatic zone of saturation) and competes for water resources with other surrounding vegetation. (16) Glycine (*N. wightii*) is present in the wetter areas of Puʻu Moaʻulanui and becomes dense after heavy rains. It has been a trip hazard for fire crew operations around LZ-1. (15) Koa Haole (*L. leucocephala*) is dense in some locations but is restricted to certain areas on Kahoʻolawe. There is a consistent seed source that keeps it established. Treatment with Garlon after cutting is not as effective as manually pulling the plant out of the ground. (14) Klu or sweet acacia (*Vachellia farnesiana*) is spreading in range and poses a threat with large sharp thorns and should be monitored for control (13) Australian Salt Bush (*A. semibaccata*) was introduced in the 1918 (KICC, 1993) and serves as an erosion control mat in the hardpan areas of Kahoʻolawe. (3) Eucalyptus (*Eucalyptus sp*.) trees also introduced in 1918 (KICC, 1993) occur below the northern face of Puʻu Moaʻulaiki on Kahoʻolawe and formed an extensive grove of trees but has recently gone through a die back.

Other notable IAS not found on the four botanical surveys, but which occur on Kahoʻolawe are discussed here: Fireweed (*Senecio madagascariensis*) has become established on Kahoʻolawe, as has the biocontrol moth (*Secusio extensa*) for it. Observed in 1980, (10) Formosan koa (*A. confusa*) grows near the 1 acre rain catchment and has been periodically cut and treated but keeps persisting. Observed in 1992, Russian thistle (*Salsola tragus*) occurs along portions of the K1 road corridor and has been treated with Garlon in the past. Iron wood (*Casuarina equisetifolia*) grows in the windbreaks established in the 1970's and 1980's in the upper elevations of the island. Some of the population has been girdled and treated with Garlon. Observed in 1980 and 1992 surveys, Sisal (*Agave sisalana*) and Mauritius hemp (*Furcurea foetida*) occur in a few locations on Kahoʻolawe and should be treated. Finally, (15) Black Wattle (*A. mearnsii*), (5) Silk Oak (*G. robusta*) and Banyan (*Ficus microcarpa*), have all been observed on Kahoʻolawe and should be treated when found. Flora previously recorded on Kahoʻolawe is in Appendix L.

Since the removal of goats (*C. hirca*) in 1993, significant amount vegetation has come back naturally in the summit area of Puʻu Moaʻulanui (Personal Communication, Paul Higashino, Natural Resources Specialist V, KIRC). While some of these plants are native species, some of the taxa are IAS, such as glycine (*N. wightii*) and koa haole (*L. leucocephala*). Management of koa haole is ongoing but will take generations to manage and completely eradicate. On the barren landscape, the koa haole is preventing erosion, fixing nitrogen and should be replaced with a native plant if it is removed from an area.

Initially observed at Lua ʻO Kealialalo in 1996, it is possible fountain grass came into the area as early as 1992. Identified as a priority threat, only a small population was known until surveys were initiated by the HISC grant. Approximately five hundred fountain grass (*C. setaceum*) plants have been treated in 209 acres in Lua ʻO Kealialalo from October, 2015 through December 2016, including 207 mature plants (Figure 26).

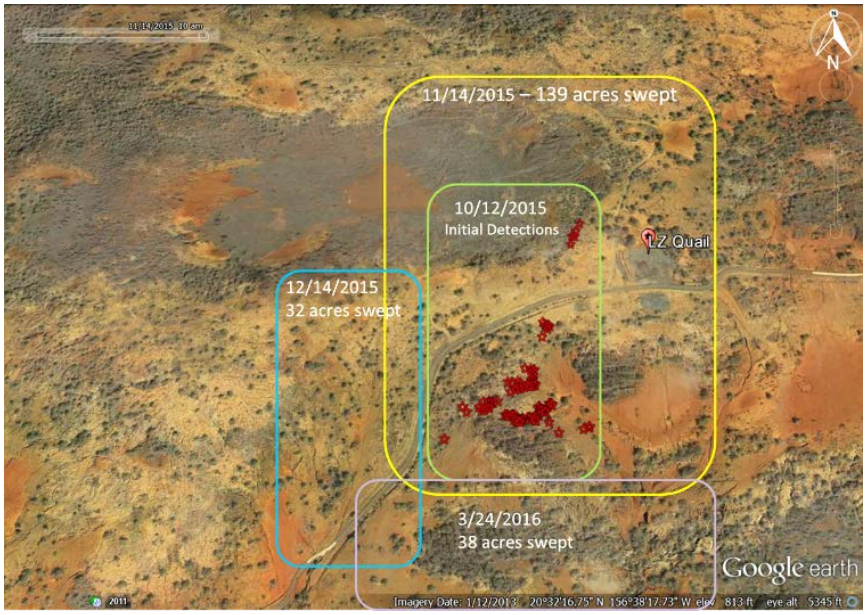

Figure 26. Location of recent Fountain grass control at Lua ʻO Kealialalo

Fountain grass surveys should be performed quarterly to keep this priority IAS in check. There are other IAS of concern from Table 11 e.g. Koa haole. While occurring in specific locations on the island, IAS plant species have the potential to spread and increase its range on Kahoʻolawe. Inadvertently transporting seeds by vehicle is a potential vector which must be avoided. There is also risk of spreading IAS from Kahoʻolawe to other islands. Volunteers should be aware of this as they return to their home islands.

Island-wide Eradication of Invasive Mammals

For the proposed eradication of rodents and feral cats on Kahoʻolawe it is vital that the required standard of biosecurity (i.e. preventing any rodent invasions) is put in place well in advance of the eradication effort so that the systems and processes can be vetted, reviewed and audited. The investment in a rodent eradication is significant and one of the requirements for an eradication (Cromarty et al., 2002) is that reinvasion can be managed to near zero. As Kahoʻolawe is outside the swimming range for rodents, any reintroduction will be human assisted hence the need for a comprehensive biosecurity system to protect the eradication investment and to prevent the establishment of additional rodent species.

Eradication is not practical or even possible for many IAS currently on Kahoʻolawe but where it is feasible and affordable, it is proposed to eradicate (or at least manage) some of them present including both plants and animals.

Detection on Kahoʻolawe

Regular annual checks of the main access sites, Hakioawa and Honokanaiʻa by field biologists, should be undertaken and continued to detect any new species before they have the opportunity to spread. Removal of any new species should be made a priority.

When rodents do settle into a new habitat, they often do so near human habitation for food and shelter. The bait stations (or preferably traps so that detection can be recorded which is often not possible with toxic bait) should be set and maintained around the buildings and 2 landing sites. The bait stations should be numbered and the details of the locations, service schedule and job position responsible for them being recorded listed in an updated Biosecurity Plan. The type of trap used is important if the quantity, species, sex and breeding status of the rodent is desired. Procured traps should be set in a way where non target animals like birds won't get caught; The Goodnature A24 self-resetting trap may fulfill this requirement. The pre-trip Prevention measures have priority over Detection on Kahoʻolawe methods as the purpose of this Biosecurity Plan is to Prevent IAS from getting to Kahoʻolawe rather than trying to detect and eradicate them once they are present.

Native Fauna on Kahoʻolawe

Appendix M lists selected native fauna on Kahoʻolawe.

Non-native Vertebrates on Kahoʻolawe

Appendix N lists the non-native vertebrates (and IAS status) recorded on Kahoʻolawe (KICC 1992a, KIRC 1998, KIRC 2015b).

List of Terrestrial and Freshwater Invertebrates on Kahoʻolawe

Appendix O lists terrestrial and freshwater invertebrates recorded on Kahoʻolawe.

V. PROPOSED FUTURE ACTIONS

Additional Recommendations to the Kihei Boathouse and Nursery are listed here (McClelland, 2017). Some actions have been completed with others underway.

Kihei Boathouse Actions

1. The inside of the boathouse has recently been organized by getting everything up off the floor. Shelves are six (6) inches above the floor to reduce refugia for rodents, geckos and invertebrates (Figure 27).

Figure 27 Kihei Boathouse shelves

2. Designate a Biosecurity Officer well versed with this document and with experience in IAS Prevention, Early Detection and Rapid Response (including Quarantine and Extermination) protocols.

3. Remove (or at least organize) the clutter outside the boathouse and along fences as it provides major refugia for rodents and ants.

4. Consider painting the floor of the boathouse white or light grey to facilitate locating invasive animals like a line of ants. Mammals are less likely to go onto a bright surface where they can be seen.

5. With a service schedule, periodically review the number and location of bait stations. Each station should be individually numbered so they can be located by anyone with a map.

6. If suitable bait and traps can be used, one that isn't eaten by ants, consider using bird safe rodent traps as well as bait stations inside and outside the buildings with details of all captures recorded. This will allow a risk profile of species locations, and times of year. The Goodnature A24 self-resetting trap may fulfill this requirement.

7. Remove invasive plants and trees from the Kihei Boathouse and Nursery, storage areas and access roads which may drop seeds into vessels. This priority for the detection of unwanted seeds is more difficult with seeds from other plant species even if already on Kahoʻolawe.

Cargo Management

1. Mark an area (painted square) away from the walls in which all bins are to be loaded. This is to keep the bins as far from the walls as possible to keep IAS from moving across open ground.

2. Ensure the lids are placed on the bins whenever they are not attended.

3. Only fill the bins as close to the island access date as possible (such as the day before) and make sure to inspect every container (boxes and bags) thoroughly before loading into the bins.

4. Minimize the time between equipment and supplies arriving at the boathouse and transport to island, to reduce the opportunity for IAS to enter bins or cardboard boxes.

5. Place glue traps in each bin if they are to be left overnight in the boathouse and when they are closed for loading. The glue board can be checked prior to loading or unloading to see if ants are present.

6. Consider loading the bins onto ʻŌhua as soon as they are filled as this will present a lower risk of allowing IAS into the bin on the boat than in the Boathouse. Visually inspect ʻŌhua before the trip for IAS that may have gotten on board.

7. Consider using a secondary person to assist with the biosecurity protocols in the morning when loading the ʻŌhua. Also, this person can inspect the boathouse for IAS to quantify the risk associated with different pathways utilizing available resources.

8. Establishing a Biosecurity Area within the perimeter Boathouse fence will allow maintenance of a designated pest free zone. Everything coming into the Biosecurity area (Boathouse perimeter fence) should be inspected for IAS at the Biosecurity checkpoint (cement pad).

Use of Vessels

1. All vessels should be thoroughly visually inspected prior to loading, including checking of glue boards, bait stations and traps. This would be coordinated by the Captain of ʻŌhua and the lead personnel for the other vessels. If seeds or IAS are found, the vessel should be washed down and re-checked. The occurrence of an IAS on board needs to be documented.

2. If available put glue boards, bait stations and traps on board at least the night before departure to detect the presence of IAS especially ants and rodents. These then need to be checked by the Captain of the vessel prior to loading and departure.

3. For ʻŌhua, the Captain (and crew) will be responsible for biosecurity for consistency.

It is important that a specific position (e.g. Captain, Crew) be made responsible and accountable for undertaking the required actions. Otherwise it is easy to assume that someone else is performing the protocols. This role needs to be clearly defined during the planning stages of the access so that everyone knows who it is. For other vessels, the Captain will be responsible.

It is also important to develop a collective responsibility and empower everyone that is looking for any biological risks and ways to eliminate and minimize them. This will be everyone's duty as the Biosecurity Officer will not be present for all stages of loading and unloading or even every access. Everyone involved needs to be monitoring for, identifying and reducing risks and feel empowered to raise any biosecurity issues they observe knowing they will be properly considered.

Follow Up CAPS

Follow up CAPS for ants need to be scheduled on Kahoʻolawe and the Kihei Boathouse property to continue to monitor and compare the 2016 baseline species present in both areas with any new ant introductions. New surveys should be performed quarterly and any new ant taxa should be reported immediately.

Field Guides

To assist with the first objective of Prevention, field identification guide books will be developed for IAS flora and fauna and this Biosecurity Plan will be updated once the guide is complete. This will aid all logistical personnel responsible for early detection of IAS on board vessels.

Kanapou Bay Marine Debris Clean-up

Since 2003 the KIRC has removed 55 tons of marine debris from Kanapou Bay (Personal Communication, D. Tokishi). The personnel who assist will camp for several days and bring in gear for the trip. It is essential all equipment be inspected for IAS before it is brought to the shores of Kanapou. Contractors must also take precaution with any equipment they bring in to use for the clean-up activities. Invasive foreign organisms may easily end up in Hawaiian waters just by riding along on marine debris that comes from all over the Pacific basin. An example of an invasive organism from the 2011 Japan tsunami debris is the Indo-Pacific green mussel (*Perna viridis*) that was observed in waters off of Oʻahu.

Helicopter Operations

While in a generally good condition for a busy work area, the helicopter hangar needs improved biosecurity measures by decreasing the amount of gear on the floor to remove hiding places for IAS. Rodent stations and traps (if present) need to be verified. Cargo nets need to inspected and kept free of contaminants such as seeds or invertebrates. Lifting a load of equipment directly from the back of a truck into a cargo net is preferable to lifting the material from the ground where it can pick up invertebrates or vegetative material including seeds. If the helicopter is to land on Kahoʻolawe, the skids should be checked for plant material and the inside of the helicopter checked and cleaned.

VI. KNOWN GAPS/ DEFICIENCIES

Table 12 lists known gaps and biosecurity deficiencies in the departments of the State of Hawaiʻi.

	State Department	Gaps
1	Hawaiʻi Department of Agriculture (HDOA)	Lack of data management technology and inspection facilities, not fully equipped biocontrol lab and insufficient staff.
2	Department of Land and Natural Resources (DLNR)	Lack of authority to regulate invasive organisms attached to ship hulls and lack of capacity to detect and control invasive algae, weeds, and predators in our waters and forests.
3	Department of Health (DOH)	Operating at 60% of the capacity needed to fight disease such as dengue, Zika, and chikungunya.
4	University of Hawaiʻi (UH)	Lack of stable funding for agricultural and IAS programs.

Table 12 Known Gaps in the State of Hawaiʻi

On occasion, an IAS may utilize a vector which can bring it into the KIR. One main point of departure is the Kihei Boathouse, and the following section describes occurrences that have been detected so far.

Faunal IAS Observed at Kihei Boathouse

Table 13 list the faunal IAS that has been observed at the Kihei Boathouse property.

Kihei Boathouse		**Present on Kahoʻolawe**	
IAS Taxa	**Common Name**	**Yes**	**No**
Achatina fulica	Giant African Snail		X
Felis catus	Feral Cat	X	
Gallus gallus domesticus	Red Junglefowl		X
Herpestes auropunctatus	Mongoose		X
Mus musculus	House Mouse	X	
Rattus norvegicus	Norway rat		X
Rattus rattus	Roof rat		X

Table 13 Faunal IAS observed at the Kihei Boathouse Property

The giant African snail is considered one of the top 100 IAS in the world (Global Invasive Species, 2000). It can also carry the pathogens responsible for human meningitis. Feral cats on Kahoʻolawe, possibly introduced during the ranching period, have tested positive (47.8%) for the parasitic amoeba, *Toxoplasma gondii*. Over 30 Red Junglefowl were removed from the Kihei Boathouse property in January, 2016 but continue to persist. Of the 8 main Hawaiian Islands only Kahoʻolawe does not have Mongoose. The House mouse undergoes periodic population blooms on Kahoʻolawe and has been documented to transmit typhus (fleas) and leptospirosis. Also, while the presence of the Polynesian rat has been detected on Kahoʻolawe, neither the roof rat nor the Norway rat have been observed to date. See Appendix P for Hawaiʻi Administrative Rules listing the regulations and statutes regarding management of pests in the State of Hawaiʻi.

Examples of IAS on Board the ʻŌhua

In December 2009, a Norway rat (*R. norvegicus*) was observed on board the ʻŌhua vessel at the Kihei Boathouse and was exterminated on board. The Norway rat (Figure 28) has been known to swim 800m interisland (Broome, 2007).

Figure 28 *Norway rat* (*R. norvegicus*)

In March 2015, Carpenter ants (*Camponotus variegatus*) in a large cardboard box holding a Rubbermaid container were placed on board ʻŌhua and delivered to Kahoʻolawe. The large cardboard box had been sitting on the ground outside of the Kihei Boathouse for many months before transport to Kahoʻolawe. In February 2016, a gold dust day gecko (*Phelsuma sp.*) was observed on board the ʻŌhua from ceremonial offerings in transit to Kahoʻolawe, and was captured on board and then released at the Kihei Boathouse.

Table 14 lists the date of occurrence of inadvertent introduction and action taken.

	Date	**Description**	**Action Taken**
1	December 2, 2009	Norway Rat (*R. norvegicus)* on board ʻŌhua at Kihei Boathouse	Exterminated on board
2	March, 2015	Carpenter Ants (*C. variegatus*) in large cardboard box delivered to Kahoʻolawe	None
3	February 16, 2016	Gold Dust Day Gecko (*Phelsuma sp.*) on ʻŌhua in transit to Kahoʻolawe	Captured on board and released at Kihei Boathouse
4	November 7, 2017	Rosy Wolf Snail (*Euglandina rosea*) on ʻAkiʻaki (*S. virginicus*) grass on board ʻŌhua	Rosy Wolf Snail collected on vessel and on Kaho`olawe at Honukanaenae while planting.

Table 14 Date of occurrence and action taken of IAS observed on ʻŌhua vessel

Personal property will not be stored at the Kihei Boathouse and abandoned vehicles should be removed from the premises. It was determined the rat probably accessed the boat from the front ramp which was in a lowered position. Protocols for leaving the ramp up were changed after this occurrence. Also, reduced clutter, use of metal trash bins, control of water supplies and properly discarded food will help eliminate resources for rodents. It should be realized exclusion of IAS from property and storage units is never permanent and must be maintained on a continual basis (Hoddenbach, 2005). The ʻŌhua should not have anything hanging off the side of the vessel such as lines or webbing. Ladders should not be stored leaning against the vessel in which rats or mongoose could crawl up and into the holds. Rats have been known to be able to jump 4 feet high.

It is imperative IAS detected at the Kihei Boathouse be quarantined, eradicated and kept out of the KIR. Also, IAS found at other locations that vessels originate from and bring personnel and materials to Kahoʻolawe, should be inspected periodically for IAS and documented with a date and photographs if possible.

VII. CONCLUSIONS

This Biosecurity Plan is intended to identify necessary protocols, vectors, and quarantine procedures in the Kahoʻolawe Island Reserve. The one objective of the Biosecurity Plan is to keep any new IAS from entering the KIR. Using an ED/RR approach, the three actions to achieve this objective are **Prevention**, **Detection**, and **Response**. Also, using the Pre-Border, Border and Post Border approach, IAS should be kept out of the KIR.

Prevention is key and linked to education and engagement of personnel, it will be crucial for a successful implementation of this Biosecurity Plan. Education and engagement will not only include personnel to achieve the objective of this Biosecurity Plan, but it will also establish a new mind set for those coming to Kahoʻolawe. The main message is that IAS are detrimental to native ecosystems and Prevention is the most cost effective and efficient approach to control them. Early Detection will be important for new IAS, and a program for Rapid Response for Quarantine and Eradication. This will eliminate any impact the IAS would otherwise have on Kahoʻolawe.

On February 24 2016, Rep. Tulsi Gabbard from Hawaiʻi (2nd District), in recognition of National Invasive Species week (February 22-26, 2016) presented the following arguments on the floor of the House of Representatives of the US Congress.

> *"Invasive species cost our local economy millions and threaten our unique ecosystems and water ways. Supporting Bill HR3893 - Area Wide Integrated Pest Management Act, would be a call for action that would bring local stake holders together with researchers and other key players, in order to find sustainable, cost effective and comprehensive solutions that will better help all to manage and prevent the spread of harmful pests and invasive species*."

With due diligence, any IAS observations on Maui and Kahoʻolawe, should quickly lead to the chain of action of Early Detection/Rapid Response and thorough mitigation. Involving all personnel that come to Kahoʻolawe is vital to the execution of the Biosecurity concepts presented in this Biosecurity Plan. With the simple common objective of not allowing any new IAS from entering the Kahoʻolawe Island Reserve, generations to come will be able to enjoy the island free of pest species that can potentially disrupt human activity, as well as the ecological balance maintained on Kahoʻolawe today.

While biosecurity can always be improved, the existing processes are to a high standard (McClelland Environmental Services, 2017). Documentation is important to maximize consistency among staff. All biosecurity procedures must be readily accessible to show they are in place, allowing them to be audited, reviewed and revised as necessary.

In May 2017, a two year $2.16 million budget was approved by the Hawaiʻi state legislature for 15 positions for the KIRC for FY18 and FY19. Due to the minimal number

of staff positions funded, the responsibility of each member of the KIRC is accentuated. Engagement, compliance and cooperation from each employee will be critical to carrying out the details of this Biosecurity Plan.

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http://idtools.org/id/ants/pia/

Coordinating Groups on Alien Pests Species (CGAPS)
https://www.invasivespeciesinfo.gov/docs/council/HISC%20Presentation.pdf

Fountain Grass - (*Cenchrus setaceum*)
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2889798/pdf/mcq090.pdf
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Global Invasive Species Database http://www.iucngisd.org/gisd/

Hawaii Ant Lab http://www.littlefireants.com/
DOI: http://dx.doi.org/10.1093/jee/78.5.1083 1083-1088 October, 1985.
http://entnemdept.ufl.edu/creatures/urban/ants/little_fire_ant.htm

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http://dlnr.hawaii.gov/hisc/

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(HPWRP, 2016) https://sites.google.com/site/weedriskassessment/home
http://www.agriculture.senate.gov/imo/media/doc/FIFRA.pdf

Invasive.org - Center for Invasive Species and Ecosystem Health
https://www.invasive.org/index.cfm

Resource Kit for Cat and Rat Eradication - Biosecurity
http://rce.pacificinvasivesinitiative.org/intro/Biosecurity.html

US EPA Worker Protection Standard for Nurseries
http://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps

APPENDIX A - Goats, Sheep and Cattle on Kahoʻolawe

Year	Goats	Sheep	Cattle	Source	Goats Killed
1793	2			2	
1859		2,075		1	
1875	200	20,000		1	
1876		16,000		1	
1881	2,000	1,000		1	
1884	9,000	2,000	200	1	
1888		1,000	800	1	
1890	9,000	12,000	900	1,2,3	
1903		7,000		1	
1904		5,000	60	1	
1906	10,000	3,200		1	
1909	5,000	3,200	40	1	1,144
1910	1,500	1,500		1	550
1912	250	200		1	200
1913		300		1	
1915	300	75		1	
1916		150		1	
1917	900	10		1	
1918	13,000			3	13,000
1920			500	2	
1932	15	20	300	1	
1939	25	200	500	1	
1941	25		460	1	
1944	100	2,000		1	
1953	1,000	1,000		1	
1969	2,000	132		1	
1970	5,000			1	
1971	5,000	400		1	
1990	3			1	

Appendix A. Number of Goats, Sheep and Cattle on Kahoʻolawe.
Source [1]KICC, 1992b [2] KICC, 1993 [3] KIRC, 1998.

APPENDIX B - KIR Biosecurity Signs

APPENDIX B (Continued)
KIR Biosecurity Signs

KIR BIOSECURITY – E MAKA`ALA KĀKOU

Before Going to Kaho`olawe:

- **Have you checked your gear for Invasive Alien Species? Animals, Insects, Weeds, Seeds and Soil.**
- **All dive gear must be clean of algae.**
- **Report any IAS you find to KIRC Staff for Quarantine.**



Animals (rodents, lizards) **Insects (esp. ants)** **Weeds, Seeds and Soil**

GOAL - To Prevent **I**nvasive **A**lien **S**pecies (**IAS**) from Entering the Kaho`olawe Island Reserve (KIR).

- **PREVENTION**
- **DETECTION**
- **QUARANTINE**
- **ERADICATION**
- **EDUCATION**

- Hawaii Invasive Species Council -
Kaho`olawe Island Reserve Commission

APPENDIX C - Biosecurity Quarantine Self Check Sheet

Kahoʻolawe Biosecurity Quarantine Self Check Sheet
One Biosecurity quarantine form to be completed by every group/vessel traveling to island. Please bring this form with you. "**E Makaʻala Kākou" (Lets be Vigilant)**

Date:	Date inspected:
Name:	Departure port / Destination port:

INSTRUCTIONS: ***Prior*** to arrival for quarantine check all clothing and equipment. Personal ukana must have been recently washed, dried and cleaned of any seeds, organic material and insects. Snorkel gear and footwear should be scrubbed in a weak (2%) bleach solution. ***Pay particular attention to any velcro, inner pockets, socks, footwear, pant legs and bags for seeds, soil, organic material etc.*** Any unclean items will not be permitted onto the island. Vessel Hulls must be free of Aquatic Alien Species e.g. algae biofouling. **Contractors to provide KIRC with a manifest of all items going to Kahoʻolawe at least 48 hours prior to launch.**

	Tick if in compliance	**Inspected by KIR Staff**	**Comments-**
Boots			
Other footwear (Socks)			
Clothing including parka/coat			
Dive / snorkel equipment			
Tent/sleeping bag (if applicable)			
Field Research Equipment			
Tools/Construction Equipment			
Food stores (boxed/bagged)			
Cultural Materials			
Vessel Operators Only **Date of Last Hull Biofouling Reduction Type? Dry dock/Water**			
SIGNED: Group Leader/Vessel Captain			**SIGNED: KIR Staff**

APPENDIX D - Invasive Alien Species (IAS) Encounter Form - Kahoʻolawe

	Information		Comments
1	Name(s)		
2	Date		
3	Time		
4	Location		
5	IAS Common Name		
6	IAS Taxa		
7	Number of individuals		
8	Organism Type[1]		
9	Take Picture		
10	Other		

[1]Please note if IAS is a Plant, Insect, Ant, or Animal

KIRC mainline (808) 243-5020. Or Please Call Hawaii Pest Hotline if needed at: 1 800 643-PEST. Or online; http://reportapest.org U.S. Department of Agriculture

IAS Rapid Response Kit Contents

1. Insecticide
2. Sticky Traps
3. Glass Jars/Vials
4. IAS Quarantine Forms

Please let KIRC Biosecurity personnel know if any items in the IAS Rapid Response Kit need to be replaced.

APPENDIX E - Rodent Control Log

Rodent Control Log
Kihei Boat House Facility
Contrac (active indgredient - 0.005% Bromadiolone) 1 oz. bait blocks (3-16 blocks per label)
Sticky Traps (S), Snap traps (ST)
"X" indicates a number is needed
When filling in caught or killed index indicate mice (M), rats (R).

Date MM/DD/YYY	(X) traps set (if needed)	Caught or killed index (X)	Number of rats sighted monthly (X)	Placed (X) new stations	Refreshed bait in (X) stations	Total lbs. of bait used (X)	Initials - Comments

Include diagram of rodent control at facility
Dispose of spoiled bait at an approved waste disposal facility
Service schedule monthly or sooner as needed if rodent sign is evident

APPENDIX F – Treatment and Control of Fire Ants

There are many products which claim to take care of fire ants. However, there are many different species of fire ants in the world (two species have made it to Hawaiʻi), and not all products will work on all species. Little Fire Ants do not build mounds, and they live in cooperative colonies which can span over large areas, in the trees, in rock walls, and in many small crevices and spaces. Their unique ecology requires a special approach to treatment that is based on their behavior and appetites. The Hawaiʻi Ant Lab has been studying Little Fire Ants in Hawaiʻi for more than a decade, and the University Cooperative Extension service has independently tested many ant products as well. Additional information for Little Fire Ant can be found at http://www.littlefireants.com.

Contact Pesticides:

Substances like Raid, Sevin, and Orange Guard; these are made to kill a wide range of insects and bugs, which includes beneficial insects if they also come in contact with the spray. These pesticides are only a short term fix, and are mainly used for keeping ants out of a certain area. Using contact pesticides will not kill the colony, only the ants that come in contact with the spray. These are best used in the house where you just need to get rid of the few that are biting you.

If you have a potted plant that is infested with Little Fire Ant, then creating a drench using contact pesticides is a good way to get rid of the Little Fire Ant. Homeowners can use Sevin to create a drench. Create the Sevin mixture using the adequate amount of water as instructed on the label. Place the infested potted plant in your lawn or over a screen and bucket. Pour the mixture into the potting media until all of the potting media is completely soaked. The excess mixture will flow into the grass or into the bucket. Use the extra in the bucket to spray onto other plants in your yard to treat common garden pests.

Insect Growth Regulators (IGR's):

Unlike toxicants, IGRs don't kill the pests, but disrupt their life cycle. These products reduce or stop the egg production of queens, and prevent eggs and larvae from developing, thus weakening the colony. IGRs are not poison and will not kill adult workers (these are the ones that sting). Since IGRs have no impact on non-reproductive ants, the product will take some time to take effect: workers have a lifespan of about 3 months, and the impacts will be seen once the workers start to die off. IGRs contain the active ingredients *methoprene* or *pyriproxyfen.* However, only Tango (methoprene) has been approved to be mixed into the gel bait developed by HAL. The original recipe for the gel bait can be found on the Hawaiʻi Ant Lab website, http://www.littlefireants.com/. One gallon of bait will generally treat 1 acre (you may go up to 2 gal/acre for very heavy vegetation).

Barrier Treatments:

Barrier treatments can be used when you have infestations occurring on neighboring properties or stretches of land where control is not taking place. You may want to spray around the base of your house and all entryways to prevent ants from coming in to your house, while you are also baiting the ants outside in your yard to get rid of the colonies.

Do not apply a barrier treatment and bait at the same time in your yard! The barrier may prevent workers from reaching the bait or keep them from returning to the colony, which would be a waste of time and money for you. It's best to use a barrier treatment once your infestation is under control. If you are using a barrier around your house to prevent ants form coming inside, do not apply on the same day as you bait.

This is the type of product used by pest control companies who spray to prevent ants from entering or forming colonies inside your home. If you would prefer to apply these treatments yourself, know that they come as a granular or a liquid. Unlike bait products, these granulars must be mixed with water to be effective. Products may contain the active ingredients *bifenthrin*, *cyfluthrin*, and *cypermethrin*.

Examples of Barrier Treatments:

Talstar Brand
Active: Bifenthrin (and zeta-cypermethrin in some products)

- Talstar P (Talstar One) EPA Reg No.279-3206
- Talstar PL Granular EPA Reg No. 279-3168
- Talstar XTRA Granulars EPA Reg. No. 279-9552

Over N Out Advanced Fire Ant Killer
Active: Bifenthrin and zeta-cypermethrin
EPA Reg No.279-3344-71004

Ortho MAX Fire Ant Killer Broadcast Granules
Active: Bifenthrin
EPA Reg. No. 239-2681

Upstar Gold
Active: Bifenthrin
EPA Reg No. 70506-24

Toxicant Baits:

These kinds of baits are meant to kill insects a short time after ingestion. Granular baits are normally made of corn grit that is infused with oil and the active ingredient. Worker ants suck the oil out of the corn grit and share the food with the queen and the rest of the colony. Normally worker ants die a few days after taking the

bait. Toxicant baits that work on Little Fire Ant will contain one of these active ingredients: *hydramethylnon*, *indoxacarb*, and *metaflumizone*. They many come in a granular form, good for spreading on lawns or open areas, or they may come in a powder form that can be mixed into the protein gel bait, which can be used in areas of heavy vegetation. Please note while all of these products are safe for mammals and birds, they are not approved for use in all types of vegetation (for instance, some are not labeled for use in fruit trees, while others may be labeled for use in avocado or citrus trees only). Please read the label to ensure you have the right product for your landscape. Below are some

Examples of Toxicant Baits:

Siesta (granular bait)
Active: Metaflumizone
EPA Reg No.7969-232

Provaunt (powder, needs to be mixed into a bait)
Active: Indoxicarb
EPA Reg. No. 100-1487

MaxForce Complete (granular bait)
Active: Hydramethylnon
EPA Reg No.432-1255

Altrevin (granular bait)
Active: Metaflumizone
EPA Reg No.7969-270
-can be used for citrus and nut trees

Amdro Brand (granular bait)
Active: Hydramethylnon
Amdro is a large company and has many different pesticide products. Make sure to read the label to be sure that you're buying an ant bait.

- Amdro Fire Ant Bait Kills Fire Ants EPA Reg No.73342-1
- Amdro Ant Block Home Perimeter Ant Bait EPA Reg No.73342-2
- Amdro Pro EPA Reg No.241-322

Do not get granular baits wet, or they will lose attractiveness to the ants. Try to apply on a day when it appears you will have a few hours of dry weather. The product will decompose (break down) within a couple of days of application. Applications should be 5-6 weeks apart.

Label Information for Amdro® Ant Block Home Perimeter Ant Bait

One of the most prevalent insects in the environment, ants are also leading household pests in the United States. Ants vary significantly in color and size, and have different food preferences, from proteins to fats and sweets. Ants treat this specially formulated bait as food, so they carry it back to the colony to share. Once the queen and other ants eat it, the whole mound dies. It kills 15 species of ants. Ants are notoriously difficult to control around houses and other structures. Often the use of toxic sprays and dusts have little effect. While some workers (*ants*) will be killed the ant colonies recover very quickly and this often leads to a cycle of spraying to gain temporary relief.

Amdro® is a trade name for a hydramethylnon-based hydrazone insecticide. Be sure not to apply when ground is wet, if rain is expected within 24 hours or when temperatures are below 50°F. Application rate is 43 lbs/ac, max 3 times per year (usual rate is 2 lbs per acre).

Handling:
Avoid contact with eyes or clothing. Avoid breathing dust. Wash thoroughly with soap and water after handling. When engineering control is not feasible wear a NIOSH approved pesticide respirator. When there is risk of exposure to eyes, wear dust proof goggles, overalls, and gloves.

PPE:
If prolonged exposure is expected or adequate ventilation during formulation process cannot be maintained, it is recommended to wear a MSHA/NIOSH approved organic vapor/pesticide respirator, impervious gloves, chemical goggles or safety glasses with side shields.

Instructions:
Obtain SDS Sheet for Amdro®
Read all instructions on Amdro® label.

Toxicological Information:
Avoid contact with skin, eyes and clothing. Wash hands thoroughly with soap and water after handling. Slightly irritating to the skin (based on technical active ingredient). If ingested, drink two glasses of water, induce vomiting if the person is conscious. Seek medical attention. If in eyes, hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

Toxic to fish. Do not apply directly to water. Do not contaminate water when disposing of equipment wash waters. Do not apply when weather conditions favor drift from target areas.

Literature Cited:
http://www.amdro.com/all-products/ant-block-home-perimeter-ant-bait-granules
http://www.littlefireants.com/Amdro%20firestrike.pdf

APPENDIX G - List of Ants in Hawaiʻi and Kahoʻolawe

For ants in Hawaiʻi this assemblage is unique in that nearly all of the species qualify with habits and life histories that make them efficient at moving about in conjunction with human activity (tramp species). Among them are a majority of the world's most successful, and damaging IAS. Although highly invasive species such as Argentine Ant (*Linepithema humile*), Big Headed Ant (*Pheidole megacephala*) and the Yellow Crazy Ant (Anoplolepis gracilipes) may dominate, a fairly diverse array of other ants with differing habits and ecological strategies are also successful in the Hawaiian Islands. These include highly active and common species (*Paratrechina longicornis*, *Nylanderia spp.* and *Technomyrmex spp.*), others that form small and inconspicuous colonies (*Hypoponera spp.* and *Cardiocondyla spp.*), as well as some highly specialized species (*Strumigenys spp.*). Some Cardiocondyla tramp ant species (*C. wroughtonii, C. obscurior, C. emeryi* and *C. minutior*) are even known to be polygynous.

> Ants represent a wholly introduced component of Hawaiian ecosystems. The establishment of roughly 45 ant species over the past two centuries has wide ranging implications for agriculture, other sectors of the economy, and the conservation of native biodiversity. Although ants have received considerable attention in Hawaii, many questions regarding the factors that determine their distributions and influence patterns of species co-occurrence remain largely unexplored. More focus has been directed at their ecological effects in natural areas, where they can directly threaten native invertebrates and vertebrates and indirectly impact native plants. Increased awareness of the negative repercussions of ant introductions in Hawaii has led to improvements in preventative quarantine policy in the last decade, however agencies responsible for ant and other invasive species interdiction remain severely understaffed. Efforts to control or eradicate ant infestations for conservation purposes in Hawaii represent a recent development, and have so far met with variable success. The threat of other destructive ant species, such as the red imported fire ant, arriving in Hawaii underscores the importance of an early detection network and an established infrastructure ready for rapid response. (Krushelnycky et al., 2005)

As of 2003, all species of ants intercepted at US ports of entry and destined to or through the state of Hawaiʻi require quarantine action. They are also considered reportable if they are not already established and widespread in Hawaiʻi and if life stages found in a shipment indicate the ability to reproduce.

This table lists the ants that are present in Hawaiʻi, and the yellow highlighted rows are ants that have been found on Kahoʻolawe (N=19)

Ants In Hawaiʻi		
Number	**Taxa**	**Common Name**
1	*Anoplolepis gracilipes*	Yellow Crazy Ant
2	*Bannapone zwaluwenburgi*	
3	*Brachymyrmex obscurior*	Rover Ant
4	*Camponotus variegatus*	Carpenter Ant
5	*Cardiocondyla emeryi*	Tramp Ant
6	*Cardiocondyla kagutsuchi*	Tramp Ant
7	*Cardiocondyla minutior*	Tramp Ant
8	*Cardiocondyla obscurior*	Tramp Ant
9	*Cardiocondyla venustula*	Tramp Ant
10	*Cardiocondyla wroughtonii*	Tramp Ant
10a	*Cardiocondyla sp.*	Tramp Ant
11	*Cerapachys biroi*	
12	*Hypoponera ergatandria*	
13	*Hypoponera hi01*	
14	*Hypoponera opaciceps*	
15	*Hypoponera opacolor*	
16	*Hypoponera punctatissima*	
17	*Hypoponera ragusai*	
18	*Hypoponera zwaluwenburgi*	
19	*Lepisiota hi01*	
20	*Leptogenys falcigera*	Ponerine Ant
21	*Linepithema humile*	Argentine Ant
22	*Monomorium destructor*	Singapore Ant
23	*Monomorium floricola*	
24	*Monomorium indicum*	
25	*Monomorium liliuokalanii*	Liliʻuokalani Ant
26	*Monomorium pharaonis*	Pharoah Ant
27	*Nylanderia bourbonica*	Tramp Ant
28	*Nylanderia sharpii*	
29	*Nylanderia vaga*	
30	*Ochetellus glaber*	Black Household Ant
31	*Paratrechina longicornis*	Black Crazy Ant
32	*Pheidole fervens*	
33	*Pheidole megacephala*	Big Headed Ant
34	*Pheidole navigans (P. moerens)*	
35	*Plagiolepis alluaudi*	Little Yellow Ant
36	*Ponera swezeyi*	

Ants In Hawai'i		
Number	**Taxa**	**Common Name**
37	*Pseudomyrmex gracilis*	Elongate Twig Ant
38	*Solenopsis geminata*	Tropical Fire Ant
39	*Solenopsis globularia*	
40	*Solenopsis hi01*	
41	*Solenopsis papuana*	
42	*Strumigenys emmae*	
43	*Strumigenys godeffroyi*	
44	*Strumigenys lewisi*	
45	*Strumigenys membranifera*	
46	*Strumigenys rogeri*	
47	*Syllophopsis sechellensis*	
48	*Tapinoma melanocephalum*	Ghost Ant
49	*Tapinoma sessile*	
50	*Technomyrmex albipes*	White Footed Ant
51	*Technomyrmex difficilis*	
52	*Technomyrmex pallipes*	
53	*Technomyrmex vitiensis*	
54	*Tetramorium bicarinatum*	Guinea Ant, Pavement Ant
55	*Tetramorium caldarium*	Pavement Ant
56	*Tetramorium insolens*	Pavement Ant
57	*Tetramorium lanuginosum*	Pavement Ant
58	*Tetramorium simillimum*	Pavement Ant
59	*Tetramorium tonganum*	Pavement Ant
60	*Trichomymex destructor*	
61	*Wasmannia auropunctata*[1]	Little Fire Ant

Ants found in Hawai'i. [1]By law, Little Fire Ant is a regulated species (HRS 150A and HAR Chapter 4-72).

Regular ant monitoring and identification using traps with both protein and sugar based baits is a standard operating procedure. In feeding tests, Argentine Ant, (*L. humile)* workers chose 25% honey water or sucrose water over granulated brown sugar or other solid foods with high protein content such as tuna meal (Baker et al., 1985). Stanley and Robinson (2007) report that of several baits available, tuna fish was the most preferred by the Black Crazy Ant (*P. longicornus*) foragers and sugar water was preferred second. Bait preferences for ant taxa is listed in the following Table.

	Taxa	**Bait Preference**	**Source**
1	*Linepithia humile*	Honey Water	Baker et al., 1985
2	*Paratrechina longicornis*	Tuna Fish	Stanley and Robinson, 2007

Bait preference for ant taxa; note both ant taxa found on Kahoʻolawe.

Literature Cited for List of Ants in Hawaiʻi and Kahoʻolawe:

AntWeb https://www.antweb.org/

Baker et al., 1985. Bait-preference Tests for the Argentine Ant (Hymenoptera: Formicidae)

Krushelnycky et al., 2005. The Ecology, Policy and Management of Ants in Hawaii.

Stanley and Robinson, 2007. Relative Attractiveness of Baits to *Paratrechina longicornis* (Hymenoptera: Formicidae)

APPENDIX H - Pesticide Use Log

Kihei Nursery Pesticide Use Log

Entry	Date	Time	Name	Pesticide Used	Concentration (%)	Carrier	Total Quantity	Area Sprayed	Comments
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

APPENDIX I - KIRC Plant Specifications

KIRC 11/15/01

Standards and Specifications for Native Plant Suppliers

Plant Specifications

- All plants (species determined by the Kaho`olawe Island Reserve Commission) will be grown on either raised benches, weed cloth-covered ground, plastic-covered ground, cement slab or in a certified nursery.

- Seeds and/or cuttings for plants will come from dryland habitats from the islands of Maui, Lana`i and Moloka`i or will be supplied by the KIRC from Kaho`olawe seed source depending on the species requested by the KIRC.

  Kaho`olawe seed provided by the KIRC to the Contractor shall not be grown out as seed stock for additional seed supply in any nursery without explicit permission from the KIRC. This is to prevent cross-pollination of small but unique gene pools of native species on Kaho`olawe with same species from other sites.

- Plant containers will be either dibble tube or containers, as specified.

- Plants will be grown in a sterile medium. Plants will be free of nematodes.

- No compost will be used that contains sewage sludge.

- Height requirements and/or plant length for out-plantings will be at least 21cm (8in) and not more than 31.5cm (12in) for all plants.

- Root structure development will be well established, but without being root-bound within containers.

- Plants will show overall vigor in leaf, stem and root structure.

Kahoʻolawe Island Reserve Commission, 811 Kolu St., Ste. 201, Wailuku, Hawai'i 96793.
Tel: (808) 243-5020

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APPENDIX I
KIRC Plant Specifications

KIRC 11/15/01

Delivery Specifications

- Plants and specified quantities will be delivered to Pacific Helicopter Tours at the Pu'unene heliport, Island of Maui on specified dates to be determined by contract.

- Upon delivery, all plants will be free of alien plants, free of nematodes, free of fungal or other diseases, free of ants, and/or any type of alien organism that may be harmful to the restoration efforts on the Island of Kaho`olawe.

- Shipping boxes and containers in which plants come in will be free of unwanted alien organisms. Containers will be no bigger than 17in x 13in x 13in (1.5cu.ft.) and weigh no more than 50lbs per container.

- *All plants will be inspected at the heliport for alien organisms by the KIRC prior to shipment to the island of Kaho`olawe. If the shipment does not meet agreed standards, the plants will be rejected. It is the responsibility of the vendor to remove the plants from the heliport facilities by the end of that workday, 5:00 pm.*

The Kaho`olawe Island Reserve Commission, Department of Land and Natural Resources, State of Hawai`i is the entity which regulates all access and activities within the Kaho`olawe Island Reserve. The Commission will be the entity purchasing the plants.

Written quotes should be provided in writing to:
Restoration Manager
Kaho`olawe Island Reserve Commission
811 Kolu St.
Wailuku, Hawai`i 96793

For questions and additional growing and shipping requirements, call:
(808) 243-5890 or 243-5031.

Kahoʻolawe Island Reserve Commission, 811 Kolu St., Ste. 201, Wailuku, Hawai'i 96793. 2
Tel: (808) 243-5020

APPENDIX J – FIFRA and US EPA Worker Protection Standards

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA):

The storage of pesticides is regulated under FIFRA which governs the sale distribution and use of pesticides in the United States. The Act provides for federal regulation of pesticide distribution, sale, and use. All pesticides distributed or sold in the United States must be registered (licensed) by EPA. Before EPA may register a pesticide under FIFRA, the applicant must show, among other things, that using the pesticide according to specifications "*will not generally cause unreasonable adverse effects on the environment."* FIFRA defines the term *"unreasonable adverse effects on the environment*" to mean: " *(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act*." (http://www.agriculture.senate.gov/imo/media/doc/FIFRA.pdf).

The storage of pesticides is regulated under FIFRA which governs the sale, distribution and use of pesticides in the United States, pesticides are regulated under FIFRA until they are disposed. Then they are regulated by Resource Conservation and Recovery Act (RCRA) which ensures the responsible management of hazardous and non-hazardous waste. An Emergency Response Plan will be in place in case of an accident or Pesticide spill. Contact names and phone numbers to the KIRC and Hawaiʻi Poison Control Center emergency response personnel will be available on site. The list of pesticides should be readily available for emergency responders. Please use Proper Personnel Protective Equipment (PPE) and immediately report all spills and accidents to KIRC personnel. Follow guidelines on pesticide labels and document quantity of pesticide used.

US EPA Worker Protection Standard:

The Worker Protection Standard (40 CFR Part 170) from the US EPA are regulations reducing the risk of pesticide poisonings and injuries among pesticide handlers. The standard contains requirements for pesticide safety training, notification of pesticide applications, personnel protective equipment (PPE), restricted entry intervals following pesticide application, decontamination supplies and emergency medical assistance. To protect the health and safety of workers and handlers, employers are responsible for training them in the safe use of pesticides. The training manual for the Worker Protection Standard for Agricultural Pesticides (http://www.epa.gov/oecaagct.htc.html) provides detailed information on who is covered and how to meet regulatory requirements. The WPS requires that owners and employers on agricultural establishments provide protections to workers and handlers from potential pesticide exposure and provide mitigations in case exposures may occur (MDAR, 2010). The Occupational Safety and Health Administration (OSHA) "Right to Know" Act will be clearly displayed in the Kihei Nursery area for workers and information on chemical hazards.

USDA Animal and Plant Health Inspection Service (APHIS):

APHIS is a multi-faceted Agency with a mission that includes protecting and promoting US agricultural health, regulating genetically engineered organisms, administering the Animal Welfare Act and carrying out wildlife damage management activities. These efforts support the overall mission of USDA, which is to protect and promote food, agriculture, and natural resources. (https://www.aphis.usda.gov/aphis/banner/aboutaphis)

Safety Data Sheets (SDS):

Safety Data Sheets (SDS) sheets will be readily available on site for safety concerns and proper use of Pesticides. All chemicals used at the Kihei Nursery and in this Biosecurity Plan will have a SDS on file to provide safety information and the correct application for the personnel using them. Also, the KIRC Health and Safety Plan (KIRC, 2003) complies with Title 29 of the Code of Federal Regulations Part 191 of the US Department of Labor Occupational Safety and Health Administration (OSHA), the Hawaiʻi Occupational Health and Safety Division (HIOSH) and US EPA regulations.

Emergency Eyewash:

Eyewash meeting the requirements of the ANSI standard Z358.1-1990 should be utilized at the work sites for hands free irrigation for both eyes for at least 15 minutes at a flow rate of at least 0.4 gallons / minute.

Emergency Eye Wash

APPENDIX K - Four Botanical Surveys performed on Kahoʻolawe in 2015

APPENDIX K - Four Botanical Surveys performed on Kahoʻolawe in 2015					
	Taxa	**Base Camp**	**LZ Quail**	**LZ One**	**Hakioawa**
1	*Abutilon grandifolium*	1			1
2	*Abutilon incanum*	1			1
3	*Ageratum conyzoides*				1
4	*Alternanthera caracasana*				1
5	*Alternanthera pungens*	1			
6	*Asclepias physocarpa*			1	1
7	*Atriplex semibaccata*		1	1	1
8	*Batis maritima*				1
9	*Boerhavia coccinea*	1	1		
10	*Bothriochloa pertusa*	1		1	1
11	*Broussonetia papyrifera*				1
12	*Calyptocarpus vialis*				1
13	*Cenchrus ciliaris*	1	1	1	1
14	*Chamaecrista nictitans var. glabrata*			1	1
15	*Chenopodium murale*				1
16	*Chenopodium oahuense*				1
17	*Chloris barbata*				1
18	*Chloris virgata*	1			1
19	*Conyza bonariensis*		1	1	
20	*Cordia subcordata*				1
21	*Cyanthillium cinereum*				1
22	*Dactyloctenium aegyptium*				1
23	*Desmanthus pernambucanus*	1		1	
24	*Desmodium triflorum*		1	1	
25	*Digitaria insularis*			1	1
26	*Dodonaea viscosa*	1			1
27	*Eclipta prostrata*				1
28	*Emilia fosbergii*	1	1	1	1
29	*Eragrostis amabilis*	1			
30	*Erythrina sandwicensis*				1
31	*Euphorbia hirta*	1			1
32	*Euphorbia hyssopifolia*				1
33	*Gossypium tomentosum*	1			1
34	*Heteropogon contortus*	1	1	1	1
35	*Heterotheca grandiflora*		1		

APPENDIX K - Four Botanical Surveys performed on Kahoʻolawe in 2015					
	Taxa	**Base Camp**	**LZ Quail**	**LZ One**	**Hakioawa**
36	*Indigofera spicata*	1			
37	*Ipomoea pes-caprae*				1
38	*Jacquemontia sandwicensis*				1
39	*Lantana camara*			1	1
40	*Leonotis nepetifolia*				1
41	*Leucaena leucocephala*	1	1	1	1
42	*Macroptilium atropurpureum*		1	1	1
43	*Macroptilium lathyroides*	1	1	1	1
44	*Malvastrum coromandelianum ssp. coromandelianum*				1
45	*Melinis repens*		1	1	
46	*Merremia aegyptia*	1			
47	*Myoporum sandwicense*				1
48	*Neonotonia wightii*			1	
49	*Nicotiana glauca*			1	1
50	*Ocimum gratissimum*				1
51	*Pennisetum polystachion*	1	1		
52	*Pluchea carolinensis (odorata)*		1	1	1
53	*Pluchea indica*				1
54	*Pluchea x fosbergii*			1	
55	*Portulaca oleracea*	1			
56	*Portulaca pilosa*				1
57	*Prosopis pallida*	1	1		1
58	*Psilotum nudum*		1		
59	*Salsola tragus*		1		
60	*Scaevola taccada*				1
61	*Senecio madagascariensis*		1	1	1
62	*Sesuvium portulacastrum*				1
63	*Setaria verticilliata*				1
64	*Sida ciliaris*				1
65	*Sida fallax*	1		1	1
66	*Sonchus oleraceus*			1	1
67	*Sporobolus africanus*	1			
68	*Sporobolus virginicus*				1
69	*Stachytarpheta jamaicensis*			1	
70	*Stapelia gigantea*				1
71	*Synedrella nodiflora*				1
72	*Tamarix aphylla*			1	

APPENDIX K - Four Botanical Surveys performed on Kahoʻolawe in 2015					
	Taxa	**Base Camp**	**LZ Quail**	**LZ One**	**Hakioawa**
73	*Thespesia populnea*				1
74	*Tragus berteronianus*	1			
75	*Tribulus sp. (cistoides?)*	1			
76	*Tridax procumbens*	1		1	
77	*Urochloa maxima (Megathyrsus maximus)*		1	1	1
78	*Vachellia farnesiana*	1			1
79	*Verbena litoralis*			1	
80	*Vitex rotundifolia*				1
81	*Waltheria indica*	1	1	1	1
82	*Xanthium strumarium var. canadense*				1
	Sum	28	20	29	59

Appendix K. Four Botanical Surveys on Kahoʻolawe in 2015

APPENDIX L - Kahoʻolawe Island Botanical Inventory

Family	Species	Common Name
Malvaceae	*Abutilon grandifolium*	hairy abutilon
Malvaceae	*Abutilon incanum*	hoary abutilon
Malvaceae	*Abutilon menziesii*[1]	koʻoloaʻula
Fabaceae	*Acacia confusa*	formosa koa
Fabaceae	*Acacia implexa*[2]	lightwood
Fabaceae	*Acacia koa*[1]	koaiʻa, koa
Fabaceae	*Acacia mangium*[2]	brown salwood
Fabaceae	*Acacia mearnsii*[2]	black wattle
Asteraceae	*Acanthospermum australe*	spiny-bur
Amaranthaceae	*Achyranthes splendens*[1]	ʻewa hinahina
Pteridaceae	*Adiantum hispidulum*	rough maidenhair fern
Agavaceae	*Agave sisalana*	sisal, century plant
Asteraceae	*Ageratina riparia*	pamakani
Asteraceae	*Ageratum conyzoides*	maile honohono
Euphorbiaceae	*Aleurites mollucana*	kukui
Asphodelaceae	*Aloe barbadense*[2]	aloe
Amaranthaceae	*Alternanthera caracasana*	mat chaff flower
Amaranthaceae	*Alternanthera pungens*	khaki weed
Apocynaceae	*Alyxia stellata*	maile
Amaranthaceae	*Amaranthus spinosus*	spiny amaranth
Amaranthaceae	*Amaranthus viridis*	slender amaranth
Plantaginaceae	*Antirrhinum orontium*	lesser snapdragon
Poaceae	*Arachis glabrata*[2]	forage peanut grass
Araucariaceae	*Araucaria heterophylla*[2]	norfolk Island pine
Papaveraceae	*Argemone glauca var. glauca*	pua kala
Asteraceae	*Artemesia mauiensis*[1]	hinahina
Asteraceae	*Artemisia australis*[1]	hinahina
Aspleniaceae	*Asplenium adiantum-nigrum*	ʻiwaʻiwa
Amaranthaceae	*Atriplex semibaccata*	australian saltbush
Chenopodiaceae	*Atriplex suberecta*	saltbush
Bataceae	*Batis maritima*	pickleweed
Asteraceae	*Bidens alba var. radiata*	spanish needle
Asteraceae	*Bidens mauiensis*	koʻokoʻolau
Asteraceae	*Bidens micrantha*[1]	koʻokoʻolau
Asteraceae	*Bidens pilosa*	spanish needle
Nyctaginaceae	*Boerhavia acutifolia*	alena
Nyctaginaceae	*Boerhavia coccinea*	boerhavia
Nyctaginaceae	*Boerhavia herbstii*	alena
Nyctaginaceae	*Boerhavia repens*	alena
Poaceae	*Bothriochloa bladhii*	bluestem
Poaceae	*Bothriochloa pertusa*	pitted beardgrass
Poaceae	*Botriochloa ischaemum*[2]	yellow bluestem grass
Moraceae	*Broussonetia papyrifera*[2]	wauke, paper mulberry
Poaceae	*Buchloe dactyloides*[2]	american buffalo grass
Cupressaceae	*Callitris calcarata*[2]	pine

Family	Species	Common Name
Cupressaceae	*Callitris columellaris*[2]	murray river pine
Pinaceae	*Callitris endlicheri*[2]	black cypress pine
Clusiaceae	*Calophyllum inophyllum*[1]	kamani
Asclepiadaceae	*Caloptris gigantea*	crown flower
Asteraceae	*Calyptocarpus vialis*	straggler daisy
Fabaceae	*Canavalia pubescens*[1]	ʻawikiwiki
Cannabaceae	*Cannabis sativa*	marijuana, pakalolo
Solanaceae	*Capiscum frutescens*[2]	chili pepper
Capparaceae	*Capparis sandwichiana*[1]	maiapilo
Cyperaceae	*Carex meyenii*	carex
Fabaceae	*Cassia sp.*	cassia
Casuarinaceae	*Casuarina equisetifolia*[1]	common ironwood
Casuarinaceae	*Casuarina glauca*[1]	longleaf ironwood
Apocynaceae	*Catharanthus roseus*	madagascar periwinkle
Poaceae	*Cenchrus agrimonioides*[1]	kamanomano
Poaceae	*Cenchrus ciliaris*	buffelgrass
Poaceae	*Cenchrus echinatus*	sandbur
Poaceae	*Cenchrus purpureus*	cane grass
Poaceae	*Cenchrus setaceus*	fountain grass
Poaceae	*Cenchrus tribuloides*	sandbur
Asteraceae	*Centaurea melitensis*	yellow star thistle
Gentianaceae	*Centaurium erythraea ssp. erythraea*	bitter herb
Fabaceae	*Chamaecrista nictitans ssp patellaria var glabrata*	partridge pea
Chenopodiaceae	*Chenopodium carinatum*	chenodpodium
Chenopodiaceae	*Chenopodium murale*	goosefoot, lamb's quarters
Chenopodiaceae	*Chenopodium oahuense*[1]	ʻaweoweo
Poaceae	*Chloris barbata*	swollen fingergrass
Poaceae	*Chloris divaricata var. divaricata*	windmill grass
Poaceae	*Chloris truncatata*	fingergrass
Poaceae	*Chloris virgata*	feather fingergrass
Thelypteridaceae	*Christella dentata*	paiʻiha
Thelypteridaceae	*Christella parasitica*	fern
Asparagaceae	*Chrysodracon auwahiensis*[1]	hala pepe
Asparagaceae	*Chrysodracon aurea*[1]	hala pepe
Asteraceae	*Cirsium vulgare*	bull thistle, pua kala
Cucurbitaceae	*Citrullus lanatus*	watermelon
Polygonaceae	*Cocoloba urifera*[2]	seagrape
Arecaceae	*Cocos nucifera*[1]	niu, coconut
Rubiaceae	*Coffea arabica*	arabian coffee
Poaceae	*Coix lacryma-jobi*	job's tears
Rhamnaceae	*Colubrina asiatica*[1]	ʻanapanapa
Asteraceae	*Conyza bonariensis*	hairy horseweed
Asteraceae	*Conyza canadensis*	horseweed
Boraginaceae	*Cordia subcordata*	kou
Liliaceae	*Cordyline fruiticosa*[1]	ti, ki
Asteraceae	*Crassocephalum crepidioides*	ebolo, redflower ragleaf

Family	Species	Common Name
Hymenophyllaceae	*Crepidomanes minutum*	filmy fern
Convolvulaceae	*Cressa truxillensis*	makihi, cressa
Fabaceae	*Crotalaria incana*	fuzzy rattlepod
Cucurbitaceae	*Cucumis dipsaceus*	teasel gourd
Cucurbitaceae	*Cucumis sativius*	cucumber
Cupressaceae	*Cupressus sempervirens*[2]	mediterranean cypress
Asteraceae	*Cyanthillium cinereum*	little ironweed
Poaceae	*Cynodon dactylon*	bermuda grass
Poaceae	*Cynodon plectostachyus*[1]	stargrass
Cyperaceae	*Cyperus gracilis*	mccoy grass
Cyperaceae	*Cyperus javanicus*[1]	ʻahu ʻawa
Cyperaceae	*Cyperus phleoides var. phleoides*	cyperus
Cyperaceae	*Cyperus trachysanthos*[1]	puʻu kaʻa
Poaceae	*Dactyloctenium aegyptium*	beach wiregrass
Fabaceae	*Desmanthus pernambucanus*	slender mimosa
Fabaceae	*Desmodium sandwicense*	spanish clover
Fabaceae	*Desmodium tortuosum*	florida beggarweed
Fabaceae	*Desmodium triflorum*	tick clover
Poaceae	*Dichanthium aristatum*	wilder grass, angleton
Poaceae	*Dichanthium sericeum*	australian bluestem
Poaceae	*Digitaria ciliaris*	henry's crabgrass
Poaceae	*Digitaria eriantha*[2]	finger grass
Poaceae	*Digitaria insularis*	sourgrass
Poaceae	*Digitaria pentzii*[2]	pangola grass
Ebenaceae	*Diospyros sandwicensis*[1]	lama
Poaceae	*Distichlis stricta*[2]	salt grass
Sapindaceae	*Dodonaea viscosa*[1]	ʻaʻaliʻi
Pteridaceae	*Doryopteris decipiens*	ʻiwaʻiwa
Pteridaceae	*Doryopteris decora*	ʻiwaʻiwa, lance fern
Asteraceae	*Dubautia linearis*[1]	kupaoʻa
Amaranthaceae	*Dysphania carinata*	keeled wormseed
Asteraceae	*Dyssodia tenuiloba*	dogweed, dahlberg daisy
Poaceae	*Echinochloa colona*	jungle-rice
Asteraceae	*Eclipta prostrata*	false daisy
Poaceae	*Ehrharta stipoides*	meadow ricegrass
Cyperaceae	*Eleocharis calva*	kohekohe, pipiwai, spikerush
Poaceae	*Eleusine indica*	wiregrass
Asteraceae	*Emilia fosbergii*	pualele
Asteraceae	*Emilia sonchifolia*	lilac tassleflower
Poaceae	*Eragrostis amabilis*	lovegrass
Poaceae	*Eragrostis atropioides*[1]	hard-stem lovegrass
Poaceae	*Eragrostis cilianensis*	stinkgrass
Poaceae	*Eragrostis curvula*	lovegrass
Poaceae	*Eragrostis grandis*	lovegrass
Poaceae	*Eragrostis leptophylla*	lovegrass
Poaceae	*Eragrostis pectinacea*	carolina lovegrass
Poaceae	*Eragrostis superba*[2]	lovegrass
Poaceae	*Eragrostis tenellea*	japanese lovegrass

Family	Species	Common Name
Poaceae	*Eragrostis variabilis*[1]	kawelu, emoloa, kalamalo
Poaceae	*Eragrostris (Ehrharta?) calycina*[2]	veldt grass
Asteraceae	*Erechtites valerianifolia*	tropical burnweed
Fabaceae	*Erythrina sandwicensis*[1]	wiliwili
Myrtaceae	*Eucalyptus camaldulensis*[2]	murray redgum
Myrtaceae	*Eucalyptus citriodora*[2]	lemon gum
Myrtaceae	*Eucalyptus globulus var compacta*[2]	compacta
Myrtaceae	*Eucalyptus punctata*[2]	punctata
Myrtaceae	*Eucalyptus robusta*[2]	robusta
Myrtaceae	*Eucalyptus sideroxylon*[2]	redbark ironwood
Myrtaceae	*Eucalyptus tereticornis*[2]	redgum
Myrtaceae	*Eucalyptus torelliana*[2]	torelliana
Euphorbiaceae	*Euphorbia celastroides var. amplectens*	ʻakoko
Euphorbiaceae	*Euphorbia celastroides var. stokesii*	ʻakoko
Euphorbiaceae	*Euphorbia heterophylla*	spurge
Euphorbiaceae	*Euphorbia hirta*	hairy spurge
Euphorbiaceae	*Euphorbia hypericifolia*	graceful spurge
Euphorbiaceae	*Euphorbia hyssopifolia*	hyssopleaf sandmat
Euphorbiaceae	*Euphorbia prostrata*	prostrate spurge
Euphorbiaceae	*Euphorbia skottsbergii var. vaccinioides*	ʻakoko
Santalaceae	*Exocarpos gaudichaudii*	hulumoa
Moraceae	*Ficus microcarpa*	chinese banyan
Asteraceae	*Flaveria trinervia*	flaveria
Asparagaceae	*Furcreae foetida*	mauritius hemp
Asteraceae	*Galinsoga parviflora*	gallant soldier
Asteraceae	*Gamochaeta pensylvanica*	purple cudweed
Apocynaceae	*Gomphocarpus curassavica*	butterfly weed
Apocynaceae	*Gomphocarpus physocarpus*	balloon plant
Malvaceae	*Gossypium tomentosum*[1]	maʻo, hawaiian cotton
Rhamnaceae	*Gouania hillebrandii*	gouania
Proteaceae	*Grevillea robusta*	silk oak
Hernandiaceae	*Gyrocorpus americanus*[2]	gyrocarp
Boraginaceae	*Heliotropium curassavicum*	nena, seaside heliotrope
Boraginaceae	*Heliotropium foertherianum*[2]	heliotrope
Poaceae	*Heteropogon contortus*[1]	pili
Asteraceae	*Heterotheca grandiflora*	telegraph weed
Malvaceae	*Hibiscus brackenridgei ssp. brackenridgei*[1]	maʻo hau hele
Malvaceae	*Hibiscus tiliaceus*[1]	hau
Cactaceae	*Hylocereus undatus*	night-blooming cereus
Asteraceae	*Hypochoeris glabra*	smooth cat's-ear
Asteraceae	*Hypochoeris radicata*	hairy cat's-ear, gosmore
Fabaceae	*Indigofera suffruticosa*	indigo
Convolvulaceae	*Ipomoea cairica*	ivy-leaved morning glory, koali ʻai
Convolvulaceae	*Ipomoea indica*[1]	morning glory, koali ʻawa
Convolvulaceae	*Ipomoea pes-caprae ssp. brasiliensis*[1]	pohuehue, beach morning glory

Family	Species	Common Name
Convolvulaceae	*Ipomoea tuboides*	hawaiian moon flower
Poaceae	*Ischaemum byrone*[1]	hilo ischaemum
Convolvulaceae	*Jacquemontia ovalifolia ssp. sandwicensis*	paʻu o hiʻiaka
Fabaceae	*Kanaloa kahoolawensis*	ka palupalu o kanaloa
Poaceae	*Lachnagrostis filiformis*	heupueo
Asteraceae	*Lactuca sativa*	prickly lettuce
Verbenaceae	*Lantana camara*	lantana
Lamiaceae	*Leonotis nepetifolia*	lion's ear, lion's tail
Brassicaceae	*Lepidium bidentatum var. o-waihiense*¹	ʻanaunau
Brassicaceae	*Lepidium didymum*	swinecress
Brassicaceae	*Lepidium oblongum*	pepperwort, peppergrass
Fabaceae	*Leucaena leucocephala*	koa haole, ekoa, lilikoa
Asteraceae	*Lipochaeta rockii*	nehe
Asteraceae	*Lipochaeta succulenta*	nehe
Poaceae	*Lolium multiflorum*[2]	annual ryegrass
Solanaceae	*Lycium sandwicense*	ʻohelo kai
Solanaceae	*Lycopersicon esculentum*	tomato
Solanaceae	*Lycopersicon pimpinellifolium*	currant tomato
Lycopodiaceae	*Lycopodium spp.*[2]	club moss
Primulaceae	*Lysimachia arvensis*	scarlet pimpernel
Fabaceae	*Macroptilium atropurpureum*	twining cow pea
Fabaceae	*Macroptilium lathyroides*	erect cow pea
Malvaceae	*Malva parviflora*	cheese weed
Malvaceae	*Malvastrum coromandelianum ssp. coromandelianum*	false mallow
Anacardiaceae	*Mangifera indica*	mango
Poaceae	*Megathyrsus maximus*	guinea grass
Poaceae	*Megathyrsus maximus var trichoglume*[2]	green panic grass
Asteraceae	*Melanthera bryanii*	nehe
Asteraceae	*Melanthera integrifolia*	nehe
Asteraceae	*Melanthera lavarum*	nehe
Meliaceae	*Melia azederach*[2]	pride of India
Poaceae	*Melinis minutiflora*	molasses grass
Poaceae	*Melinis repens*	natal redtop
Convolvulaceae	*Merremia aegyptia*	hairy merremia
Myrtaceae	*Metrosideros polymorpha*¹	ʻohiʻa
Cucurbitaceae	*Momordica charantia*	bitter melon
Asteraceae	*Montanoa hibiscifolia*	tree daisy
Rubiaceae	*Morinda citrifolia*[1]	noni
Myoporaceae	*Myoporum sandwicense*¹	naio, false sandalwood
Fabaceae	*Neonotonia wightii*	glycine
Nephrolepidaceae	*Nephrolepis brownii (syn. multiflora)*	kupukuku, asian sword fern
Urticaceae	*Neraudia sericea*	neraudia
Asclepiadaceae	*Nerium oleander*	oleander
Sapotaceae	*Nesoluma polynesicum*¹	keahi
Solanaceae	*Nicotiana glauca*	tree tobacco
Solanaceae	*Nicotiana tabacum*	tobacco

Family	Species	Common Name
Oleaceae	*Noronhia emarginata*[2]	Madagascar olive
Solanaceae	*Nothocestrum latifolium*[1]	ʻaiea
Amaranthaceae	*Nototrichium sandwicense*[1]	kului
Lamiaceae	*Ocimum gratissim*	wild basil
Rubiaceae	*Oldenlandia corymbosa*	old world diamond flower
Ophioglossaceae	*Ophioglossum polyphyllum*	pololei, adder's tongue
Cactaceae	*Opuntia ficus-indica*	panini
Rosaceae	*Osteomeles anthyllidifolia*[1]	ʻulei
Oxalidaceae	*Oxalis corniculata*	yellow wood sorrel
Pandanaceae	*Pandanus odoratissimus*[1]	pandanus
Poaceae	*Panicum antidotale*[2]	blue panic grass
Poaceae	*Panicum fauriei var. fauriei*	panicum
Poaceae	*Panicum fauriei var. latius*[1]	panicum
Poaceae	*Panicum ramosius*	panicum
Poaceae	*Panicum torridum*	kakonakona
Poaceae	*Panicum xerophilum*	kakonakona
Passifloraceae	*Passiflora edulis*	passion fruit
Poaceae	*Pennisetum polystachion*	feathery pennisetum
Asteraceae	*Perityle emoryi*	rock daisy
Polypodiaceae	*Phymatosorus scolopendria*	laua‘e
Phytolacaceae	*Phytolacca dioica*	ombu, bella sombra
Pinaceae	*Pinus brutis*[2]	brutis pine
Pteridaceae	*Pityrogramma austroamericana*	goldfern
Pteridaceae	*Pityrogramma calomelanos*	silverfern
Asteraceae	*Pluchea carolinensis*	sourbush, marsh fleabane
Asteraceae	*Pluchea indica*	Indian fleabane
Asteraceae	*Pluchea x fosbergii*	marsh fleabane
Plumbaginaceae	*Plumbago zeylanica*[1]	ilie‘e
Caryophyllaceae	*Polycarpon tetraphyllum*	four-leaved allseed
Portulacaceae	*Portulaca molokiniensis*	ʻihi
Portulacaceae	*Portulaca oleracea*	pigweed
Portulacaeae	*Portulaca pilosa*	pigweed
Portulacaceae	*Portulaca villosa*	ʻihi
Fabaceae	*Prosopis pallida*	kiawe
Psilotaceae	*Psilotum nudum*	moa
Rubiaceae	*Psydrax odorata*[1]	alahe‘e
Brassicaceae	*Raphanus sativus*	wild radish
Apocynaceae	*Rauvolfia sandwicensis*[1]	hao
Araliaceae	*Reynoldsia sandwicensis*[1]	ohe makai
Rhizophoraceae	*Rhizophora mangle*	american mangrove
Euphorbiaceae	*Ricinus communis*	castor bean
Poaceae	*Saccharum officinarum*	sugar cane
Amaranthaceae	*Salsola tragus*	russian thistle, tumbleweed
Santalaceae	*Santalum ellipticum*[1]	ʻiliahi alo‘e, coast sandalwood
Goodeniaceae	*Scaevola sericea (syn. taccada)*[1]	naupaka kahakai
Asteraceae	*Senecio madagascariensis*	fireweed
Fabaceae	*Senna gaudichaudii*[1]	kolomona

Family	Species	Common Name
Fabaceae	*Sesbania grandiflora*[2]	vegetable hummingbird tree
Fabaceae	*Sesbania tomentosa*[1]	ʻohai
Aizoaceae	*Sesuvium portulacastrum*	akulikuli, sea purslane
Poaceae	*Setaria gracilis*	yellow foxtail
Poaceae	*Setaria leucopila*[2]	plains bristlegrass
Poaceae	*Setaria verticillata*	bristly foxtail
Cucurbitaceae	*Sicyos pachycarpus*	ʻanunu
Malvaceae	*Sida ciliaris*	red sida
Malvaceae	*Sida fallax*[1]	ʻilima
Malvaceae	*Sida rhombifolia*	sida
Malvacaeae	*Sida spinosa*	prickly sida
Asteraceae	*Sigesbeckia orientalis*	small yellow crown-beard
Brassicaceae	*Sisymbrium altissimum*	tumble mustard
Solanaceae	*Solanum americanum*	glossy nightshade, popolo
Solanaceae	*Solanum linnaeanum*	apple of sodom
Solanaceae	*Solanum lycopersicum var. cerasiforme*	cherry tomato
Asteraceae	*Sonchus oleraceus*	sow thistle, pualele
Fabaceae	*Sophora chrysophylla*[1]	mamane
Poaceae	*Sorghum sp.*	sorghum
Asteraceae	*Sphagneticola trilobata*	wedelia
Poaceae	*Sporobolus africanus*	rattail grass
Poaceae	*Sporobolus pyramidatus*	dropseed
Poaceae	*Sporobolus virginicus*[1]	ʻakiʻaki
Verbenaceae	*Stachytarpheta jamaicensis*	jamaica vervain
Apocynaceae	*Stapelia gigantea*	zulu giant, carrion plant
Poaceae	*Stylosanthes fruiticosa*[2]	shrubby pencil-flower
Poaceae	*Stylosanthes humulis*[2]	townsville lucerne grass
Asteraceae	*Synedrella nodiflora*	nodeweed
Tamariacaceae	*Tamarix aphylla*[1]	tamarix
Fabaceae	*Tephrosia purpurea var. purpurea*	ʻauhuhu
Poaceae	*Tephrosia vogelli*[2]	tephrosia
Combretaceae	*Terminalia catappa*	false kamani
Malvaceae	*Thespesia populnea*[1]	milo
Asteraceae	*Thymophylla tenuiloba*	dog fennel
Urticaceae	*Touchardia latifolia*[1]	olona
Poaceae	*Tragus berteronianus*	bur grass
Aiaoaceaea	*Trianthema portulacastrum*	giant pigweed
Zygophyllaceae	*Tribulus cistoides*	nohu
Asteraceae	*Tridax procumbens*	coat buttons
Fabaceae	*Trifolium sp.*[2]	clover
Poaceae	*Urochloa decumbens*	signal grass
Fabaceae	*Vachellia farnesiana*	klu
Verbenaceae	*Verbena litoralis*	vervain, oi
Asteraceae	*Verbesina encelioides*	golden crown-beard
Asteraceae	*Vernonia cinerea var. parviflora*	little ironweed
Fabaceae	*Vigna o-wahuensis*	vigna
Lamiaceae	*Vitex rotundifolia*[1]	pohinahina

Family	Species	Common Name
Malvaceae	*Waltheria indica*	uhaloa
Thymelaeaceae	*Wikstroemeia uva-ursi*[1]	ʻakia
Asteraceae	*Xanthium strumarium var. canadense*	cocklebur
Asteraceae	*Zinnia peruviana*	pua pihi

Appendix L. Kahoʻolawe Island Botanical Inventory. [1] Outplanted since 1980 consent decree and/or naturally occurring, [2] Alien plants species used in previous planting trials.

Literature Cited for Kahoʻolawe Island Botanical Inventory:

Flora of the Hawaiian Islands – Botany – The Smithsonian Institute http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/

KICC, 1992a. Biological Database and Reconnaissance Survey of Kahoʻolawe Island including Rare Plants, Animals and Natural Communities.

KIRC, 1998. Kahoʻolawe Environmental Restoration Plan.

KIRC, 2005. Final Report, Watershed Restoration at Moaʻulanui Kahoʻolawe, Hawaiʻi.

KIRC, 2010. Final Report, A Three-Phase Kahoʻolawe Island Reserve Commission Project Extension.

KIRC, 2015a. Final Report, Reducing Excessive Sedimentation in the Hakioawa Watershed of Kahoʻolawe by Restoring Native Ecosystems.

KIRC, 2018. Final Report, Restoration of the Hakioawa Watershed on Kahoʻolawe for Ground Water Recharge

Starr Environmental Plants of Kaho`olawe http://www.hear.org/naturalareas/kahoolawe/index.html.

Starr, F., K. Starr, and L. Loope. 2010. New Plant Records from the Hawaiian Archipelago. Bishop Mus. Occas. Pap. 107: 61-68.

Starr, F. and K. Starr. 2011. New plant records from Midway Atoll, Maui, and Kahoʻolawe. Bishop Mus. Occas. Pap. 110: 23-35.

APPENDIX M – Selected Native Faunal Species Recorded from Kahoʻolawe

	Taxa	Common Name	Hawaiian Name
1	*Anous minutus*	Black Noddy	Noio (ʻEkiʻeki)
2	*Arenaria interpres*	Ruddy Turnstone	ʻAkekeke
3	*Asio flammeus sandwichensis*	Short-eared Owl	Pueo
4	*Bulweria bulwerii*	Bulwer`s Petrel	ʻOu
5	*Calidris alba*	Sanderling	Hunakai
6	*Coleotichus blackburniae*	Koa Shield Bug	
7	*Chelonia mydas* (E)	Green Turtle	Honu
8	*Fregata minor palmerstoni*	Frigate Bird	ʻIwa
9	*Halocaridina rubra*	Anchialine Pool Shrimp	ʻOpaeʻula
10	*Heteroscelus incanus*	Wandering Tattler	ʻUlili
11	*Hylaeus anthracinus* (E)	Yellow-faced Bee	
12	*Hylaeus assimulans* (E)	Yellow-faced Bee	
13	*Lasiurus cinerus semotus* (E)	Hawaiian Hoary Bat	ʻŌpeʻa peʻa
14	*Larus spp.*	Migratory gulls	
15	*Manduca blackburni* (E)	Blackburn's Sphinx Moth	
16	*Neomonachus schauinslandi* (E)	Hawaiian Monk Seal	ʻIlio holo i ka uaua
17	*Numenis tahitiensis*	Bristle-thighed Curlew	Kioea
18	*Nycticorax nyticorax*	Black-crowned Night Heron	ʻAukuʻu
19	*Oceanodroma castro* (E)	Band-rumped Storm Petrel	ʻAkeʻake
20	*Oceanodroma tristrami*	Tristans Storm Petrel	
21	*Phaethon lepturus*	White-tailed Tropicbird	Koaʻe kea
22	*Phaethon rubricauda*	Red-tailed Tropicbird	Koaʻe ʻula
23	*Phoebastria immutabilis*	Laysan Albatross	Moli
24	*Pterodroma sandwichensis* (E)	Hawaiian Petrel	Ua'u
25	*Pluvialis squatarola*	Black-bellied Plover	
26	*Pluvialis fulva*	Pacific Golden Plover	Kolea
27	*Puffinus pacificus*	Wedge-tailed Shearwater	ʻUaʻu kani
28	*Sterna fuscata*	Sooty Tern	ʻEwaʻewa
29	*Sula leucogaster*	Brown Booby	'A
30	*Sula sula*	Red-footed Booby	'A
31	*Triops longicaudata*	Dinosaur or Tadpole Shrimp	

Appendix M. Selected Native Faunal Species Recorded from Kahoʻolawe. (E) = Federally listed as an endangered species.

Literature Cited for Selected Native Faunal Species Recorded from Kahoʻolawe:

KICC, 1992a. Biological Database and Reconnaissance Survey of Kahoʻolawe Island including Rare Plants, Animals and Natural Communities.

KIRC, 1998. Kahoʻolawe Environmental Restoration Plan.

KIRC, 2015b. Kahoʻolawe Island Seabird Restoration Project.

APPENDIX N – Non-native Vertebrates Recorded on Kahoʻolawe

	Taxa	Common Name	IAS
1	*Acridotheres tristis*	Common Myna	
2	*Alectoris chukar*	Chukar	
3	*Alauda arvensis*	Eurasian Skylark	
4	*Anas sp.*	Unidentified Duck	
5	*Callipepla gambelii*	Gambel's Quail	
6	*Cardinalis cardinalis*	Northern Cardinal	
7	*Carpodacus mexicanus*	House Finch	
8	*Cettia diphone*	Japanese Bush-warbler	
9	*Columba livia*	Rock Dove	
10	*Cryptoblepharus boutoni poeciloplerus*	Snake-eyed Skink	
11	*Emoia cyanura*	Azur-tailed Skink	
12	*Felis catus*	Feral Cat	*
13	*Gehyro mutiliata*	Stump-toed Gecko	
14	*Geopelia striata*	Zebra Dove	
15	*Hemidactylus frenatus*	House gecko	
16	*Hemidactylus garnoti*	Indo-Pacifc Gecko (Fox Gecko)	
17	*Hemiphllodactylus typus typus*	Tree Gecko	
18	*Leiolopisma metallicum*	Metallic Skink	
19	*Lepidodactylus lugubris*	Mourning Gecko	
21	*Lipinia noctua noctua*	Moth Skink	
22	*Lonchura malabarica*	Warbling Silverbill	
23	*Lonchura punctulata*	Nutmeg Mannikin	
24	*Mimus polyglottos*	Northern Mockingbird	
25	*Mus musculus*	House Mouse	*
26	*Paroaria coronata*	Red-crested Cardinal	
27	*Passer domesticus*	House Sparrow	
28	*Rattus exulans*	Polynesian Rat	*
29	*Streptopelia chinensis*	Spotted Dove	
30	*Tyto alba*	Barn Owl	*
31	*Zosterops japonicus*	Japanese White-eye	

Appendix N. Non-native Vertebrates Recorded on Kahoʻolawe. * = IAS

Literature Cited for Non-native Vertebrates Recorded on Kahoʻolawe:

KICC, 1992a. Biological Database and Reconnaissance Survey of Kahoʻolawe Island including Rare Plants, Animals and Natural Communities.

KIRC, 1998. Kahoʻolawe Environmental Restoration Plan.

APPENDIX O – Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Acanthoscelides sp. (obtectus?)	Bean Weevil
Achaea janata	Castor Semi Looper
Acrosticha apicalis	Picture-winged fly
Aedes albopictus	Asian Tiger Mosquito
Afrolistrophorus musculus	Fur Mite
Algarobius bottimeri	Kiawe Bean Weevil
Allograpta exotica	Syrphid Fly
Allograpta obliqua	Hover fly
Alydus pilosus	Broad Headed bug
Amastra morticina	Amastrid Land Snail
Amastra sp.	Amastrid Land Snail
Amorbia sp. (emigratella?)	Mexican Leaf Roller
Amphicerus cornutus	Powderpost Bostrichid
Ampulex compressa	Emerald Cockroach Wasp
Anacamptodes fragilaria	Koa Haole Moth, Citrus Looper
Anax junius	Green Darner Dragonfly
Androlaelaps hermaphrodita	Mite
Anoplolepis gracilipes	Yellow Crazy Ant
Anthicus vexator	Anthicus Beetle
Aphelacarus sp.	Mite
Aphis nerii	Milkweed Aphid
Apis mellifera	European Honey Bee
Aracerus levipennis	Koa Haole Seed Weevil
Archytas cirphis	Mexican Cutworm Tachinid
Argiope appensa	Garden Spider
Argius cingulata	Sweet Potato Hornworm
Ascalapha odorata	Black Witch
Asynonychus godmanii	Fuller Rose weevil
Atropacarus (Hoplophorella) singularis	Oribatid Mite
Bactrocera dorsalis	Oriental Fruit Fly
Barichneumon californicus	Parasatoid Wasp
Blaesoxipha plinthopyga	Checkerboard Fly, Flesh Fly
Borborillus sordidus	Jumping Fly
Brachydeutera hebes	Shore Fly, Brine Fly
Brachydeutera ibari	Shore Fly, Brine Fly
Brachymyrmex obscurer	Rover Ant
Brachystomella sp. (contorta?)	Springtail
Bradybaena similaris	Bradybaenid Land Snail
Bradysia nr. hoyti (bishopi?)	Dark-Winged Fungus Gnat

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Bradysia radicum	Dark-Winged Fungus Gnat
Bradysia spatitergum	Dark-Winged Fungus Gnat
Bradysia tritici	Dark-Winged Fungus Gnat
Brephidium exilis	Western Pygmy Blue Buttlerfly
Brumoides suturalis	Three-striped Lady Beetle
Bryania bipunctata	Two-spotted Asteriid Fly
Caconemobius sp. (howarthi?)	Flightless Cricket
Cadrema pallida	Chloropid Fly
Camponotus variegatus	Carpenter Ant
Canaceoides angulatus	Beach Fly
Carabidae sp.	Carabid Beetle
Cardiocondyla sp.	Tramp Ant
Ceratina arizonensis	Small Carpenter Bee (native)
Ceropsilopa coquilletti	Water Fly
Chaetogaedia monticola	Tachinid Fly
Cheiracanthium diversum?	Pale Leaf Spider
Cheiracanthium mordax	Biting Garden Sac Spider
Chelonus blackburni	Braconid Parasitoid Wasp
Chrysodeixis erisoma	Green Garden Looper Moth
Chrysomya megacephala	Oriental Blow Fly
Chrysosoma globiferum	Metallic Fly
Chrysosoma sp.	Metallic Fly
Clasiopella uncinata	Water Fly
Clogmia sp. (albipunctata)	Drain Fly
Coccinella septempunctata	Seven Spotted Ladybird
Coelophora inaequalis	Variable Ladybird
Coleotichus blackburniae	Koa Shield Bug
Copromyza equina	Lesser Dung Fly
Corythuca morrilli	Morrill Lace Bug
Cosymbia serrulata	Geometrid caterpillar/Kiawe Flower Looper
Cremastobombycia lantanella	Lantana Leaf Miner
Cryptolaemus montrouzieri	Mealy Bug Destroyer
Cryptotermes brevis	Drywood Termite
Ctenolepisma sp.	Bristletail
Cubaris murina	Little Sea Pill Bug
Curinus coeruleus	Metallic Blue Ladybird Beetle
Cyclophora nanaria	Dwarf Tawny Wave Moth
Danaus plexippus	Monarch Butterfly
Delta campaniforme ssp. esuiens	Yellow and Black Potter Wasp
Delta campniforme	Yellow Potter Wasp
Diachus auratus	Bronze Leaf Beetle

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Diomus notescens	Minute Two-spotted Ladybird
Dioxyna sorocula	Fruit Fly
Diploptera punctata	Cypress Cockroach
Dolichurus stantoni	Black Cockroach Wasp
Draeculacephala minerva	Grass Sharpshooter
Drosophila melanogaster	Common Fruit Fly
Drosophila sulfurigaster bilimbata	Fruit Fly
Ectemnius distinctus	Sphecid wasp
Ectemnius mandibularis	Sphecid wasp
Ectomyelois ceratoniae	Carob Moth
Eidoleon perjurus	Molokai Ant Lion
Eidoleon wilsoni,	Hawaiian Ant Lion
Elaphria nucicolora	Sugarcane Moth
Entomobrya atrocincta	Slender Springtail
Entomobrya multifasciata	Slender Springtail
Epitrix hirtipennis	Flea Beetle
Eristalinus arvorum	Syrphid Fly
Ethirothrips brevis	Thrip
Ethonia nigroapicella	Kou Leaf Worm
Eublemma accedens	Uhaloa Moth
Euborellia annulipes	Earwig
Euborellia eteronoma	Earwig
Eucelatoria armigera	Tachinid Fly
Euchromius ocelleus	Grass veneer moth
Eupodes hawaiiensis	Mite
Euryomma peregrina	Little House Fly
Euthyrrhapha pacifica	Pacific cockroach
Evania appendigaster	Larger ensign wasp
Eysarcoris ventralis	Small Stinkbug
Folsomides sp. (parvulus?)	Springtail
Galumna flabellifera	Oribatid Mite
Gasteracantha mammosa	Asian spiny backed spider
Gastrocopta servillis	Pupillid Land Snail
Gnathaphanus picipes	Carabid Beetle, Ground Beetle
Gonocephalum adpressiforme	Darkling Beetle
Graptostethus manillensis	Woodrose Bug
Gryllodes sigillatus	Flightless Field Cricket
Gymnochiromyia hawaiiensis	Acalyptrate Fly
Halobates sericeus	Pelagic Water Strider
Halocaridina rubra	Anchialine Pool Shrimp
Haplothrips gowdeyi	Black Flower Thrips

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Hecamede granifera	Shore Fly
Helcinia sp.	Helicinid Land Snail
Hemicheyletia bakeri	Predatory Mite
Herpetogramma licarsisalis	Grass Webworm
Heterospilus prosopidus	Braconid Wasp
Hierodula patellifera	Giant Asian Mantis
Hydrellia tritici	Black Pasture Fly
Hylaeus anthracinus (E)	Yellow-faced Bee
Hylaeus assimilans (E)	Yellow-faced Bee
Hylaeus connectans	Yellow-faced Bee
Hyles lineata	White-lined Sphinx
Hypena strigata	Lantana Biocontrol Moth
Hyposmocoma spp. (10 endemic species to Kahoʻolawe)	Fancy Case Caterpillars
Hypozetes laysanensis	Mite
Ischnura ramburii	Rambur's Forktail Damselfly
Isometrus maculatus	Lesser Brown Scorpion
Kilauella sp. (debilis?)	Bark Louse
Lamellina gracilis	Achatinellid Land Snail
Lampides boeticus	Bean Butterfly
Lasioglossum spp.	Halticid Sweat Bee
Latrodectus geometricus	Brown Widow Spider
Latrodectus hesperus?	Western Black Widow
Lepidocyrtus sp.	Springtail
Leptachatina sp.	Amastrid Land Snail
Leptachatina subcylindricea	Amastrid Land Snail
Leptobrysa decora	Lace Bug
Leptogenys falcigera	Ant
Lespesia archippivora	Lesser Army Worm Parasite Fly
Leucopis albipuncta	Acalyptrate Fly
Ligia sp.	Rock Lice
Linepithema humilis	Argentine Ant
Lispe metatarsalis	Muscid Fly
Lumbricadae	Earthworm
Lycophotia porphyrea	True Lovers Knot Moth
Lygaeidae sp.	Lygaeid Seed Bug
Lyropupa kahoolavensis	Pupillid Land Snail
Lyropupa sp.	Pupillid Land Snail
Macaria abydata	Koa haole Moth, Dot Lined Angle
Manduca blackburni (E)	Blackburn's Sphinx Moth
Mantidae spp.	Praying Mantid

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Megalographa biloba	Bilobed Looper
Megalorrhipida leucodactyla	Plume Moth
Melipotis indomita	Monkeypod-Kiawe Caterpillar, Indomitable Melipotus
Melophagus ovinus	Sheep Ked
Melormenis basilis	West Indian Flatid Planthopper
Micraspis lineola	Ladybird Beetle
Mimosestes nubigens	Leaf Beetle
Miridae spp.	Mirid Plant bug
Monomorium bicolor complex	Bicolor Ant
Monomorium destructor	Destructive Trailing Ant
Monomorium floricola	Bicolored Trailing Ant
Monomorium pharaonius	Pharaoh Ant
Multioppia wilsoni	Mite
Myobia musculi	Fur Mite
Myocoptes musculinus	Fur Mite
Mythimna sp. (loreyimima?)	Sugar Cane Armyworm
Mythimna sp. (scottii?)	Noctuid Moth
Neacoryphus bicrucis	Whitecrossed Seed Bug
Neoscona oaxacensis	Western Spotted Orb Weaver
Neoseiulus oahuensis	Phytoseiid Mite
Neostylopyga rhombifolia	Harlequin Cockroach
Nesoclimacias (Mertraga) lanaiensis?	Seed Bug
Nesopupa dispersa	Pupllid Land Snail
Nesopupa newcombi interrupts	Pupillid Land Snail
Nesopupa sp.	Pupillid Land Snail
Nezara viridula	Southern Green Stinkbug
Notiobia purpurascens	Ground Beetle
Nylanderia bourbonica	Ant
Nysius coenosulus	Seed Bug
Nysius kinbergi	Seed Bug
Nysius terrestris	Seed Bug
Ochetellus glaber	Black Household Ant
Ochthera sp. (circularis?)	Shore Fly
Odonata spp.	Dragonfly
Oechalia pacifica	Native Stinkbug
Oestrus ovis	Sheep Bot Fly
Oligotoma saundersii	Saunders' Embiid, Webspinner
Olla v-nigrum	Ashy Gray Ladybird Beetle
Omiodes blackburnii	Coconut Leaf roller
Omiodes continuatalis	Grass Leaf roller

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Omiodes demaratalis	Grass Leaf Roller
Opeas clavulinum hawaiiense	Subulinid Land Snail
Opeas javanicum	Subulinid Land Snail
Oppia sp.	Oribatid Mite
Ornithonyssus bacoti	Tropical Rat Mite
Orthemis ferruginea	Libellulid Dragonfly
Orthomecyna keoniae	Crambid, Grass Moth
Orthomecyna sp.	Orthomeycna Crambid Moth
Otobius megnini	Ear Tick
Oxydema longulum	Oxydema Weevil, Snout Beetle
Pachodynerus nasidens	Ichneumonid Wasp
Pagiopalus atomarius	Cane Hunting Spider
Pantala flavescens	Globe Skimmer
Paratrechina longicornis	Black Crazy Ant
Paurocephala sp.	Psyllid, Jumping Plant Lice
Pelypedilum nubiferum	Chironomid, Spotted Wing Midge
Periplaneta americana	American Cockroach
Phanerotoma hawaiiensis	Braconid, Parasatoid Wasp
Pheidole megacephala	Big-headed Ant
Phidippus sp (audax?)	Jumping Spider
Philonesia guavarum	Helicarionid Land Snail
Philonesia sp.	Helicarionid Land Snail
Physalis ixocarpa	Three-lined Potato Beetle
Pigritia sp.	Casebearer Moth
Pigritia uuku	Casebearer Moth
Placopsidella grandis	Shore Fly
Placosternus crinicornis	Kiawe Round Headed Borer
Planiocephalus flavicosta	Leafhopper
Platosciara adrostylata	Dark Wing Fungus Gnat
Platosciara perniciosa	Dark Wing Fungus Gnat
Platyzosteria soror	White Margined Cockroach
Plautia stali	Stink Bug
Polistes aurifer	Golden Paper Wasp
Polistes exclamens	Common Paper Wasp
Polychaete sp.	Tube worm
Porcellio laevis	Isopod
Proisotoma centralis	Spring tail
Proprioseiopsis ovatus	Mite
Protaetia fusca	Mango Flower Beetle
Pseudomyrmex gracilis	Elongate Twig Ant
Pseudopterocheilus congruus	Vespid Wasp

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Pseudopterocheilus spp.	Wasp
Psoroptes ovis	Sheep Scab Mite
Psychoda alternata	Drain Fly, Moth Fly
Ptycta spp.	Barklice
Pycnoscelus indicus	Surinam Cockroach, Greenhouse Cockroach
Radfordia affinis	Fur Mite
Rodiola cardinalis	Cardinal Ladybird Beetle, Vedalia Beetle
Sarcophaga africa	Flesh Fly
Scapheremaeus sinuosus	Oribatid Mite
Scaptomyza sp. (bunostoma?)	Scaptomyza Fly
Scatella bryani	Shore Fly
Scatella hawaiiensis	Shore Fly
Sceliphron caementarium	Black and Yellow Mud Dauber
Scheloribates elegans	Oribatid Mite
Schistocerca nitens	Gray Bird Grasshopper
Scolopendra subspinipes	Giant Centipede
Scopula personata	Geometer Moth
Scymnodes lividigaster	Yellow Shouldered Lady Beetle
Scymnus loewii	Loew's Lady Beetle
Seira terrestris	Springtail
Simosyrphus grandicornis	Hoverfly, Syrphid Fly
Sinoxylon conigerum	Conifer Auger Beetle
Sminthurides biniserratus	Sminthurid Springtail
Sminthurides lolelua	Sminthurid Springtail
Sminthurinus kaha	Springtail
Solenopsis geminata	Tropical Fire Ant
Spanagonicus albofasciatus	Whitemarked Fleahopper
Spathius prusius	Braconid Parasitic Wasp
Specularis impressithorax	Wiliwili Bruchid Beetle
Sphaerochthonius suzukii	Oribatid Mite
Spinibdella bioculata	Mite
Spoladea recurvalis	Hawaiian Beet Webworm
Stator limbatus	Bean Weevil
Stator pruininus	Bean Weevil
Stenocorse bruchivorus	Braconid Parasitic Wasp
Stoeberhinus testaceus	Potato Moth
Striatura sp. OR *Hawaiia sp.*	Zonitid Land Snail
Strymon bazochi	Lantana Scrub Hairstreak, Lantana Butterfly
Styringomyia didyma	Crane Fly
Succinea sp.	Succineid Land Snail
Sybra alternans	Longhorned Beetle

Terrestrial and Freshwater Invertebrates Recorded on Kahoʻolawe	
Taxa	**Common Name**
Symploce capitata	Smooth Cockroach
Syntormon flexibilis	Long-legged Fly
Tamisca kawikae	Crambid Moth
Tapinoma melanocephalum	Ghost Ant
Technomyrmex albipes	White Footed Ant
Tectocepheus sarekensis	Mite
Tenodera aridifolia sinensis	Chinese Praying Mantis
Tethina variseta	Beach Fly
Tethina willistoni	Beach Fly
Tetramorium bicarinatum	Guinea Ant
Tetramorium caldarium	Tramp Ant
Tetramorium simillimum	Tramp Ant
Thaumatodon sp.	Endodontid Land Snail
Thiaridae sp.	Thiarid Aquatic Snail
Thyanta sp. (custator?)	Red Shoulder Stink Bug
Thyrocopa epicapna	Hawaiian Moth
Thyrocopa kanaloa	Endemic Kahoʻolawe Moth
Tornatellides kahoolavensis	Achatinellid Land Snail
Tornatellides spp.	Achatinellid Land Snail
Tortanellina baldwini	Achatinellid Land Snail
Toxomerus marginatus	Hover Fly, Syrphid Fly
Tramea lacerata	Black Saddlebags, Raggedy Skimmer
Trichocorixa reticulata	Water Boatman
Trichorhina tomentosa	Dwarf Tropical Woodlice
Triops longicaudatus	Dinosaur Shrimp, Tadpole Shrimp
Trupanea crassipes	Tephrited Fly, Fruit Fly
Udara blackburnii	Hawaiian Blue Butterfly
Urophorus humeralis	Sap Beetle
Uroplata girardi	Leaf-mining Lantana beetle
Urosigalphus bruchi	Braconid Parasitic Wasp
Vanduzea segmentata	Vanduzea Treehopper
Vepracarus sp.	Mite
Vernicella cubensis?	Cuban slug (2018)
Xenopsylla cheopis	Oriental Rat Flea
Xenylla yucatana	Springtail
Xylocopa sonorina	Carpenter bee
Xylopsocus casanoptera	Horned Powder Post Beetle
Xystrologa sp.	Clothes Moth
Zelus renardii	Leaf Hopper Assassin Bug

Appendix O. Terrestrial and Aquatic Invertebrates Recorded on Kahoʻolawe. (E) = Federally listed as an endangered species.

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APPENDIX P- Hawai‘i Administrative Rules - State Regulations

- **Department of Agriculture** (Title 4)
  - Division of Plant Industry (Subtitle 6)
    - Seed Rules (Chapter 67)
    - Noxious Weed Rules (68)
    - Pests for Control or Eradication (69A)
    - Plant and Non-Domestic Animal Quarantine Plant Import Rules (70)
    - Plant and Non-Domestic Animal Quarantine Non- Domestic Animal Quarantine Import Rules (71)
    - Plant and Non-Domestic Animal Quarantine Microorganism Import Rules (71A)
    - Plant and Non- Domestic Animal Quarantine Plant Intrastate Rules (Amended 72)
    - Plant and Non-Domestic Quarantine Plant Export Rules (73)

- **Department of Land and Natural Resources** (Title 13)
    - Fisheries (Subtitle 4)
      - Fisheries Resource Management (Part IV)
        - Non- Indigenous Aquatic Species
    - Protected Freshwater Fisheries Resources (Part VI)
        - Introduced Fresh Water Fishes (Chapter 99)
        -

Hawai‘i Revised Statutes

- Agriculture and Animals (Title 11)
  - Noxious Weed Control (Chapter 152)
    - Prohibited Acts (152-3)
    - Noxious Weed Control and Eradication (152-6)
- Conservation and Resources (Title 12)
  - Aquatic Resources (Chapter 187A)
    - Release and Confiscation of Harmful Aquatic Life (187A-6.5)
    - Alien Aquatic Organisms (187A-32)
  - Invasive Species Council (Chapter 194)
  - General Provision Relating to Aquatic Resources and Wildlife (Chapter 197)
    - Introduction of aquatic life and wildlife (197-3)
- Property (Title 28)
  - Landowners liability for access to control invasive species (Chapter 520)

End of KIR Biosecurity Implementation Plan