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DAVID Y. IGE
GOVERNOR OF HAWAII

SUZANNE D. CASE
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
1151 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

July 12, 2017

Mr. Scott Glenn, Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 S. Beretania Street, Room 702
Honolulu, Hawaii 96813

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OFC. OF ENVIRONMENTAL
QUALITY CONTROL

Dear Mr. Glenn:

With this letter, the Hawaii Department of Land and Natural Resources hereby transmits the final environmental assessment and finding of no significant impact (FEA-FONSI) for the Lehua Island Ecosystem Restoration Project situated at TMK: 1-1-01:2, in the district of Waimea on the island of Lehua for publication in the next available edition of the Environmental Notice.

The Hawaii Department of Land and Natural Resources has included copies of comments and responses that it received during the 30-day public comment period on the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI).

Enclosed is a completed OEQC Publication Form, two copies of the FEA-FONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Patrick Chee of the Division of Forestry and Wildlife at 808-587-4191.

Sincerely,

Suzanne Case

Enclosures:

OEQC Publication Form
Lehua Island Ecosystem Restoration Project Lehua FEA-FONSI

18012

AGENCY
PUBLICATION FORM

Project Name:	Lehua Island Ecosystem Restoration Project
Project Short Name:	Lehua Island Ecosystem Restoration Project
HRS §343-5 Trigger(s):	Using State funds
Island(s):	Lehua Island
Judicial District(s):	Waimea
TMK(s):	1-1-01:2
Permit(s)/Approval(s):	Permits and approvals come under the following authorities. Federal: National Environmental Policy Act (NEPA) National Historic Preservation Act (NHPA) Endangered Species Act (ESA) Migratory Bird Treaty Act (MBTA) Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Marine Mammal Protection Act of 1972, as amended Water Pollution Control Act of 1948, as amended Coastal Zone Management Act of 1972, as amended State: Hawaii Administrative Rules 13-124 Hawaii Revised Statutues 343 Various permits under the above Federal laws have been delegated to the State to administer. Further authorities for action can be found under section 2.5, Authority for Action and Regulations Governing Action of the Final EA
Proposing/Determining Agency:	Department of Land and Natural Resources
Contact Name, Email, Telephone, Address	Patrick Chee, LehuaRestoration@hawaii.gov, 808-587-4191, 1151 Punchbowl St. Rm. 325, Honolulu, HI 96813
Accepting Authority:	(for EIS submittals only)
Contact Name, Email, Telephone, Address	
Consultant:	
Contact Name, Email, Telephone, Address	

Status (select one)	**Submittal Requirements**
____ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
__X__ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.

____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.
____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary

The Hawaii Department of Land and Natural Resources' (DLNR) Division of Forestry and Wildlife (DOFAW), in cooperation with the members of the Lehua Island Restoration Steering Committee (see EA for membership) are proposing a conservation intervention to continue the restoration of Lehua Island.

Lehua Island is a sanctuary for many birds and it has great potential to become a sanctuary for several more threatened and endangered birds and native plants. Unfortunately, the island is inhabited with Pacific rats that eat bird eggs, chicks and even adults on nests. They also consume a wide variety of the island's plants. For Lehua to reach its conservation potential, the rats must be eradicated.

DOFAW is proposing the eradication of rats from Lehua using rodenticide. DOFAW acknowledges there are risks using rodenticide and they can be mitigated for as set forth in this EA. In addition, the potential long term benefits outweigh the temporary risks posed by this proposed action. If successful, an eradication of rats from Lehua could have lasting benefits for native species on Lehua, especially seabirds, as they face habitat loss due to future sea level rise.

Final Environmental Assessment
Lehua Island Ecosystem Restoration Project
July 2017

Co-Lead Agency:
U.S. Fish and Wildlife Service
Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife
Cooperating Federal Agencies:
U.S. Department of Homeland Security, U.S. Coast Guard
U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center

Executive Summary

Lehua Island is a 115 hectare island located 1.2 km off the northern shore of Niʻihau (a privately owned, 18,650 hectare island). Lehua is a state-designated seabird sanctuary managed by the Hawaiʻi Department of Land and Natural Resources (DLNR) and federally owned by the U.S. Coast Guard (USCG). Lehua is one of Hawaiʻi's most important seabird colonies because of its size and height above sea level. It also offers an opportunity for restoring an island ecosystem in the main Hawaiian Islands.

DLNR-Division of Forestry and Wildlife (DOFAW), in conjunction with federal sponsors U.S. Fish and Wildlife Service (USFWS), technical partner Island Conservation (IC), and the cooperating members of the Lehua Island Restoration Steering Committee (LIRSC) are proposing to complete the eradication of rats from Lehua Island so further restoration efforts can move forward in the future.

The LIRSC is a multidisciplinary stakeholder body including representatives from DOFAW, USFWS, the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA), U.S. Coast Guard (USCG), National Tropical Botanical Garden (NTBG), the owners of Niʻihau, and IC.

In 2005, DOFAW and the USFWS embarked on a plan to restore Lehua Island. As part of the compliance for the action proposed in the plan, both federal and state Environmental Assessments (EA) were submitted, commented on by the public, and resulted in a Finding of No Significant Impact (FONSI) for both the 2005 Lehua EAs and the supplemental EAs in 2009. The alternatives approved in the EAs were followed and the actions resulted in the complete eradication of rabbits from Lehua in 2006 and an incomplete eradication of rats in 2009.

The purpose of the proposed action would be to eradicate non-native rats from Lehua and maintain its rodent-free status, which would facilitate the restoration of the natural island ecosystem. The proposed action could improve seabird nesting habitat and could aid in the recovery of rare endemic seabirds such as band-rumped storm petrels, Hawaiian petrels, and Newell's shearwaters, and native coastal plants, and insects. The proposed action would not be anticipated to have any significant negative environmental effects.

The proposed action involves the aerial broadcast of bait pellets containing rodenticide into all potential rat territories on Lehua Island. Rat eradication would occur in the summer dry season to maximize the probability of success by targeting the rats when food resources are lowest and rat abundance is declining. Conducting the operation during this period would also minimize the risk of rain washing rodenticide pellets into the ocean.

DOFAW, USFWS, and IC have conducted extensive scoping of the proposed action since 2005, and additional scoping following the 2009 incomplete eradication attempt. As a result of comments from interested public, Federal and State agencies, and conservation groups, DOFAW, USFWS, and IC identified a number of environmental issues. These issues are: 1) restoration efficacy; 2) impacts on non-target species; 3) increase in weed abundance caused by rat eradication; 4) impacts on cultural resources; 5) impacts on human health and safety; and 6) introduction of non-native species caused by project activities. Following the 2009 rat eradication attempt, there was a coincidental fish mortality event reported on Niʻihau and a dead whale calf also was found around the same time. Several tests of the affected fish were done and showed no rodenticide in tissues. Nonetheless, further analysis and research is included in this document to address impacts to marine species.

To address these environmental issues, the USFWS and DOFAW prepared three alternatives. Each alternative was developed to respond to the environmental issues identified. USFWS and DOFAW also considered many other alternatives and methods to eradicate rats on Lehua Island, but rejected the methods that failed to meet the purpose and need of the project.

Within this EA, USFWS, and DOFAW also describe the affected environment of the project. This section describes what is currently known about the status and trend of affected island resources, including the physical features of the island, and its terrestrial and marine resources. There would also be an analysis of the environmental consequences that could occur should any of the alternatives presented be chosen for implementation, and a description of proposed mitigation measures.

The DOFAW Administrator is responsible for the final decision on the proposed action, in addition to plan implementation and monitoring.

Table of Contents

Glossary of Terms

Anticoagulant - a class of drugs that work to prevent blood clotting.

Behaviorally plastic - change in an organism's behaviors or habits that results from change in the environmental conditions, such as a shift to a new primary food source due to changes in food abundance.

Brodifacoum - a second-generation rodenticide that requires only one feeding for a rodent to receive a lethal dose.

Colony (of seabirds) - a large group of birds from one or more species that nest or roost (sleep) close to each other at a particular location. Most seabirds are social nesters and display extraordinary site fidelity.

Colonization - the process in biology by which a species successfully spreads to a new area.

Diphacinone - a first-generation rodenticide which requires multiple feedings over several days for a rodent to receive a lethal dose.

Endemic - a species that is native to just one place.

Ephemeral (plants) - those which sprout, reproduce, and die back very quickly as an evolutionary adaptation to take advantage of brief wet periods in an otherwise dry climate.

Eradication - the complete removal of a damaging species from a specific location to enable ecosystem recovery.

Extinction - when the last of a species dies and that species ceases to exist anywhere in the world.

Extirpation - the complete removal of an organism from a specific location but it continues to exist in other places. Also known as local extinction.

Granivory - seed predators feed on the seeds of plants as a main or exclusive food source leaving seeds damaged and not viable.

Hemorrhaging - the flow of blood out from a blood vessel; bleeding.

Herpetofauna - amphibians (frogs, toads, salamanders and newts) and reptiles (snakes, lizards, turtles, tortoises and crocodilians).

Hopper - a piece of equipment used in many types of industry to discharge products at a steady rate.

Immigration - the movement of an organism to a new area from elsewhere, assisted or unassisted.

Insectivorous - an animal that eats insects as a primary or exclusive food source.

Invasive - a non-native species whose introduction causes or is likely to cause economic or environmental harm, or harm to human health.

Ionic strength (of seawater) - a measure of the concentration of ions in a solution which affects important properties such as the dissociation or solubility of different salts.

LC_{50} – the concentration of the chemical in feed that kills 50% of test samples; usually administered over a multi-day period (e.g. 5 to 7 days).

LD_{50} - the amount of an ingested substance that kills 50% of test samples; usually administered as a single dose.

Mitigation - steps taken to reduce or avoid negative environmental impacts.

Native - a species that occurs naturally (without human agency) in an area.

Non-native (introduced, alien) - an organism that is not native to the place it occurs having been accidentally or deliberately transported to the new location by human activity.

Palatability - having an agreeable or pleasant taste that is accepted by the target consumer.

Pica - behavior displaying an indiscriminate preference for foods and nonfoods; such as chicks eating or pecking at rocks, sticks and other foreign objects.

Pinnipeds - seals; a diverse group of carnivorous semi-aquatic marine mammals.

Predation - the act of one organism killing and eating other organisms can refer to both animals and plants.

Pyranine - a fluorescent dye commonly found in highlighters and used as a biological stain to show ingestion pathways.

Recruitment - the ability of juvenile organisms to survive and add to the population of that species.

List of Acronyms and Abbreviations

a.i. - Active ingredient

bwt - Bodyweight

DLNR - State of Hawai‘i Department of Land and Natural Resources

DOFAW - Division of Forestry and Wildlife, a subset of DLNR

EA - Environmental Assessment

EIS - Environmental Impact Statement

EO - Executive Order

EPA - U.S. Environmental Protection Agency

ESA - Endangered Species Act

FGAR – First generation anticoagulant rodenticide

FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act

FONSI - Finding of No Significant Impact

GIS - Geographic information system

GPS - Global positioning System

HDOA - Hawai‘i Department of Agriculture

HNP - Haleakalā National Park

HOIRC - Hawai‘i Offshore Islet Restoration Committee

HRS - Hawai‘i Revised Statutes

IC - Island Conservation

LIERP - Lehua Island Ecosystem Restoration Project

LIPP - Lehua Island Protocols and Procedures

LLD - Lowest lethal dose

LOEL - Lowest observed adverse effect level

MBTA - Migratory Bird Treaty Act

MHI - Main Hawaiian Islands

MMPA - Marine Mammal Protection Act

NEPA - National Environmental Policy Act

NHPA - National Historic Preservation Act

NISC - National Invasive Species Council

NMFS – National Marine Fisheries Service

NOAA - National Oceanic and Atmospheric Administration

NOAA-PIFSC - NOAA Pacific Islands Fisheries Science Center

NOEL - No observable effect level

NOI - Notice of Intent

NTBG - National Tropical Botanical Gardens

NWHI - Northwestern Hawaiian Islands

OEQC - Office of Environmental Quality Control

PIFWO - Pacific Islands Fish and Wildlife Office

SEA - Supplemental Environmental Assessment

USCG - U.S. Coast Guard

USDA - U.S. Department of Agriculture

USFWS - U.S. Fish and Wildlife Service

1. Background

1.1 Introduction

Lehua is home to one of the most important seabird colonies in Hawai‘i and has potential for ecosystem-wide restoration. Currently, Lehua is home to the largest breeding colonies of brown boobies (*Sula leucogaster*) and second largest for red-footed boobies (*S. sula*) in the Hawaiian Islands, the fifth-largest Hawaiian breeding ground for wedge-tailed shearwaters (*Puffinus pacificus*), an important large colony of red-tailed tropicbirds (*Phaethon rubricauda*) and is home to the westernmost colony of Hawaiian black noddies (*Anous minutus*). Three federally-listed species are suspected of nesting on Lehua: Newell's shearwaters (*Puffinus newelli*), band-rumped storm-petrels (*Oceanodroma castro*) and Hawaiian petrels (*Pterodroma sandwichensis*).

There are no native terrestrial mammals known from Lehua. However, several species of introduced mammals have or do occur on the island. The European rabbit (*Oryctolagus cuniculus*) was first recorded on Lehua by Caum (1936) and this species contributed to island-wide impacts, but is no longer present. The Pacific rat (*Rattus exulans*) is present on the island and impacts both native flora and fauna.

Lehua is federal property administered by the U.S. Coast Guard (USCG) and is also a State Seabird Sanctuary, managed by DLNR. Lehua is a small, uninhabited tuff cone island lying less than 1 mile from the larger island of Ni‘ihau and located off to the west of Kaua‘i. In general Lehua has steep slopes with a high point of 212 m and land area of approximately 115 ha. USCG permission is required to access and carry out natural resource enhancement and vegetation management projects on Lehua. In this case, National Environmental Policy Act (NEPA) compliance is required for the necessary USCG permit. Since the U.S. Fish and Wildlife Service (USFWS) is a lead agency in this restoration project, based on the use of the agencies buckets, which are essential to the project, the USCG is able to fulfill NEPA requirements in the capacity of a cooperating agency by adopting the findings of this analysis. The USCG guidelines for being a cooperating agency are listed in Commandant Instruction M16475.1D. The State of Hawai`i Department of Land and Natural Resources' Division of Forestry and Wildlife (DOFAW) is a co-lead agency with USFWS for the proposed action and for the purposes of preparing this document. DOFAW is also a co-trustee with USFWS for seabird resources in Hawai`i.

1.2 Overview of the Lehua Island Ecosystem Restoration Project Environmental Assessment of 2005

The Hawai'i Department of Land and Natural Resources-Division of Forestry and Wildlife (DLNR-DOFAW) and the United Sates Fish and Wildlife Service (USFWS) in conjunction with Island Conservation (IC) and the Hawai'i Offshore Islet Restoration Committee (HOIRC) formulated the proposed action in the draft Lehua Island Ecosystem Restoration Project (LIERP) Environmental Assessment (EA) of 2005 to reverse the ecological degradation occurring on

Lehua Island caused by two invasive species, namely the Pacific rat and the European rabbit. In order to achieve this goal, the LIERP EA (2005) proposed eradicating both rats and rabbits on Lehua, implementing appropriate actions to maintain Lehua rat- and rabbit-free and furthering the restoration of native plants on the island.

In the LIERP EA (2005) three alternatives were proposed for rat and rabbit eradication: 1) no-action; 2) diphacinone (50ppm) followed by brodifacoum (25ppm) for rat eradication and hunting and trapping for rabbit eradication; and 3) brodifacoum (25ppm) for rat eradication and hunting and trapping for rabbit eradication. The preferred alternative was the aerial and hand broadcast of bait pellets containing the rodenticide diphacinone, followed by the rodenticide brodifacoum, only if necessary, into all rat territories on Lehua Island, as well as removal of all rabbits via hunting and trapping. Rat eradication was proposed to occur in the summer dry season to minimize risk of rain washing rodenticide pellets into the ocean and to maximize the efficacy of eradication by targeting the rats at the low point in their population cycle and low food availability. Rabbit eradication, which involved more on-the-ground activity than rat eradication, would occur in the winter, at the low point in the annual seabird breeding season, to minimize risk to nesting seabirds. Plant restoration would occur after the removal of the invasive rabbits and rats, improving likelihood of plant survival.

In September 2005, the USFWS and the DLNR-DOFAW, as joint lead agencies, and the U.S. Department of Homeland Security and the U.S. Coast Guard (USCG), as the cooperating agencies, published the Final Environmental Assessment for the Lehua Island Ecosystem Restoration Project, with a finding of No Significant Impact (FONSI) from the proposed action. As documented in the FONSI, the DOFAW Administrator, and the USFWS Assistant Regional Director, Ecological Services, Region 1 determined to implement the proposed action of Alternative 2. These actions included:

- Eradication of the non-native European rabbit and Pacific rat on Lehua Island, followed by implementation of a long-term ecological restoration strategy;
- Adoption of a preventive strategy to reduce the potential for non-native animals and plants to be accidentally reintroduced to Lehua Island during and after restoration activities occur (island biosafety/quarantine strategy);
- Reintroduce appropriate native plant species that cannot effectively recolonize on their own; and
- Monitor project actions for effectiveness and overall restoration success.

Following completion of the 2005 Final EA for ecological restoration of Lehua Island, rabbits were successfully eradicated from Lehua through intensive hunting efforts in 2005 and 2006.

1.3 Overview of the Lehua Island Ecosystem Restoration Project Supplemental Environmental Assessment of 2008

The USFWS and DLNR-DOFAW, as joint lead agencies, determined to supplement the LIERP EA (2005) to evaluate the impacts associated with proposed modifications to the rat eradication operation plan for Lehua Island and accordingly a LIERP Supplemental Environmental Assessment (SEA) was completed in 2008. The LIERP Supplemental Environmental Assessment (SEA) of 2008 resulted in a FONSI and no significant impacts were determined per Hawai'i Revised Statutes (HRS) Chapter 343.

In January 2009, two aerial applications of Diphacinone-50 Conservation (0.005%), a fish-flavored, pelletized rodenticide (each pellet measuring 12 mm in diameter and weighing approximately 1 g), were made seven days apart. This effort failed to achieve the specified purpose of eradication of rats from Lehua.

1.3.1 Factors Evaluated as Potential Causes of the 2009 Rat Eradication Failure

- Rats were eradicated, but reinvaded from another source island: DNA analysis indicated that the pre- and post-eradication rat populations could have been one and the same, but rats from other potential source islands were not analyzed to confirm these findings (Piaggio and Hopken 2009 in Parkes and Fisher 2011).
- Widespread availability of competing food sources: Lehua received heavy rains in December 2008, triggering vigorous new growth in vegetation immediately before the eradication. This flush of new growth, coupled with the increase in island-wide vegetative biomass as a result of the previous rabbit eradication, may have resulted in a situation where rats had an abundance of alternative food sources and consumed insufficient quantities of rodenticide bait.
- Bait product palatability and efficacy: A study conducted by Pitt et al. (2011) found that a 0.005% Diphacinone formulation was not preferred over "laboratory chow" and only caused mortality in 40% (n = 5) of wild-caught Pacific rats involved in a 7-day, two-choice trial. However, Pitt et al. (2011) contrast with those from other studies and projects. Pacific rats were eradicated from Mōkapu Island (Dunlevy and Swift 2010) and 100% control of rats was achieved on a project on the island of Hawai'i, (Spurr et al. 2013)– both projects used Diphacinone-50 Conservation.
- Rodenticide type and function: Diphacinone is a multi-feed rodenticide that requires rats to consume several doses over a course of multiple days in order to reach lethal levels in 100% of a rat population (Parkes and Fisher 2011). During the 2009 Lehua eradication attempt, bait may not have been available for long enough in all potential rat territories for all rats to accumulate a lethal dose of the rodenticide. Additionally, feeding of rodenticide may have been interrupted with consumption of natural food.
- Constraints on the bait application: The Hawai'i Department of Agriculture (HDOA) stipulated that bait could not be broadcast within 30 m of the shoreline. Because some Pacific rats have very small home ranges (120 m^2) (Wirtz 1972), it is possible that

individual rats living within the shoreline buffer zone did not access lethal doses of bait. Implementing partners made a joint decision to proceed with the understanding that if the project failed because of this restriction, the restriction needed to be removed for future attempts to eradicate rodents from offshore islands.

- Ineffective post-eradication monitoring: Robust monitoring protocols were detailed in the LIERP SEA. These included the use of telemetered rats, chew cards, and tracking tunnels to evaluate survivorship post-application of the rodenticide. However, these measures appear not to have been employed.
- Ineffective response to detection of survivors: When rats were detected on Lehua in August 2009, a series of factors hindered mounting a response to conduct a follow-up eradication. The reasons for the lack of follow-up are not clear. These are discussed in Parkes and Fisher (2011), but include permit expiration issues, inadequate coordination among implementing agencies, insufficient funding, and constraints on employing the backup option of applying brodifacoum.

1.4 Consequences of Rabbit Eradication

Vegetation monitoring on Lehua began in 2003 prior to rabbit eradication and continued into 2008, several years after rabbits were successfully removed from the island. On Lehua, the 2005 rabbit eradication was followed by an approximately 60% increase in vegetation cover. This cover was composed mainly of non-native grasses (83.3% of all grass coverage) and shrubs (79% of all shrub coverage) (Eijzenga 2011). Following eradiation, plant diversity increased 31.7 %, with ten new species of herbaceous flowering plants (one native) and grasses recorded (Eijzenga 2011). In addition, two species of native plants (*Sicyos maximowiczii* and *Sida fallax*) increased in abundance (Eijzenga 2011).

1.5 Plant Restoration

As described in the LIERP EA (2005), restoring Lehua's native plant community was a part of the long-term restoration plan for the island. Following the eradication of rabbits, plant restoration began in 2007 with a survey of the habitat and development of an out-planting species list. In February 2008 the first plants were transported to the island. A total of 27 trips were undertaken until efforts were ended in May 2014. Some of the native species that were part of this plant restoration effort are still surviving from these initial efforts. Although plant restoration is still a part of the overall LIERP, it would not be a part of the efforts being proposed under the current EA. And further plant restoration efforts are a possibility should rat eradication be confirmed in the future.

1.6 Feasibility Assessment

In 2014, an assessment of the technical, social, and political feasibility of eradicating rats from Lehua Island was commissioned by DLNR-DOFAW and conducted by IC. The National Fish and Wildlife Foundation's Pacific Seabird Program provided funding for this assessment through

a grant awarded to IC. The 2014 feasibility assessment was based on using established eradication guidance derived from successful eradications efforts. The fundamental principles of successful eradication are:

- All individuals from the targeted population can be put at risk by the eradication strategy.
- Target species must be removed at a rate exceeding their rate of increase.
- The benefits from the eradication must outweigh the potential risk of conducting the eradication, including impacts to non-target species.
- Immigration must be zero.
- The eradication strategy must be known by, and acceptable to, project partners and stakeholders, including local communities.

Of the ~500 island rodent eradications worldwide, all but the smallest island eradications utilized these principles by:

- Evaluating and adopting strategies to minimize risks to non-target species.
- Ensuring all rodents came in contact with the bait by distributing rodenticide bait into every potential rodent territory.
- Timing baiting to when the rodents are most likely to consume the bait and to minimize risk to non-target species.

The 2014 feasibility assessment concluded that rat eradication operation on Lehua is technically feasible and there are many precedents for eradicating rodents from islands similar in size and topography. It also recommended the strategy employed to eradicate rats from Lehua take into consideration the constraints of the local legal, social and political environment. This includes federal and state regulatory limitations on the application of restricted use pesticides and the level of risk that project stakeholders (such as the Ni'ihau community) and the general public would accept based on information regarding the potential risks and benefits of the action.

In an effort to establish an open dialogue about the Lehua rat eradication project, a multi-stakeholder steering committee was formed and staffed with representatives from DLNR, USFWS, USCG, USDA, National Tropical Botanical Gardens (NTBG), IC and the owners of Ni'ihau. The Lehua Steering Committee holds meetings regularly and made several decisions and recommendations for the project. A Lehua Project Management Team was also created and is comprised of personnel from DLNR-DOFAW and IC.

2. Purpose and Need

2.1 Introduction

This environmental assessment (EA) evaluates the environmental effects of the no-action alternative and two action alternatives for rat eradication on Lehua Island, a Hawaiian State wildlife sanctuary. An EA is used to solicit public involvement and determine whether implementation of the alternatives will have a significant impact on the environment. This EA is part of the decision-making process and e used to assist in determining how and if the covered restoration efforts for Lehua should proceed.

2.2 Purpose of Action

The purpose of the proposed action would be to eradicate non-native rats from Lehua and maintain its rodent-free status, which would facilitate the restoration of the natural island ecosystem.

2.3 Need for Action

2.3.1 Follow-up to 2005 and 2009 Eradication Efforts

In 2005, DOFAW and the USFWS embarked on a plan to restore Lehua Island. As part of the compliance for the action proposed in the plan, both federal and state EAs were submitted, commented on by the public, and resulted in a FONSI for both the 2005 Lehua EAs and the supplemental EAs in 2009. The alternatives approved in the EAs were followed and the actions resulted in the complete eradication of rabbits from Lehua in 2006 and a failed eradication of rats in 2009.

2.3.2 Impacts of Non-Native Predators on Islands

Insular systems often have unfilled niches that non-native species are able to exploit in many cases. An example of such an unfilled niche is that of native terrestrial mammalian predators. Because of this, many insular terrestrial faunas evolved without or with very limited predation pressure and consequently are highly vulnerable to the establishment of predatory invasive species (Rodda and Savidge 2007, Scott et al. 2001, Hodges and Nagata 2001, USFWS 2011). Invasive predators also are often ecological generalists that can successfully colonize a wide range of habitats (Caut et al. 2008). This combination contributes to invasive predators being some of the most harmful species to insular systems (Jones et al. 2008, Lowe et al. 2000, Blackburn et al. 2005, Doherty et al. 2016, Rogers et al. 2017).

2.3.3 Impacts to Islands from Non-native Rodents

One group of invasive predators, rodents, occur on more than 80% of the world's major islands and island groups (Atkinson 1985). Even now, rodents continue to

invade previously rodent-free islands (for a recent example see: Pitman et al. 2005). Rodents, as omnivores, can directly impact terrestrial plants, invertebrates, reptiles, mammals, and birds (Atkinson 1985; Cuthbert et al. 2013; Towns, Atkinson, and Daugherty 2006). Introduced rodents may impact native species directly through depredation or indirectly through competition, resource depletion, or by subsidizing populations of larger invasive predators that also prey on native species (e.g., feral cats). Globally, invasive rodents have contributed to declines and extinctions of numerous native vertebrate species, including endemic species (Towns, Atkinson, and Daugherty 2006; Harris 2009; Meads, Walker, and Elliott 1984; Atkinson 1985; Tomich 1986). Documentation of severe impacts attributed to invasive predators exists for insular avifaunas, including population declines and extinctions of various seabird species (Atkinson 1977, 1985; Doherty et al. 2016; Towns, Atkinson, and Daugherty 2006).

The effects of a single species of rat can be extremely destructive to a population of colony-nesting sea birds (Simons 1983, Bartle et al. 1993). Bonin petrel (*Pterodroma hypoleuca*) populations on Midway have been impacted by black rat (*R. rattus*) through predation on eggs and possibly chicks (Seto and Conant 1996). On Kure Atoll, Kepler (1967) observed and photographed Pacific rats eating nesting Laysan albatross (*Phoebastria immutabilis*), and Fleet (1972) reported that rats were killing most of the red-tailed tropicbird nestlings in his study area, as well as causing more than half of the total egg loss. Graham and Veitch (2002), reporting on recovery efforts on Tiritiri Matangi Island, New Zealand, showed that monitoring before and after rat eradication indicated that prior to eradiation, rats may have been effecting bird population through predation, competition for food, and habitat modification.

Though less well supported than the direct negative effects of rodents on insular avifaunas, introduced rodents also have the potential to impact native plant communities, invertebrates, and other components of native systems (Towns, Atkinson, and Daugherty 2006 and references therein; Auld et al. 2010; Angel, Wanless, and Cooper 2009; Cuddihy and Stone 1990 and references therein). Rodents, as omnivores, feed on plants, and can alter the floral communities of island ecosystems (Pender et al. 2013; Shiels 2011; Shiels and Drake 2011), potentially directly or indirectly impacting ecosystem processes.

Non-native rodents have affected numerous island biotas (Atkinson 1985) and Harper and Bunbury 2015 for reviews of rodent impacts on islands) and are known to prey on numerous native organisms, including birds (Fleet 1972, Fisher and Baldwin 1946, Tweed et al. 2006, Snetsinger et al. 2005), small mammals (Brosset 1963, see Harris 2009 for a comprehensive review), and herpetofauna (Ohashi and Oldenburg 1992, Witmer et al. 2007, MacFarland et al. 1974,). The magnitude of these effects depends on various attributes, including predator and prey behavior, competition, ecosystem

complexity, and prey availability. Differences in behavior among rodent species are also particularly important in relation to their specific effects on avifuanas (Atkinson 1985).

2.3.4 Rodent Impacts in Hawai‘i

Prior to the arrival of humans, no mammalian predators of birds (and other terrestrial vertebrates) existed in Hawai‘i (Atkinson 1977, Scott et al. 1986, VanderWerf and Smith 2002). Currently, Hawai‘i has a variety of established non-native mammalian predators, including four rodent species, which occur throughout the archipelago with various species or suites of species being established on different islands. These invasive rodent species include the black rat (also known as the roof or ship rat), Norway rat (*R. norvegicus*), Pacific rat (also known as the Polynesian rat), and house mouse (*Mus musculus*). Pacific rats likely arrived with Polynesians early on in the settlement of the Hawaiian Islands (Kirch 1982). Black and Norway rats, as well as mice, likely arrived later during the European contact era (Atkinson 1977). All four of these rodent species have impacted the Hawaiian Islands, but the exact extent of these impacts may never be known.

Although a variety of factors threaten seabird populations globally, predation from rodents is one of the primary threats to sea birds in Hawai‘i (Mitchell et al. 2005, Simons 1983, Hodges and Nagata 2001). Historically, high densities of seabirds nested on all Hawaiian Islands, but now most are restricted to the Northwest Hawaiian Islands (NWHI) or to predator-free offshore islands within the Main Hawaiian Islands (MHI) (Scott et al. 1988). Two species of sea bird endemic to the MHIs, the Hawaiian petrel and Newell’s shearwater, are declining precipitously (Griesemer and Holmes 2011; Welch et al. 2012). One of the many factors responsible for these declines is low reproductive success due to predation by non-native rodents, and other predators (Griesemer and Holmes 2011; Welch et al. 2012). Both the Hawaiian petrel and the Newell’s shearwater are now restricted to nesting in high elevations or in relatively inaccessible locations such as sheer cliffs on the MHIs (Scott et al. 1988). Hodges and Nagata (2001) found in 1979 that introduced predators were a significant limiting factor for Hawaiian petrel at Haleakalā National Park (HNP), Maui. Hodges and Nagata (2001) identified rats as the predator causing the most known mortality of Hawaiian petrel eggs and chicks in the years 1964-1996 at HNP (rats accounted for 41% of known predation events, while mongoose and feral cats jointly accounted for 38%). More recently, the use of cameras to monitor Hawaiian petrel and Newell’s shearwater nesting burrows at multiple locations across the main islands has documented the frequency with which black and Pacific rats, as well as mice, enter burrows (Raine and McFarland 2013). At HNP Simons (1985) found that predator control methods could be used to improve reproductive success of Hawaiian petrel. The Haleakalā Hawaiian petrel colony is the largest known extant

population of this species and on-going control of rats, and other predators, reduced predation losses (Hu et al. 2001). Following the eradication of rats from Kure Atoll, Hawai‘i (Murphy 1994), there has been a ten-fold increase in the size of the Christmas shearwater (*Puffinus nativitatis*) population (VanderWerf et al. 2015).

2.3.5 Lehua and Invasive Mammals

Lehua has no native terrestrial mammals. Aside from European rabbits, Pacific rats are the only terrestrial mammals known to have established on Lehua. Exactly when these invasive species arrived established on Lehua is unknown. The earliest report of rats the island was in 1936, but this was unconfirmed (Caum 1936). In 1940, the Coast Guard reported Pacific rats from Lehua (Bishop Museum Vertebrate Collection in Eijzenga 2011) .

Pacific rats are widespread in Hawai‘i and the smallest of the three established species of rat, being slightly smaller than black rats. They commonly nest in low vegetation or burrows and are known to prey on a variety of bird species, including large species such as adult Laysan albatross and great frigatebird (*Fregata minor*) (Atkinson 1985). While Pacific rats on Lehua prey on various species of seabirds, they also feed extensively on invertebrates and vegetation (USDA 2004).

The relative ecological similarity between neighboring islands within Hawai‘i may provide some clues to the ecological state on Lehua prior to the establishment of invasive mammals. Such a comparison is possible between Nihoa (69 ha), a rodent-free but certainly not pristine island, and Lehua (115 ha)(Note: while there are general similarities between these islands there also undoubtedly differences which may affect ecosystems and flora and fauna assemblages and these differences cannot be fully addressed within the scope of this work). This comparison reveals that Lehua has a lower diversity of avifaunal types than Nihoa even though Lehua is a larger island. Probably two of the most notable distinctions in terms of avifauna are that Nihoa has two extant endemic land birds while the only land birds known from Lehua are non-native species and that Lehua currently does not have known nesting populations of some smaller sized seabirds such as the brown noddy (*Anous stolidus*), while Nihoa does. Further work towards determining the exact nature of these differences and the potential causative factors is needed.

Forty-three bird species have been observed on Lehua (twenty-nine species between 2002-2005), including one native predatory bird, five migratory shorebirds, eleven non-native passerines and twenty-two seabirds endemic or native to the Hawaiian Islands (Appendix A, Table 4) (VanderWerf et al. 2007). At least ten species currently breed on the island (Eijzenga 2011). Lehua is home to one of the largest seabird breeding colonies in the MHIs, with an estimated 50,000 birds using the island (HOIRC 2008). Newell’s shearwater, a U.S. federally listed species, is known

from Lehua. Lehua is also home to the largest breeding colonies for red-footed booby and brown booby in the MHIs (VanderWerf et al. 2007). With more than 95% of the world's black-footed albatross (*Phoebastria nigripes*) breeding on the low-lying atolls of the Northwest Hawaiian Islands (ACAP 2012a), the population of black-footed albatross on Lehua is important as it is one of only two populations found in the MHI chain.These are the only U.S. populations on high islands, giving them a level of protection from potential sea-level rise (Baker et al. 2006, ACAP 2012a, ACAP 2012b). The other known U.S. high island population is found on Ka`ula rock, where black rats are present (ACAP 2012b) and which is currently used by the U.S. military for bombing practice. Approximately 99% of the world's Laysan albatross breed on the Northwest Hawaiian Islands, also making the colony on Lehua one of only a few left in the MHIs which is protected from sea-level rise (Baker et al. 2006, ACAP 2012a, ACAP 2012b).

Various impacts to the avifauna of Lehua are attributed to Pacific rats. They prey on seabirds, including eggs and chicks, limiting the recruitment of several species and possibly preventing the re-establishment of others (VanderWerf et al. 2007). Carcasses of Bulwer's petrels and wedge-tailed shearwaters have been found on Lehua with injuries consistent with rat predation. Rats are also suspected of completely suppressing small ground-nesting seabird species such as brown noddy, gray-backed tern *(Onychoprion lunatus*), and sooty tern (*Onychoprion fuscatus*). The brown noddy historically nested on Lehua (Caum 1936) and the two tern species are known to breed on nearby Ka'ula Rock (VanderWerf et al. 2007).

Fossil pollen types collected on Lehua indicate that the island ecosystem was once representative of dry lowland forests—an endangered habitat type in the Hawaiian archipelago (Olson and Dinerstein 2002, Eijzenga 2011). Lehua is currently home to nine endemic as well as an additional thirteen native plant species (Wood and LeGrande 2006). Herbivory from non-native mammals on Lehua has led to the suppression and possible extirpation of native plant species and subsequently, an increase in soil erosion. With the successful removal of rabbits from the island, invasive plant species, once suppressed by rabbits, now outcompete native plants for space and limited resources (Eijzenga 2011). Rats continue to pose a threat to native plant species as they browse leaves and stems and destroy seeds (USFWS and DLNR 2005, Eijzenga 2011).

Protecting seabirds and improving ecological restoration of Lehua through the removal of rats was identified as a goal in the Pacific Region Seabird Conservation Plan (USFWS 2005). In fact, predator control on Lehua was considered a top priority (USFWS 2005). The HOIRC (2008) also identified the eradication of rats from Lehua as a priority task. As part of the management action originally proposed in the 2005

Lehua Restoration EA, native plant restoration was intended as a follow-up action to the rabbit and rodent eradications (USFWS and DLNR 2005).

This evidence, when combined with the preponderance of evidence implicating rats in serious ecological damage on other islands worldwide, cast the presence of introduced rats on Lehua as a serious threat to native species and natural ecosystem processes. Eradication of rats could improve seabird nesting habitat and could aid in the recovery of rare endemic seabirds such as band-rumped storm-petrels, Hawaiian petrels and Newell's shearwater, as well as native plants and insects.

2.3.6 Rodent Eradications on Islands

Howald et al. (2007) recorded 284 successful island rodent eradications globally in their review. The fundamental methodology that all but one of these eradications used was the delivery of bait containing a rodenticide into every potential rat territory on the island. Bait was typically delivered during the time of year when rats were relatively food deprived, as indicated by annual resource-dependent population declines. Depending on island topography and size, climate, native species assemblages, operational logistics, and other factors, these eradication projects applied bait using broadcast or bait stations or both. Bait stations were typically laid out on a grid pattern. Bait broadcast was by hand or using spreaders suspended under a helicopter.

Island ecosystems worldwide have repeatedly demonstrated major positive changes as a result of rat eradication. Some examples follow:

- Breaksea Island, Fiordland, New Zealand, where numbers of tree and shrub seedlings increased after rat eradication (Allen et al. 1994).
- Anacapa Island, off the coast of southern California, where the number of breeding attempts and proportion of successful breeding attempts in Xantus' murrelets (*Synthliboramphus hypoleucus*) have both increased since rats were eradicated (Whitworth et al. 2008)
- Cocos Island, Guam, where the introduced endangered Guam rail has successfully established a breeding population after the eradication of rats (Pitt et al. 2012).
- Mokoli‘i Islet, offshore of the Hawaiian island of O‘ahu, where breeding success in wedge-tailed shearwaters, intertidal invertebrates, and native plants increased after rat eradication (Smith et al. 2006)

2.4 Scope of Analysis

The proposed action would focus on methods for the eradication of introduced rats from Lehua. Other actions that may occur in the future as a result of the proposed action will not be analyzed in detail in this document. The potential implications of the proposed action in relation to future

actions will be discussed in the Cumulative Impacts (Section 6). This analysis will not focus on restoration actions on Lehua other than the eradication of rats.

2.5 Authority for Action and Regulations Governing Action

The proposed action would be carried out in compliance with various federal and state laws including those listed below.

2.5.1 Authorizing Federal laws, Executive Orders and Supporting Agency Guidelines

National Environmental Policy Act of 1969 (NEPA) – NEPA requires that federal actions be evaluated for environmental impacts, that these impacts be considered by the decision maker(s) prior to implementation, and that the public be informed. This EA is prepared in compliance with NEPA (42 USC Section 4231, et seq.,); the President's Council for Environmental Quality Regulations, 40 CFR Section 1500 – 1508.

National Historic Preservation Act of 1966 (NHPA) – The NHPA requires: 1) federal agencies evaluate the effects of any federal undertaking on cultural resources, 2) consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological, and historic resources, and 3) consult with appropriate American Indian tribes or Native Hawaiians to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings.

The Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l, 70 Stat. 1119) – , as amended, gives general guidance which can be construed to include alien species control, that requires the Secretary of the Interior take steps "required for the development, management, advancement, conservation, and protection of fish and wildlife resources."

Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884) – The ESA requires that all federal agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA (Sec.2(c)). Section 7 consultations with USFWS are conducted to use the expertise of the USFWS to ensure that "any action authorized, funded, or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species. Each agency shall use the best scientific and commercial data available" (Sec. 7(a)(2)).

Migratory Bird Treaty Act of 1918 (MBTA) – The MBTA protects more than 1,000 species of birds, including the species native and not native to Hawai‘i, by implementing U.S. obligations under four treaties within the United States. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell,

purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior.

Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (FIFRA) – FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The Environmental Protection Agency (EPA) is responsible for implementing and enforcing FIFRA. All chemical methods integrated into any selected program as implemented by the Service or other cooperating agencies must be registered with and regulated by the EPA (FIFRA Section 3).

Marine Mammal Protection Act of 1972 (MMPA), as amended – The MMPA protects all marine mammals, including cetaceans (whales, dolphins, and porpoises), pinnipeds (seals and sea lions), sirenians (manatees and dugongs), sea otters, and polar bears within the waters of the United States.

Magnusen-Stevens Act and Essential Fish Habitat – The Act provides for protecting certain fish stocks that have declined to the point where their survival is threatened and other stocks that have been so substantially reduced in number that they could become threatened from fisheries and direct and indirect marine, estuarine, and other aquatic habitat losses. Essential Fish Habitat (EFH) identified in Fishery Management Plans required by law includes those waters and substrates necessary to identified stocks of fish for spawning, breeding, feeding, and/or growth to maturity, considering the species' full life cycle. The Federal action agency retains the discretion to make their own determinations as to what actions may fall within NMFS' definition of "adverse effect."

Water Pollution Control Act of 1948, as amended – A law enacted by Congress to address the problems of water pollution in the United States. Now commonly known as the Clean Water Act

Coastal Zone Management Act of 1972, as amended – A law enacted by Congress to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and esthetic values as well as the needs for compatible economic development.

Executive Order (EO) 13112 Invasive Species as amended 12/08/2016 by E0 13751 – The original EO called upon executive departments and agencies to take steps to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established. It also created a coordinating body, the National Invasive Species Council (NISC), to oversee

implementation of the order, encourage proactive planning and action, develop recommendations for international cooperation, and take other steps to improve the federal response to invasive species. This 2016 EO amends the original EO and directs actions to continue coordinated federal prevention and control efforts related to invasive species. It also maintains the NISC and the Invasive Species Advisory Committee; expands the membership of the Council; clarifies the operations of the Council; incorporates considerations of human and environmental health, climate change, technological innovation, and other emerging priorities into Federal efforts to address invasive species; and strengthens coordinated, cost-efficient Federal action.

Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds (66 FR 3853, Jan. 17, 2001) – This order requires federal agencies, to the extent practicable, to avoid or minimize adverse impacts on migratory bird resources when conducting agency actions, and to restore and enhance the habitat of migratory birds. Specifically, it requires federal agencies to develop and use principles, standards, and practices that will lessen the amount of unintentional take reasonably attributed to agency actions.

Executive Order 13089 Coral Reef Protection (June 11, 1998) – Section 3, on federal agency responsibilities, states: In furtherance of Section 2 of this order, federal agencies whose actions affect US coral reef ecosystems, shall, subject to the availability of appropriations, provide for implementation of measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. To the extent not inconsistent with statutory responsibilities and procedures, these measures shall be developed in cooperation with the US Coral Reef Task Force and fishery management councils and in consultation with affected States, territorial, commonwealth, tribal, and local government agencies, nongovernmental organizations, the scientific community, and commercial interests.

Executive Order 12898, Environmental Justice in Minority Populations and Low-Income Populations – This executive order directs federal agencies to assess whether their actions have disproportionately high and adverse human health or environmental effects on minority and low-income populations. EAs and EISs must specifically discuss and evaluate the impact of the proposal on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risk of the decision. If the issue is dismissed from detailed analysis, the EA or EIS must specifically indicate this.

US Coast Guard Guidelines – The guidelines for the management of natural resources for the USCG are listed in Commandant Instruction Manual 5090.3, and state that the

USCG shall inventory, preserve, restore, and enhance natural resources on its administered lands to the maximum extent practicable and in the best public interest.

2.5.2 Hawai‘i State Laws and Agencies that Apply to or Support the Proposed Action

Hawai‘i Department of Agriculture, Pesticides Branch (HDOA) – The HDOA has a cooperative agreement with the EPA to enforce FIFRA and is considered the State Lead Agency by the EPA and has the authority to enforce federal law (FIFRA) and promulgate Hawai‘i State law regarding pesticides:

Hawai‘i Revised Statutes Chapter 149a – Hawaii state law related to the licensing, sale or distribution and use of pesticides within the state.

Hawai‘i Administrative Rules 4-66 Pesticides – These rules define licensing, application information, restrictions and aerial application permitting, etc.

The Pesticides Branch have at their discretion the authority to inspect any site where pesticides are being used.

State of Hawai‘i Administrative Rules:

Title 13 Department of Land and Natural Resources, Subtitle 5 Forestry and Wildlife, Part 2 Wildlife.*Chapter 124* – The Indigenous (native) wildlife, endangered and threatened wildlife, injurious, wildlife, introduced wild birds, and introduced wildlife, Subchapter 4, Scientific, propagation, and educational permits. Permits for collecting, possessing, killing, selling or offering for sale, and transporting indigenous wildlife, introduced wild birds, game birds, or game mammals may be issued by the board or its authorized representative for scientific or educational purposes including cultural activities, or for activities which will enhance the survival of the wildlife species.

Hawai‘i Revised Statutes Chapter 344, Environmental Policy Act – Contains comprehensive environmental policy, goals, and objectives for conserving the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State’s unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawai‘i .

Hawai‘i Revised Statutes Chapter 343, Environmental Impact Statements – Provides the guidance to develop an informational document prepared in compliance with the rules adopted under section 343 and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic welfare, social welfare, and cultural practices of the community and State, effects of the economic activities

arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects.

Hawai‘i Revised Statutes Chapter 341, Environmental Quality Control Act – Creates the Office of Environmental Quality and Control, which facilitates the Hawai‘i environmental review process. The office announces the availability of EAs and environmental impact statements (EISs) for public review and comment in its semi-monthly publication, *The Environmental Notice*

Hawai‘i Revised Statutes Chapter 128D, Environmental Response Law – This statute establishes authority at the state level to respond to releases of hazardous substances. It is fashioned after the 1980 Comprehensive Environmental Response, Compensation & Liability Act (CERCLA), commonly known as the Federal Superfund Law, which grants authority to the U.S. Environmental Protection Agency (EPA). The HERL grants certain authority and responsibility to the HDOH to respond to both emergency and non-emergency hazardous substance releases or threats of releases.

Hawai‘i Revised Statutes Chapter 342D, Water Pollution – HRS §342D-50(a) requires that “No person, including any public body, shall discharge any water pollutant into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this chapter, or a permit or variance issued by the director.” As such, water pollutants that enter State waters from all sources, point or non-point, shall comply with applicable requirements as established in HAR, Chapter 11-54.

Hawai‘i Revised Statutes Chapter 321, Department of Health – Creates the State of Hawai‘i Department of Health, which houses the Office of Environmental Quality and Control.

Hawai‘i Revised Statutes, Title 12, Conservation and Resources Chapter 183D, Wildlife – This statute exists to Manage and administer the wildlife and wildlife resources of the State. Additionally, to enforce all laws relating to the protecting, taking, hunting, killing, propagating, or increasing the wildlife within the State and the waters subject to its jurisdiction.

Hawai‘i Department of Land and Natural Resources Statutes – a*) Hawai‘i Revised Statutes, Chapter 26-15*. Provides general authorities to the Department of Land and Natural Resources to manage and administer public lands, including wildlife resources and coastal areas; b) *Hawai‘i Revised Statutes, Chapter 195D-5* (general agency authorities in Hawai‘i to conserve, manage and protect indigenous species) §195D-5 Conservation programs. (a) The department shall conduct research on indigenous aquatic life, wildlife, and land plants, and on endangered species and their

associated ecosystems, and shall utilize the land acquisition and other authority vested in the department to carry out programs for the conservation, management, and protection of such species and their associated ecosystems. In addition, the department is hereby authorized to acquire by purchase, donation or otherwise, lands or interests therein needed to carry out the programs relating to the intent and purpose of this chapter; c) *Hawai‘i Revised Statutes, Chapter 183D-4* (agency authorities to manage wildlife sanctuaries, including Lehua State Seabird Sanctuary) §183D-4 Game management areas, wildlife sanctuaries, public hunting areas. (a) For the purposes of preserving, protecting, conserving, and propagating wildlife, the department shall establish, maintain, manage, and operate game management areas, wildlife sanctuaries, and public hunting areas on land under its control and, as it deems desirable, enter into agreements for taking control of privately owned lands for those purposes.

2.6 Rodenticide Label and Permit Requirements

All applications of rodenticides must follow label requirements as approved by the US Environmental Protection Agency (EPA) pursuant to FIFRA.

2.6.1 EPA-Approved Labels

Diphacinone - The FIFRA Section 3 label (see label in Appendix B) for conservation purposes (EPA reg. no. 12455-147, Diphacinone--50, 0.005% or 50 ppm active ingredient).

Brodifacoum - The nationwide label (see Label in Appendix B) approved by EPA for conservation purposes (EPA reg. no. 56073-10-0, Brodifacoum-25D, 0.0025% or 25 ppm active ingredient) (Special Local Needs label pending HDOA approval).

2.6.2 Permits

For conducting any actions on Lehua, which is designated as a State Wildlife Sanctuary, DOFAW must issue a permit (HAR 13-125-6). For aerial application of rodenticide on Lehua, a permit from the Hawai‘i Department of Agriculture per HRS 149A and HAR 4-66 must be acquired prior to beginning the operation. If diphacinone fails to achieve eradication and the decision is made to use brodifacoum, it could only be applied if the State Department of Agriculture’s Pesticides Branch also finalizes the process to license the FIFRA Section 3 label for brodifacoum use within Hawai‘i under HRS Chapter 149A.

A Special Purpose Permit (50 CFR 21.27) under the MBTA, for the potential incidental take of birds, would be required to conduct the proposed action. The analysis in this draft Environmental Assessment of impacts to non-target birds serves also as the analysis that will underpin the Service’s permit decision.

2.7 Purpose of this Analysis

The analysis is composed of four parts.

The purpose of the proposed action and the need for action are described:

- The reasonable ways to meet the purpose of the action are discussed, including a description of the proposed action as well as a description of the no-action alternative for comparison purposes;
- The natural and physical environment potentially affected by the action is described; and
- The potential for a range of environmental impacts as a result of the action is analyzed, quantified as much as possible, and described.
- Using this document, the decision maker who has authority to approve the proposed action should be able to make an informed decision as to how best to meet the purpose of the action, which action is environmentally preferable, whether or not the proposed action may have significant environmental impacts, and to address any unresolved environmental issues.

3. Alternatives

This chapter will describe the three alternatives that will be considered for implementation, including the "no-action" alternative. This chapter identifies the environmental issues used to formulate the alternatives derived from the 2005 EA, the 2009 supplemental EA, and ongoing discussions with regulatory agencies, stakeholders, and the public since the 2009 rat eradication attempt.

3.1 Alternative Development

Section 102(e) of NEPA states that all federal agencies shall "study, develop, and describe appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." In addition to responding to unresolved conflicts, an environmental analysis must "rigorously explore and objectively evaluate all reasonable alternatives" [40CFR 1502.14(a)].

The proposed action aims to reverse the ecological degradation occurring on Lehua Island caused by non-native Pacific rats.

The alternatives detailed below were developed to focus on the issues identified by USFWS and DOFAW biologists, invasive mammal control experts, rat eradication specialists, State and Federal regulatory agencies, and the general public.

3.2 Internal Scoping and Public Involvement

This section summarizes the scoping that was conducted to identify environmental issues to be considered.

DOFAW has an extensive record of studying the impact of and responding to control or eradication of invasive mammals throughout the State of Hawai`i, including the Northwest Hawaiian Islands. DOFAW, USFWS, and IC have each successfully conducted eradications of invasive species (including rats) from a number of Hawaiian Islands, including Midway, Kure, Mōkapu, and Mānana. In addition, the USFWS has funded studies that focus on the ecology and control of rats on public lands.

3.3 External Scoping

The external scoping refers to the effort the USFWS and DOFAW have made, and will make, to solicit input from the public, state, and federal regulatory agencies, and non-governmental organizations. The following were completed for the 2005 EA and 2008 SEA:

- The USFWS and DOFAW published a Notice of Intent (NOI) in the Federal Register (on May 17, 2004) and the State of Hawai`i OEQC Bulletin (on May 23, 2004), announcing an environmental analysis, purpose and need and the proposed action.

The USFWS also sent press releases to local newspapers, resulting in four articles in two local newspapers announcing the public meeting date and location.

- A public meeting was held in Līhu‘e, Kaua‘i June 9, 2004. The USFWS paid for the publication of an announcement in a local Kaua‘i newspaper indicating the date, time, and location of the meeting. Project biologists gave a presentation at the meeting that outlined the purpose and need and the proposed action. Public comments were requested.
- On May 21, 2004, a scoping letter describing the proposed action was mailed out to individuals and organizations that had previously expressed interest in USFWS/DOFAW management, other State and Federal agencies that may have oversight or regulatory concerns about the project.
- A public meeting was held at the Waimea Neighborhood Center on Kaua‘i where community members sought clarification several aspects of the project, including potential monitoring protocols, non-target impacts, and the persistence of rodenticide in the environment.

For the 2017, EA the LIRSC conducted additional external scoping, including:

- As part of the Lehua Island Feasibility Assessment effort, in 2012 the Lehua Island Restoration Steering Committee was created. The committee was comprised of stakeholders DOFAW, USFWS, IC, USDA, US Coast Guard, NTBG, and the Owners of Ni‘ihau. The Steering Committee has met to discuss Lehua’s restoration potential on a quarterly basis and more recently on a monthly basis. Following the findings of the feasibility study, these key stakeholders have continued to meet and discuss the issues that helped to determine the alternatives outlined below.
- In February 2017 A Pre-Consulation Letter regarding this Draft EA along with information answering potential questions about the Lehua Island Ecosystem Restoration Project was sent out to over 100 potential interested parties in the Kaua‘i community including Kaua‘i County Council members and multiple community and conservation organiations.
- On March 8, 2017 DOFAW released a Draft EA regarding LIERP which was published in the OEQC’s Environmental Notice. With the publishing of the Draft EA, it started a 30 day comment period which ended on April 7, 2017. This resulted in the collection of several comments that will be addressed in the State’s Final EA.
- Although not required, the members of the Lehua Island Restoration Steering Committee (LIRSC) conducted two public information meetings and participated in a call-in radio show during the comment period for the DOFAW’s Draft EA.
    - The first meeting occurred in Waimea on March 14, 2017 at the Waimea Neighborhood Center where community members could dialog with members of the LIRSC to ask questions and get information in small groups and in a larger panel discussion.

- The radio call-in show occurred on March 28 at the community radio station KKCR. Staffs from DOFAW, IC, and USDA were interviewed and fielded questions from the community members who called in on the phone. The show was broadcast live over the air and on the Internet.
- The second informational meeting occurred on April 3, 2017 at the request of members of the Kekaha community. The meeting was held at the Kekaha Community Center and was largely attended by members of the West Kauaʻi community who had fishing interests in the area around Lehua. Community members had an opportunity to express their concerns and dialog with members of the LIRSC

- On May 5, 2017, the Service posted the DEA on PIFWO's website for a 14-day period, closing 26 May 26, 2017 (Prior to the Service posting the federal DEA, DOFAW published the State DEA in the State of Hawaii's Office of Environmental Quality Control bi-weekly bulletin.). Twelve letters commenting on the DEA were received. Five letters were fully supportive of the project and one of these requested that additional information be provided in the FEA. Three letters were fully opposed to the project and another three letters were neutral. The comments in these 6 letters raised several questions, requested additional information, or made recommendations on the following general areas:
  - a) the need to provide greater detail on the efficacy and non-target monitoring protocols;
  - b) the likelihood of bait entering the marine environment and the potential risks posed to non-target animals and humans;
  - c) greater clarity on the factors influencing operational decisions, such as timing and application frequency;
  - d) the need to better describe efforts to outreach communicate with the public;
  - e) disagreed with the need for the project or thought the project was unfeasible; or
  - f) thought the project should wait for better methods.
- These issues are addressed in the FEA for the proposed project and the responses to the comments are also included in the FEA.
- An additional public meeting is scheduled for July 2017 on Kauai Island to inform the public of the decision to move forward with the project and when the proposed project is scheduled to be implemented.

3.4 Alternatives Being Considered

3.4.1 No-Action – Alternative 1

Rats would remain on Lehua for the foreseeable future under this alternative, which would result in the continued negative impacts of rats on native flora and fauna. Ongoing monitoring of seabirds and management of avian predators would continue.

3.4.2 Action Alternative 2 (Proposed Action): Rat Eradication with Diphacinone (50ppm), Followed by Brodifacoum (25ppm) if Necessary.

3.4.2.1 Summary of Actions:

- Pressed-grain bait pellets containing anticoagulant rodenticide (diphacinone and/or brodifacoum) applied at the minimum quantity necessary to achieve rat eradication, according to Environmental Protection Agency (EPA) approved pesticide label instructions;
- Bait applied to every potential rat territory on Lehua Island;
- Whole-island coverage attempted using helicopters and specialized bait-spreading buckets;
- Supplemental hand application of bait pellets where automated helicopter spreading would be limited or would not be feasible;
- All bait application activities to be conducted under the supervision of a Pesticide Applicator certified by the State of Hawai‘i.

3.4.2.2 Description of Operations

This alternative aims to reverse the ecological degradation occurring on Lehua Island caused by Pacific rats. The overarching goal in a successful rodent eradication would be to ensure the delivery of a lethal dose of toxicant to every rodent on the island.

3.4.2.3 Timing

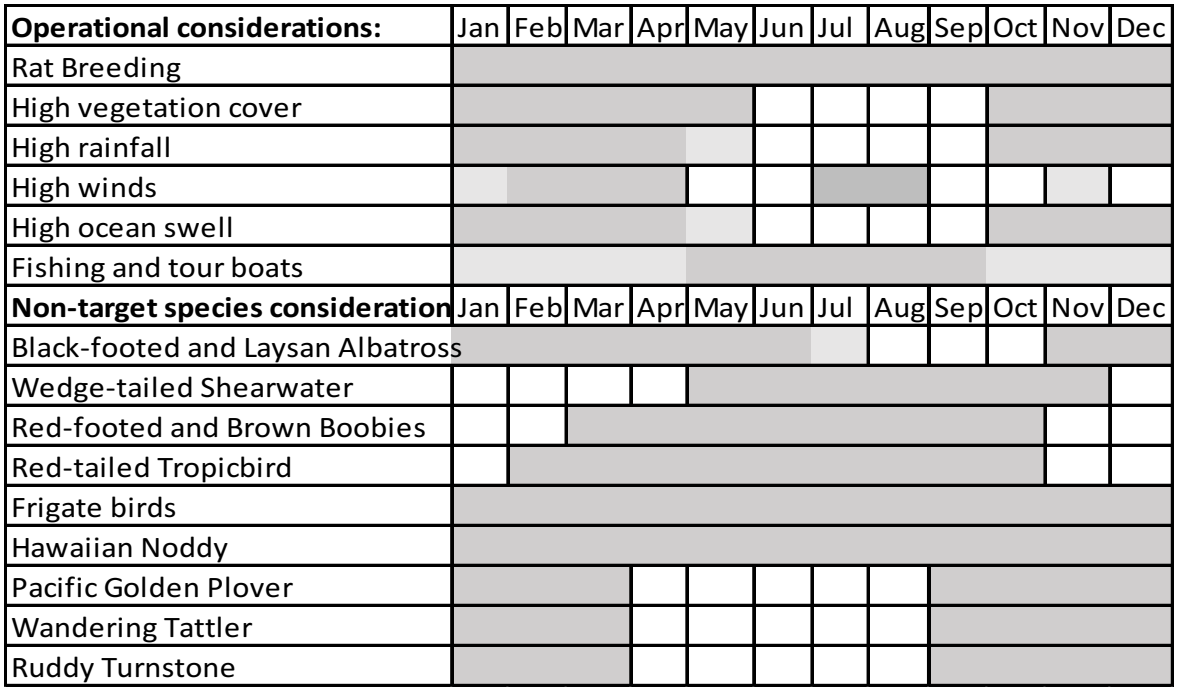
Typically, the best time to eradicate rats from island ecosystems is when the rat population is either in decline or approaching a low point in its annual cycle, which is primarily driven by *per capita* food availability. On Lehua Island, food abundance (vegetation, invertebrates), availability of water, and rat activity is high during the winter/rainy season (October – April, Fig. 1). Food availability and rat abundance decreases as the dry season progresses.

The second important component in the timing of the eradication is the potential risk to non-target species. The summer months between July and September would minimize impacts on some breeding seabirds. During these months, wedge-tailed shearwaters and red-footed boobies would still be nesting on Lehua, but the breeding season for black-footed (*Phoebastria nigripes*) and Laysan albatross (*Phoebastria immutabilis*) would be approaching the end. All albatross chicks are expected to have fledged by the end of July (Wood et al., 2004 and VanderWerf et al., 2007). In addition, timing the eradication with the dry season would minimize the chances of rain storms washing rodenticide pellets into the ocean.

Finally, the summer months are the best option from an operational perspective. The rainfall patterns and ocean conditions during the summer are

more suitable and predictable which increases the likelihood for a successful operation. If Lehua receives rainfall earlier than expected and results in a flush of vegetative growth that significantly reduces the chances of a successful operation, then the project would be delayed until conditions are more conducive for eradication.

Figure 1. Timing matrix for Lehua Island rat eradication based on parameters that influence decisions for operational considerations and non-target species. Dark grey = high influence, light grey = moderate influence and white = minimal influence



3.4.2.4 Project Staging

Two staging areas are being considered for the baiting operation: the island of Niʻihau and Kauaʻi. On Niʻihau the staging area would be located on the north end of the island at Nanina. The site is 1.2 km inland from the beach at Kaʻakuʻu Bay and is exposed to regular helicopter operations, boat landings, and motorized vehicle traffic connected to tourist and ranching activities. On Kauaʻi, the Kauaʻi Raceway Park on the west side of the island has been identified as a backup bait loading site that would be used if Niʻihau became unfeasible. The Kauaʻi Raceway Park is located in Kekaha next to the landfill, agricultural fields, and a decommissioned shooting range. The Park is mainly used on weekends for drag racing events. The west end of the drag strip has a paved helicopter landing zone that would be used for bait loading and helicopter fueling operations.

Field staff, supplies (including fuel), bait, and equipment would be staged to support the operation. A temporary field camp would be established on Niʻihau for each of the bait drops. Additional to the staging area, approximately 10 people would be camped on Lehua Island to conduct monitoring of bait application and non-target species impacts for the duration of the operation. Lehua personnel would be supplied either directly from Niʻihau or by boat, using a regularly scheduled tour charter.

Niʻihau is the preferred staging site for the proposed operation given its proximity to Lehua and resulting lower operational costs and complexity.

3.4.2.5 Bait Shipping, Storage and Handling

Bait would be delivered in shipping containers from the point of manufacture in the Mainland U.S. Bait would be packaged in either23kg bags, or in large bags (up to 318kg), and loaded into large cardboard boxes (aka pods) on skids. The shipping containers would remain locked, and staged on Kauaʻi and/or on Niʻihau, opened periodically for inspection prior to the eradication, and during the baiting operation. Bait would be loaded either manually by hand from bags into the hopper, or directly from brailer bags.

The rodenticide bait would be stored in locked shipping containers. The shipping containers would protect the bait from exposure to the elements and would allow a controllable area to access bait during aerial broadcast operations.

3.4.2.6 Fuel Storage

On Niʻihau, a separate site in close proximity to the helicopter landing site would be used to store fuel. This fuel for the helicopter would be in 208 liter drums and would be held in a containment area that meets EPA-approved Spill Prevention, Control, and Countermeasure (SPCC) rules and covered to prevent water intrusion to the fuel. On Kauaʻi, fuel would be kept in 205 liter drums on the asphalt a short distance away from the bait loading and would adhere to the same regulations as on Niʻihau.

3.4.2.7 Broadcast Bait Application

An aerial broadcast approach, using a specialized bait hopper (or bucket; Fig. 2) slung beneath a helicopter, would be used on Lehua Island as the primary means of bait delivery. Aerial broadcast is the most widely-used method of delivery of pelletized bait on islands, and is effective in delivering bait into every potential rat territory, especially on islands with steep and inaccessible cliffs where safety risks preclude people from gaining access.

Figure 2: Hopper suspended from a helicopter.

The hopper is composed of a bait storage compartment (340kg capacity), a remotely-triggered adjustable gate to regulate bait flow out of the storage compartment operated from the cockpit, providing full control to the pilot. The broadcast device would include a deflector that can be easily installed when directional (rather than 360°) broadcast is necessary, such as on the coastline.

An onboard computer linked to a GPS and light bar would guide the pilot to fly along pre-programmed flight lines over the island, which would ensure an even application rate. The helicopter would have to fly over the near shore marine environment to line up the helicopter along pre-programmed flight lines, guided by the GPS and a light bar. No intentional baiting would occur over the marine environment. The helicopter would fly over the ocean with a full bait bucket when transiting from the bait loading area on either Niʻihau or Kauaʻi.

Before bait application, the pilot, helicopter, and hopper combination to be used in the application would be calibrated and tested for consistency and accuracy of application using a placebo bait broadcast. The calibration would occur in Kauaʻi under conditions similar to those on Lehua Island. The

calibration would ensure that the equipment is fully operational and functioning according to specifications. Any issues identified would be corrected and tested again prior to the application on Lehua Island.

The helicopter pilot would be certified for aerial bait application and in compliance with both Federal Aviation Administration and Hawai‘i State law.

3.4.2.8 Flight Plan

The bait would be applied according to a flight plan that would take into account:

- The need to apply bait relatively evenly and to prevent any gaps in coverage and minimize overlap in bait application;
- Island topography ;
- minimize bait spread into the marine environment;
- minimize disturbance to native wildlife;
- to ensure personnel safety;
- minimize costs associated with helicopter flight time.

3.4.2.9 Monitoring of Bait Application

The onboard computer linked to the GPS would serve as the primary method of monitoring where bait was applied to the island. Data from the onboard computer would be downloaded from the computer and evaluated on a laptop computer to assess where bait was applied and total area treated, in order to calculate the bait application rate.

A monitoring team of approximately 10 people would be staged on Lehua Island to collect near-real time data during the bait application on Lehua to ensure that the application rate stays within the legal and optimal application rates.

3.4.2.10 Monitoring of Operation Effectiveness

A monitoring plan (Appendix D and E) would be implemented to evaluate: 1) if eradication was progressing as expected (mortality of rats), and 2) potential risks and expected impacts of the rodenticide in the environment and to non-native species are documented and in compliance with applicable permits and guidelines (e.g., NEPA and HEPA permits and labels). It is anticipated that at a minimum sampling of marine water, fish, birds, and rodents would be made. To implement the monitoring plan, a field team of approximately 10 people would be staged on Lehua for approximately 6 weeks.

Continuous monitoring protocols would be conducted after the operation and would be evaluated as part of the Lehua Bird Sanctuary's management activities.

3.4.2.11 Monitoring Environmental Impacts

A plan to monitor potential impacts of the proposed operation on non-target species would be implemented (Appendix D and E).

3.4.2.12 Toxicant

Rats would be killed with the use of bait containing 50 ppm diphacinone, a first-generation anticoagulant rodenticide. If rats persist after one year of the diphacinone treatment as prescribed below, bait containing 25 ppm brodifacoum would be used to complete the eradication.

3.4.2.13 Application Rate

Bait containing diphacinone would be broadcast at a maximum of 30 Kg/ha per treatment to ensure adequate bait was available for long enough to all rats, as per the calibration trial conducted in 2015 (Mazurek 2015). Brodifacoum bait would be applied at a maximum of than the label rates of 18kg/ha for the first application and 9 kg/ha for the second. All applications would be made in compliance with EPA bait label.

3.4.2.14 Number of Applications

A maximum of three diphacinone applications would be made, approximately 5-7 days apart depending on weather conditions. If necessary, a maximum of two applications of brodifacoum would be made, approximately 5-7 days apart.

3.4.3 Alternative 3: Same as Alternative 2, except using Brodifacoum alone

3.4.3.1 Toxicant

Rats would be killed with the use of bait containing 25 ppm brodifacoum, a second-generation anticoagulant.

3.4.3.2 Application Rate

Brodifacoum bait would be applied no higher than the label rates of 18kg/ha for the first application and 9 kg/ha for the second. All applications would be made in compliance with EPA bait label.

3.4.3.3 Number of Applications

At least two applications would be made, approximately 5-7 days apart, depending on weather conditions.

3.5 Alternatives Considered but Dismissed from Detailed Analysis

3.5.1 Exclusive Use of Diphacinone

The potential reasons for failure to eradicate rats from Lehua in 2009 using only diphacinone have been rigorously evaluated (Parkes and Fisher 2011; see section 1.3.1 above). In preparation for this proposed attempt to eradicate rats from Lehua, each of the potential causes of failure have been addressed: 1) the eradication would be conducted when rat food resources are at their lowest; 2) a new bait formulation has been tested, with much improved acceptance demonstrated (Appendix F); 3) application rate would be increased to ensure sufficient bait for all rats to receive a lethal dose; 4) constraints affecting where bait would be applied would be removed (while still adhering to label restrictions); and 5) a robust monitoring protocol would be incorporated into the operation assuring the detection of survivors in a timely manner.

With the implementation of the above measures there would be a high degree of confidence that eradication of rats using only diphacinone would be achieved and with the least potential for negative effects to non-target species. However, it is recognized that rats have been eradicated from many more islands (>400) using brodifcacoum than using diphacinone (>25). It is also recognized that failure is always a possibility (Note: Parkes and Fisher 2011 proposed several reasons for the 2009 failure, but did not identify the cause). Therefore, it is essential to have a contingency plan (brodifacoum) in the event eradication was not achieved using diphacinone alone. Furthermore, it is essential that the regulatory process for the contingency plan be incorporated into the current proposal. This would to prevent delays in implementation (if needed), which could jeopardize the likelihood of achieving eradication in a timely manner.

Therefore, the use of only diphacinone was considered but dismissed.

3.5.2 Other Rodenticides

The vast majority of island-wide rat eradication projects (>400) have used second-generation anticoagulants (e.g., brodifacoum), while 29 have used first-generation anticoagulants (e.g., diphacinone). Nine eradications have used non-anticoagulant toxins, such as zinc phosphide, strychnine, and cholecalciferol. Acute rodenticides (e.g., zinc phosphide or strychnine) are intended to kill rats quickly after a single feeding. However, because poisoning symptoms appear rapidly, acute rodenticides can induce future bait avoidance if animals consume a sub-lethal dose (Rzoska 1953; Lund 1988). Also, acute rodenticides, pose a greater safety risk to applicators and non-target species because of their toxicity, rapid action, and lack of antidotes. Cholecalciferol, a “subacute” rodenticide, can kill rats more quickly than the anticoagulant rodenticides, but generally more slowly than the acute rodenticides, making bait avoidance less of an issue. It is also an attractive alternative because of its lower toxicity to birds. However, these non-anticoagulant rodenticides are untested

on islands larger than 22 ha (~54 ac) (Howald et al. 2007). Using Lehua as a test island, without a high probability of success, would be inappropriate due to the high financial cost of the operation. These factors, lack of field-testing on islands comparable to Lehua, potential bait avoidance, and greater human safety risk disqualifies them from detailed consideration for use on Lehua Island rat eradication.

3.5.3 Exclusive Ground-based Methods: Snap Traps or Rodenticide Applied Using Bait Stations or Hand Broadcast

On Lehua Island, it would be challenging to meet the fundamental principle of rodent eradication with a strategy that relied solely on ground-based methods. Logistically, this would require a comparable number of personnel as the proposed action, but they would be present on island for a longer period, which would require greater infrastructure to support the staff. As noted above, to achieve eradication every potential rat territory must be targeted. For Pacific rats and their home range size, a grid size of 25 m x 25 m would be appropriate (Tamarin and Malecha 1971). Using this grid spacing on the 115 ha Lehua would require placing more than 1000 traps or bait stations across the island. Bait stations and traps must be visited multiple times to reset or replenish bait. Walking across the island's steep and difficult terrain would present an unacceptable safety risk to field personnel. Finally, the on-the-ground effort required to achieve eradication using these methods would expose ground-nesting seabirds, and other non-target species, to unacceptable levels of trampling. These combined factors preclude relying solely on ground-based methods to achieve eradication.

3.5.4 Fertility Control

Fertility control has been used with limited success as a method of pest management in a few species. Fertility control for male rats was developed in the 1980s. Oral fertility control is temporary and variable in its effectiveness between individual rats. Testing of fertility control in urban environments is underway, but this product is not registered for conservation purposes. Currently, there is no method of rodent sterilization developed that has demonstrated success to a wild rat population. Multiple applications would be required, which is impractical on a remote island. Impacts of experimental fertility control substances for rodents on non-target animals are unknown and would require testing before implementation. Other reproductive inhibiters are chemicals or proteins delivered by vaccine or a genetically modified viral pathogen. This lack of data and tools disqualifies the use of fertility control from detailed consideration.

3.5.5 Traditional Biocontrol

The introduction of another species such as cats, or mongoose to the island to control rodents would not be effective, and would be in violation of Hawai‘i state law. There is no known effective biological control agent for rats on large islands, and some forms of biological control would result in unreasonable damage to the environment.

The introduction of cats to islands in order to control introduced rats has been attempted numerous times since European explorers began crossing the Atlantic and Pacific Oceans. The introduction of a rat predator, such as cats, generally results in a greater impact on birds than if one or the other were present alone. When seabirds are present, cats have been known to prey heavily on seabirds (Keitt 1998; Atkinson 1985), consuming fewer rats during these times. When seabirds migrate off the islands following the breeding season, cats switch to rats, which allows the island cat population to remain stable at a higher level than if no rats were present on the island (Atkinson 1985). Thus, birds are impacted not only by rats but the larger number of cats that are sustained by rat presence on the island. Introduction of another species onto an island can have severe and permanent consequences to the ecosystem (see Quammen 1996).

3.5.6 Disease

While there is ongoing research focused on the development of taxon-specific diseases that can control populations of exotic species (such as by the Australian agency CSIRO, http://www.cse.csiro.au/research/rodents/publications.htm), there are no pathogens with proven effectiveness at eradicating rats (Howald et al. 2007). In any event, the use of lethal disease would be ineffective at eradicating rats from Lehua Island, because if the rat population rapidly declined, the introduced disease would likely disappear before being able to affect the few remaining individuals. Furthermore, the introduction of novel diseases into the environment carries tremendous potential risks to non-target species.

3.5.7 Genetic Tools

Genetic tools such as gene drives are in the initial phases of evaluation for use for eradications. This type of technology is not yet available for this purpose.

4. Affected Environment

4.1 Introduction

The area affected by this operation, the Affected Environment, is considered to be the Island of Lehua, its immediate surrounding waters, and the species that use them. The north end of the island of Niʻihau, may experience some effects from this operation due to its proximity across a deep ocean channel from Lehua as well as its being the preferred staging area for the Lehua Island Ecosystem Restoration Project (LIERP). If Niʻihau was unavailable as the staging area, an alternate staging area on Kauaʻi would be chosen.

Lehua Island is located 1.2 km off the northern shore of Niʻihau (a privately owned 18,650 hectare), and roughly 30km west of Mana Point on the island of Kauaʻi (Fig. 2). The island is a federal property administered by the U.S. Coast Guard (USCG) and was set aside for public purposes by Territorial Governor on August 10th, 1928, under Executive Order No. 343. The waters around Lehua, including the intertidal zone, are State property. Lehua Island itself is zoned as a Conservation District and is also a Hawaiʻi State Seabird Sanctuary.

4.2 Physical Characteristics

Lehua is a crescent-shaped volcanic crater open to the sea on its north side (Fig. 3). It is approximately 115 ha in total area, with a maximum elevation of 215 m. (State of Hawaiʻi Data Book 2002, Figure 2). Lehua is a volcanic cinder tuff cone. The substrate is gray to brown in color, with stratifications that are particularly visible on the inner crescent wall. The porous rock has weathered to form numerous cavities on exposed surfaces, which provide nesting habitat for ground-nesting birds. Rock is exposed on vertical cliffs throughout the island, and has eroded to form deeply carved fissures that are especially common near sea level on the inner crescent. Higher up the slopes of the inner crescent, parallel stratified beds are exposed to form a series of relatively level shelves, appearing somewhat like a natural amphitheater. Portions of the shoreline are composed of benches that are at least partially above sea level. The bench on the shoreline of the island's inner crescent contains large tide pools (Wood et al. 2004). There is no source of perennial fresh water on the island. Rain water either runs off the steep slopes to the ocean or collects in small puddles, which evaporate quickly.

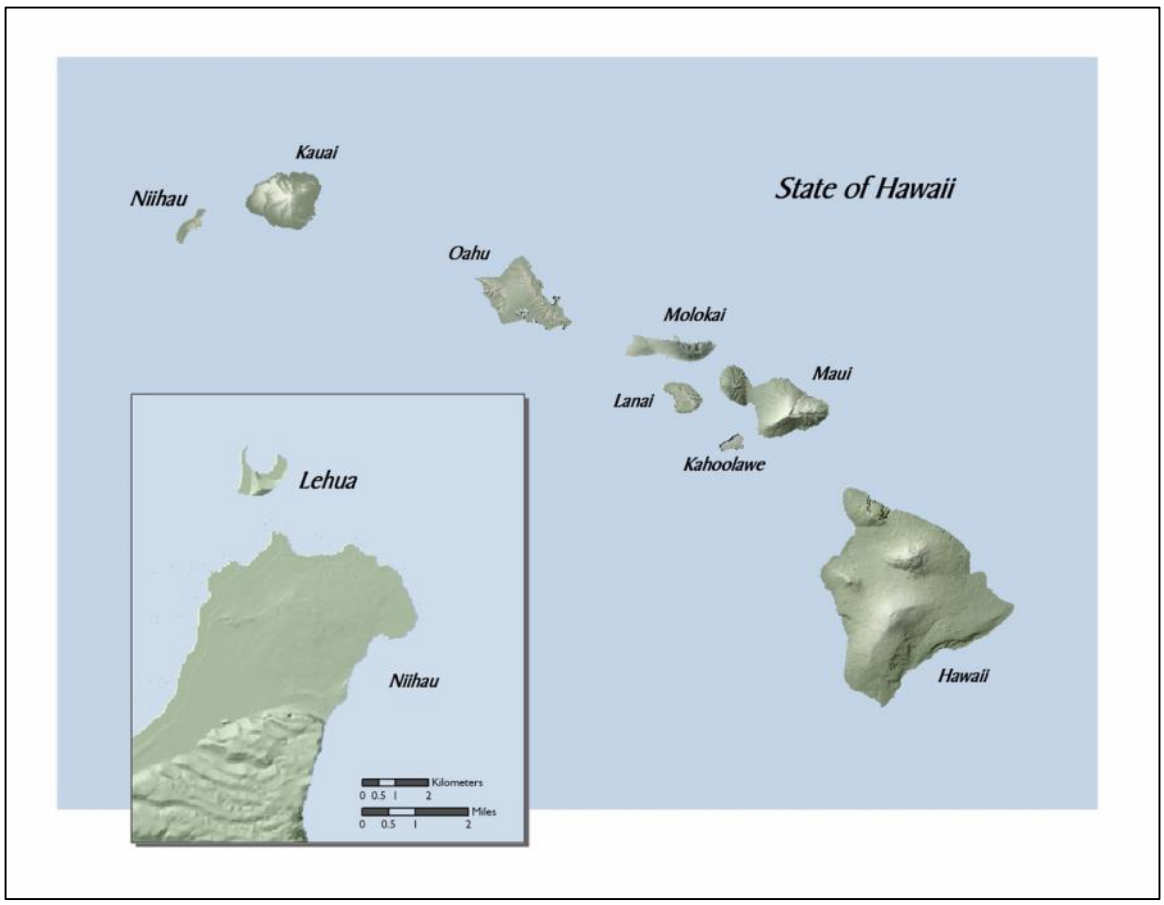


Figure 3. Map of Lehua Island

4.3 Terrestrial Biota

Bird survey data was collected from as early as 1931 and as recent as 2016 and was obtained from VanderWerf et al. (2007)and ebird.org (2017) (Appendix A, Table 4). Reptile observations were made in 1931 by Caum (1936), and invertebrate surveys were conducted in 2001 and 2003 by Wood et al. (2004) (Appendix A, Table 3). Plant surveys were conducted by Caum (1936) and Wood et al. (2004) (Appendix A, Table 1).

4.3.1 Seabirds

Twenty-three species of seabirds have been recorded on Lehua. This includes species like the wedge-tailed shearwater (*Puffinus pacificus*), Laysan albatross (*Phoebastria immutabilis*), red-tailed tropicbird (*Phaethon rubricauda*), brown booby (*Sula leucogaster*), Hawaiian black noddy (*Anous minutus melanogenys*), and great frigatebird (*Fregata minor*). All seabird species are protected under the MBTA.

4.3.2 Shorebirds

The shorebirds that have been recorded on Lehua are the Pacific golden-plover (*Pluvialis fulva*), wandering tattler (*Heteroscelus incanus*), ruddy turnstone (*Arenaria interpres*), bristle-thigh curlew (*Numenius tahitiensis*), and red phalarope (*Phalaropus fulicarius*). All shorebird species are protected under the MBTA.

4.3.3 Passerines

Twelve species of passerines, all of which are non-native, have been recorded on Lehua. Three of these species are protected under the MBTA; they are the mourning dove (*Zenaida macroura*), Northern cardinal (*Cardinalis cardinalis*), and house finch (*Carpodacus mexicanus*).

4.3.4 Predatory Birds

Non-native cattle egret (*Bubulcus ibis*) and barn owl (*Tyto alba*), as well as native peregrine falcon (*Falco peregrinus*), black-crowned night-heron (*Nycticorax nycticorax*) and great blue heron (*Ardea herodias*) have been documented on Lehua. All five species are protected under the MBTA; however, a DOFAW permit from USFWS Migratory Birds Program allows for take of cattle egret and barn owl due to depredation.

4.3.5 Reptiles

Two species of lizards are found on the island (both non-native), the snake-eyed skink (*Cryptoblepharus poecilopleurus*) and the house gecko (*Hemidactylus frenatus*).

4.3.6 Invertebrates

Twelve native species of invertebrates are documented from Lehua, with eleven of them being endemic to Hawai‘i. Forty-eight non-native species have also been documented. Some of the endemic species include, but are not limited to: the lycosid spider (*Lycos* sp.), long-legged fly (*Hydrophorus pacificus*), beach fly (*Canaceoides hawaiiensis*), yellow-faced bee (*Hylaeus flavifrons*), and seed bug (*Nysius kinbergi*). Four species of land snails (*Lamellidea gracilis, Tornatellides procerulus, Succinea caduca, and Lyropupa perlonga*) were recorded from Lehua in 2007 (Cowie and Wood 2008). The current status of these 4 snails is unknown. None of the terrestrial invertebrate species currently documented to occur on Lehua are federally listed under the ESA.

4.3.7 Plants

There are a total of twenty-two native plant species extant on Lehua, including nine endemic species such as *Portulaca villosa*, *Sicyos maximowiczii, Eragrostis variabilis, Panicum pellitum*, and *Doryopteris decipiens*. No protected species of

plants are known to be established. However, in 2007/8, fruiting was observed in outplanted adults of the federally-listed *Caonavalia napaliensis* prior to their dying; therefore, viable seeds may be present in the soil (Michael DeMotta, personal communication, NTGB, 2016). Twenty-seven non-native species have also been documented. There are no known extant populations of endangered plants on Lehua.

4.4 Marine Biota

4.4.1 Hawaiian Monk Seals

The Hawaiian monk seal (*Neomonachus schauinslandi*) is endemic to Hawai‘i and the only marine mammal found on Lehua. It is protected under the ESA, MMPA, and Hawai‘i State law. The majority of seals are found in the Northwestern Hawaiian Islands, but small resident populations are present in the main Hawaiian Islands, with the largest numbers likely on Ni‘ihau (NMFS 2007).

4.4.2 Sea Turtles

The green sea turtle (*Chelonia mydas*) is a federally-listed threatened species found in tropical and sub-tropical oceans. Approximately 90% of Hawai‘i’s green sea turtle population nests at French Frigate Shoals (NMFS and USFWS 1998). A small number of turtles nest in the main Hawaiian Islands and are occasionally seen in waters around Lehua. Hawksbills (*Eretmochelys imbricata*) are also found in the waters surrounding Hawai‘i, but normally do not occur north of Maui.

4.4.3 Fish

The waters surrounding Lehua harbor a rich marine biota of various reef fish including species of goatfish, parrotfish, surgeonfish, damselfish, and triggerfish. Surveys conducted in varying depths of 3 – 24 m observed a total of 106 fish species (NOAA-PIFSC 2008). Other surveys that focused only on near shore fish have documented a total of 48 different species, all of which were native except one (Wood et al. 2004; USFWS unpubl. Data 2004; Appendix A, Table 5; Appendix G, Table 1 and 3).

4.4.4 Algae

Marine algae collection surveys were conducted in March and May, 2003, and documented 41 different species from 23 different families (Wood et al. 2004; Appendix A, Table 2). Algae were collected from inter-tidal and shallow marine areas along Lehua’s south shore.

4.4.5 Invertebrates and Corals

Bait interaction surveys in 2004 and 2015 documented marine invertebrates such as hermit crabs and various urchin species (Appendix G, Table 1 and 3). Black-foot ʻopihi (*Cellana exarata*) are also known to occur in the intertidal areas around Lehua (Orazio et al. 2009). NOAA's (2008) near shore site survey characterized coral cover and complexity as moderate and moderate-high, respectively. The most abundant coral species they documented around Lehua were cauliflower coral (*Pocillopora meandrina*), lobe coral (*Porites lobata*), and rice coral (*Montipora capitate*). In addition, a large bed of soft coral (*Sinularia sp*.) was observed off the northwest horn of the island (NOAA-PIFSC 2008).

4.5 Human Uses and Values

4.5.1 Cultural and Archaeological Value

A complete archaeological inventory survey conducted in September 2003 and July 2004 documented the number and distribution of these archaeologically significant sites (Carpenter and Yent 2009). Sixty-five features were recorded during the survey, and subsequently grouped into three sites. One site includes three clusters of traditional ahu (altar) features spread along the crescent rim of the island comprising 36 features in total. Another site, composed of several clusters of traditional features situated on the southern flank of the island adjacent to the shoreline, comprises 19 features in total. A third site consists of two clusters of early twentieth century features associated with the construction and maintenance of the Lehua navigational Light, comprising 10 features in all.

4.5.2 Human Health and Safety

Lehua has no resident human population and state regulations prohibit overnight camping, hunting, or disturbing wildlife. Landing on the island is by USCG permission only. However, the surrounding waters are a popular destination for scuba and snorkeling trips departing from Kauaʻi. Lehua's remoteness makes this trip a full-day undertaking, so use is light compared to most dive sites in Hawaiʻ i. Sportfishing, subsistence fishing, and bird watching also occur in the waters around Lehua. People sometimes gather ʻopihi (marine limpets) from Lehua's intertidal areas.

The preferred bait storage and loading area would be located on the North end of the island of Niʻihau, at Nanina. The 2010 U.S. census states that 170 people live on Niʻihau, but the on-island presence is often less. The island is privately owned and since being sold to the owners of Niʻihau, has been variously used for cattle ranching, hunting, tours, military, and residential purposes. Nanina is an area that is used mainly by visitors to Niʻihau. The site of interest is a 1.2 km inland from the beach at Kaʻakuʻu Bay and is exposed to regular helicopter operations, boat landings, and

motorized vehicle traffic connected to tourist and ranching activities. An alternative staging site would be located on Kauaʻi in Kekaha near the Kauaʻi Raceway Park.

5. Environmental Consequences and Mitigation

The purpose of this chapter of the EA is to determine whether or not any significant impacts to the environment of Lehua would be expected from any of the alternatives. According to federal Council on Environmental Quality (CEQ) regulations (40 CFR 1508.27), significance is determined by considering both the context in which the action would occur and the intensity of the action. "Context" is the setting within which an impact is analyzed, such as a particular locality, the affected region, or society as a whole. "Intensity" is a measure of the severity of an impact. Determining the intensity of an impact requires consideration of the appropriate context of that impact as well as a number of other factors.

In the analysis below, the potential significance of impacts of the proposed action alternatives and the no action alternative will be discussed on a case-by-case basis for each impact topic, with an identification of both the context used for the analysis and the considerations included for a determination of the intensity of the impact, including the the role of mitigation measure in the significance determination.

5.1 Rodenticide toxicity and exposure

Risk of rodenticide poisoning for an animal is based on both the toxicity of the chemical and its exposure to the chemical. Exposure can arise from directly ingesting the rodenticide (i.e., primary exposure) or eating an animal that has ingested the rodenticide (i.e., secondary exposure). For the purposes of this EA, exposure is a function of the quantity of the rodenticide in the environment and the frequency of occurrence of the animal in the environment where the rodenticide is applied. The former is addressed with the application rate (described in previous section) and the latter is addressed in this section. Toxicity is taxa specific and is determined by the quantity of active ingredient (ai) for a given body weight (bwt) to achieve a certain effect, usually measured as mg ai / kg bwt. Toxicity is most frequently represented as the LD_{50} and LC_{50}. LD_{50} is the chemical dose to cause death to 50% of the test animals when administered as a single dose. LC_{50} is the concentration of the chemical administered chronically for multiple days that causes death to 50% of the test animals. A third measure of toxicity is the LLD, the lowest lethal dose of a chemical at which a single test animal died. The lower the LD_{50}, LC_{50}, or LLD value, the more toxic the chemical, or more sensitive the species. Toxicants are also evaluated by their sublethal effects on animals. These are represented by metrics, such as NOAEL (no observable adverse effect level) and LOAEL (lowest observable adverse effect level). NOAEL is a dose or exposure level of a toxicant that produces no measureable toxic effects on the test group of animals and LOAEL is the lowest dose or exposure level of a toxicant that produces a measurable toxic effect on the test group of animals. Sublethal effects observed from anticoagulant exposure may include a variety of mild adverse effects, including prolonged clotting time, internal bleeding, piloerection, lethargy, diarrhea, bloody diarrhea, and/or anorexia (Anderson, Borges, and Garber 2011).

It has been demonstrated that the LD50 is a poor measure of toxicity for first generation anticoagulant rodenticides (FGARs) such as diphacinone (Jackson and Ashton 1992), because metabolism of FGARs is rapid, and the anticoagulant inhibition requires multiple days to have an effect. LD_{50} results are obtained by giving groups of test animals a single dose of varying quantities of the chemical. A very large dose of FGAR is required to have sufficient activity over the several days required for anticoagulant action to occur. If smaller doses are administered over several days, the total amount needed to have a toxic effect is much smaller. This is the principle of the chronic dose administration, which provides a small daily dose of toxicant to sustain the activity during concomitant metabolism. The LD_{50} determination has been found to underestimate the toxicity of FGARs compared to the LC_{50}. LC_{50}, LLD, LOAEL, and NOAEL are more accurate measures of the sensitivity of birds and mammals.

Individual species of birds and mammals vary in their relative sensitivity (i.e., the toxicity) to different rodenticides. For mammals, diphacinone and brodifacoum are considered "very highly toxic" as measured by acute oral toxicity (LD_{50}) and chronic toxicity (LC_{50}) (Anderson, Borges, and Garber 2011). For birds, diphacinone is considered "slightly toxic" (LD_{50}) and "moderately toxic" (LC_{50}), respectively.
The potential ecological and human health risks associated with broadcasting diphacinone in native Hawaiian ecosystems has been examined (Eisemann and Swift 2006) and the results relevant to the proposed action have been adapted to the species of interest. The potential ecological and human health risks of brodifacoum have also been extensively studied and are presented in the following sections. It should be noted, that all pellets would not be available to all non-target species. A significant, but undetermined, portion of the pellets are expected to be deposited in crevices in the soil and cracked lava substrate, out of reach of most non-target species, yet still accessible to Pacific rats. Moreover, Pacific rats are expected to quickly begin consuming and caching bait, further reducing the quantity of bait available to non-target species. However, the removal of bait by rodents would be less of a factor for follow-up bait applications because the number of rats would have been greatly reduced from the first application.

5.2 Mitigation Measures

The aerial application of rodenticides presents potential environmental hazards to non-target resources, including birds, fish, marine mammals, and invertebrates. Precautions must also be taken to prevent exposure to the field crew loading and applying the rodenticide and post application monitoring. The mitigation measures proposed for this operation are listed below:

1. Prior to the application of bait pellets with rodenticide, the bait delivery system (bait bucket, controller, GPS units, and helicopter) would be tested and calibrated to ensure an accurate application rate.

2. An onboard computer linked to a GPS and light bar would guide the pilot along pre-programmed flight lines over the island at a prescribed airspeed, which would ensure an even application rate.
3. Aerial application of bait pellets would not occur during wind speeds in excess of 35 mph.
4. Aerial application of bait pellets would not occur when heavy rains are forecast to occur within 72 hours.
5. The hopper would be fitted with a deflector that spreads bait out to only one side (120° pattern) to minimize bait application directly into the water. Every reasonable effort would be made to minimize the risk of bait drift into the water; however, it is inevitable that a small number of pellets would roll or bounce into the ocean. The pilot and on-the-ground observers would visually monitor the application of bait and if a malfunction is detected operations would cease until the problem is corrected.
6. Bait would be applied at the lowest rate possible to achieve eradication and any bait spilled would be collected and disposed of according to label instructions.
7. The operation would be conducted in the summer when vulnerable seabirds like albatross chicks are fewer in number and the majority of migratory shorebirds have departed (or not yet returned) to Lehua for their summer breeding grounds.
8. Active nests of albatross and red-tailed tropicbird that are accessible would be mapped and bait removed to prevent chicks from accessing the pellets.
9. Ground-based personnel would be instructed to avoid walking over known shearwater burrows. If a burrow is accidently collapsed by personnel, it would be excavated to re-open the nest entrance to allow adults access to chicks. Burrows would be rebuilt as best as possible to provide chicks or eggs protection from the elements.
10. To minimize consumption of bait pellets by shorebirds and terrestrial birds the bait pellets are dyed a green or blue color, which birds appear to prefer less than yellow or red (Slaby and Slaby 1977; Hartley et al. 1999; Marples, Roper, and Harper 1998).
11. Bait pellets are formulated large enough that it would be difficult for a small, seed-eating bird to consume the whole pellet.
12. During project activities, any federally endangered or listed species or species of special concern, that is exhibiting abnormal behavior (e.g., toxicosis) would be collected and delivered to the Kaua‘i Humane Society, a permitted rehabilitation center for therapeutic treatment.
13. Any non-native MBTA-protected bird, that is exhibiting abnormal behavior (e.g., toxicosis) would be provided therapeutic treatment on island or euthanized (Leary et al. 2013)(Leary et al. 2013). That decision would be at the discretion of the project lead and based on the condition of the bird.
14. Risk of helicopter-bird collisions would be minimized by conducting the operation during the summer, flying in the early morning hours before soaring birds begin to catch thermals, and by pilot avoidance measures.

15. All project personnel on the ground would maintain a 30.5 m (100 ft) buffer from seals during operations. During aerial bait broadcast, helicopters would avoid hovering near seals and would avoid distributing pellets over seals on the shore. Although, encounters with sea turtles are not expected, similar measures would be applied.
16. Prior to the beginning of the operation NTBG would perform a plant survey to identify the presence or absence of the federally-listed *Canavalia napaliensis*. All observed plants would be marked and all ground-personnel instructed to avoid contact with these plants.
17. Archaeological sites would be flagged and field personnel informed of prohibitions from walking on or disturbing sites. Instructions would be in accordance with the Lehua Island Protocols and Procedures (LIPP) regarding "Archaeological Site Avoidance" (Appendix H). Therefore, no direct or indirect effects from the proposed action would be expected.
18. Signs would be placed on the island alerting visitors of the operation and the presence of rodenticide on the land and potentially in the near shore environment; however, because the low risk of contamination of near-shore marine organisms and the very low risk of humans being impacted from consumption of these organisms there would be no moratorium imposed on harvesting marine organisms (see Section 5.5.6).
19. During periods when aerial operations are scheduled on Lehua and Niʻihau, the USCG will release a notice to mariners advising them to remain clear of the area to prevent hazardous interactions with operational crew and boaters.
20. Ground personnel would use personal protective safety equipment in accordance with bait product labels. Equipment would include, but are not limited to, appropriate clothing, gloves and masks.
21. All personnel visiting or working on Lehua would adhere to the LIPP to prevent new alien species from becoming introduced to Lehua (Appendix H).
22. The compressed grain bait pellets are manufactured to ensure that no active seeds are embedded into the baits to ensure that no active seeds are accidentally introduced onto the island.

5.3 Aspects of the Environment Excluded from Detailed Analysis (With Rationale)

5.3.1 Cetaceans

Potential impacts of rat eradication activities to cetaceans (whales, dolphins, and their close relatives) in the waters surrounding Lehua are not analyzed in this EA. Except for small boat traffic from local tour operators, which occurs currently and would be limited in duration and concentrated immediately off shore of the island, all of the activities described in the proposed action are terrestrial, and the likelihood of the proposed action having measurable impacts on cetaceans would be negligible.

5.3.2 Air Quality

Air quality in the region of Lehua Island would not be an issue of concern. Lehau is an isolated uninhabited island and the helicopter operations described in the proposed action would not generate measurable levels of pollutants or contribute to air quality thresholds being reached. It should also be noted that Hawai‘i has no nonattainment areas identified under the Clean Water Act.

5.3.3 Wetlands and Floodplains

Lehua Island is typically very dry, except for occasional winter storms. Due to the lack of water and its steep rocky terrain, the island does not have any wetlands or floodplains and would not have any impact to these resources protected under Executive Orders 11990 and 11988.

5.4 Alternative 1 – No-Action Alternative

5.4.1 Restoration Efficacy

Under the no-action alternative, the rat population would not be eradicated, and the population size would continue to fluctuate within an annual cycle – population levels increasing during the rainy season, and declining during the dry season.

Native plant communities may continue to be negatively impacted by rat herbivory. Introduced rats would continue to prey on nesting seabirds on the island, preventing them from reaching their full population potentials and possibly contributing to accelerated decline in seabird populations, while preventing species such as Newell’s shearwaters from re-colonizing the island.

Adoption of the no action alternative would not meet the objective of restoring the Lehua ecosystem.

5.4.2 Non-Target Species Impacts

There would be no effects to non-target species under the no-action alternative.

5.4.3 Impacts on Weed Abundance

Under the no-action alternative, weed distribution could potentially be influenced by rat herbivory. Predation pressure from rats on Lehua Island may disproportionally impact native plants, which could exacerbate a shift to non-native dominated plant communities.

5.4.4 Impacts on Cultural Resources

There would be no change to the impact on cultural resources on Lehua Island under the no-action alternative.

5.4.5 Impacts on Human Health and Safety

There would be no potential impact to human health and safety under the no-action alternative.

5.4.6 Environmental Justice

Under the no-action alternative there would be potential for minor economic impact on the minority and low-income populations. Members of the Ni‘ihau community would not be hired to assist with logistics in the staging of the operation.

5.4.7 Non-native Species Introduction

Under the no-action alternative, the risk of introducing non-native species would not change. While the operation would not occur, ongoing monitoring would continue, which would present a risk of introduction; however, that risk would be small: personnel that visit the island are typically either USFWS or DOFAW sponsored scientists who comply with the DOFAW Lehua Protocols and Procedures, including the LIPP.

5.5 Alternative 2 (Proposed Action) - Rat Eradication with Diphacinone, followed by Brodifacoum only if Necessary

5.5.1 Restoration Efficacy

5.5.1.1 Rat Eradication

Rat eradication has been conducted successfully on more than 300 islands worldwide (Howald et al. 2007). With effective implementation of the specifications described in Alternative 2, there would be a high probability of successful rat eradication from Lehua. Current and ongoing biosecurity protocols (LIPP, Appendix H) would keep Lehua free of rats and allow the ecosystem to respond and recover.

Island ecosystems have a demonstrated history of responding quickly and dramatically as a result of rat eradication. On Anacapa Island in Southern California, breeding success and number of nests found for Xantus’ Murrelets (*Synthliboramphus hypoleucus*), small crevice-nesting seabirds, began increasing immediately after rat eradication and within three years hatching

success in monitored murrelet nests nearly doubled (Whitworth et al. 2008). Almost immediately after rats were eradicated on Campbell Island, the Campbell Island Snipe (*Coenocorypha aucklandica perseverance*) began successfully recolonizing the island from an offshore islet where it had persisted in low numbers for decades after being extirpated from the main island (Miskelly and Fraser 2006). Nesting success of Wedge-tailed shearwaters on Mokoli‘i Islet, Hawaii increased from a single surviving chick prior to rat eradication to 185 surviving chicks two years after rats were eradicated (Smith, Shiinoki, and VanderWerf 2006).

The removal of rats from Lehua would likely be followed by an influx of new breeding seabirds. Rat eradication would likely also support restoration of Lehua’s native vegetation, which rats are currently impacting. The restoration benefits derived from Alternative 2 would enhance the long-term productivity of Lehua as a sanctuary for native plants and wildlife.

5.5.2 Impacts to the Physical Environment

5.5.2.1 Environmental Fate of Diphacinone and Brodifacoum in Soil and Water

The active ingredients (a.i.) in diphacinone and brodifacoum have low or extremely low solubility in water, respectively, and bind tightly to organic matter in soil where the rodenticide would be degraded by soil micro-organisms and exposure to oxygen and sunlight. The half-life in soil is ~30 to 60 days for diphacinone, and ~ 84 to 175 days for brodifacoum environmental conditions. The rate of microbial degradation would be dependent on climatic factors such as temperature, light, humidity, and the presence of molds and soil microbes that potentiate degradation. Therefore, in general, degradation time would be more rapid in warm sunny places like Hawai‘i than in colder climates (Eason and Wickstrom 2001, Eisemann and Swift 2006). Trials on Lehua indicate pellets in the terrestrial environment would break down and be undectable in 35-40 days when under vegetation and around 65 days on rock or bare ground (Mazurek 2015).

Bait pellets may inadvertently fall into the ocean, but this is normally a small amount. This is illustrated from monitoring on two rodent eradication projects using brodifacoum. On Anacapa Island, divers and land-based observers monitored bait for entry at seven separate locations (Howald et al. 2009). Sites were selected based on their probability of bait entering the water (e.g., near or under steep cliffs). The application rate on the project was 15 kg / ha and no bait was observed to directly enter the water, though small quantities indirectly entered at three locations and densites were estimated at 0.15 pellets

/ m^2. On Isabel Island, Mexico, where the application rate was 20.6 kg/ ha, divers monitoring the operation documented bait in the sub-littoral zone at <1 pellet / 10 m^2 (0.1 / m^2) (Samaniego-Herrera et al. 2014). However, examples exist where large quantities of bait enter the marine environment. During the Palmyra rat eradication, where the bait application was extremely high (80 kg/ha, 1st application and 75 kg/ha, 2nd application), the average density of bait entering the water was as high as 44.7 kg/ha during the first application and 46.3 kg/ha during the second (Engeman et al. 2013). A variety of factors are thought to have contributed to the high quantity of bait entering the marine environment at Palmyra, which include: an irregular coastline, baits drifting in the wind, pilot difficulty locating the shoreline due to overhanging palm trees, and an ineffective and broken bait bait deflector.

Complete breakdown of pellets in the water would be quick, especially in rough water conditions. During the inert bait trials on Lehua in 2015, data collected shows that pellets disintegrated within 30 minutes after application to seawater and no pellets were found after 24 hours (Mazurek 2015). Disintegrating pellets would consist of suspended cereal grain flocculants and dissolution of the a.i. into seawater. In trials on Kapiti Island, New Zealand, inert bait pellets were seen to disintegrate within 15 minutes (Empson and Miskelly 1999) and on Isabel Island, pellets "sank immediately and disintegrated by wave action within a few minutes" (Samaniego-Herrera et al. 2014). On Anacapa, bait that entered the ocean completely dissolved within 5 hours (Howald et al. 2009). Sampling of seawater 24 and 48 hours post-application conducted in conjuction with the Anacapa project tested negative for brodifacoum residues.

In the process of breaking down, pellets would consist of suspended flocculants and dissolution of the a.i. into seawater. The solubility of brodifacoum in water is 0.24 mg/l and the solubility of diphacinone is 0.3mg/l (US EPA 1998). Any effect of salt water on solubility has not been reported. For the rat eradication on Mōkapu, Hawai'i and the previous attempt on Lehua seawater samples were collected five and seven days after the last application of rodenticide baits. No diphacinone was detected in the seawater samples from either operation (Gale, Tanner, and Orazio 2008; Orazio et al. 2009).

Because of the rapid breakdown of both rodenticides Alternative 2 would be unlikely to directly or indirectly impact soil on Lehua. Because very little of either rodenticide is expected to enter the water, their low solubility in water,

and the rapid breakdown in water, Alternative 2 would be unlikely to directly impact seawater on or around Lehua

5.5.3 Impacts to Terrestrial Biota

Calculations of the toxicity risk to wildlife on Lehua have been made using the most conservative assumptions in an effort to explicitly identify the greatest possible impact of rodenticides on non-target animals. In cases where measured toxicity for a given species has not been determined, the data for the most sensitive species has been used and reported in footnotes in the tables. The numbers of animals at risk have been taken from the data of counts of birds and mammals over the past 10-15 years, and the maximum number of each species has been used as the possible number of individuals at risk. As a result, it would be very unlikely that the numbers presented in the tables will represent the actual incidental take from the operation, but are the theoretical highest numbers. This is also necessary to be certain the operation would not exceed the incidental take permitted by the Migratory Birds Program.

5.5.3.1 Seabirds

All species of seabirds on Lehua are protected under the MBTA. The potential for seabird exposure to the rodenticides on Lehua would be limited. Consumption of bait pellets by adults would not be a risk, as all species are carnivorous, feeding fish, squid, eggs, or crustaceans. All of the 23 species reported from Lehua (Appendix A, Table 4), except black noddies (*Anous minutus*) and great frigatebirds (*Fregata minor*), forage many kilometers away from the island.

Frigatebirds (*Fregata minor*) are at risk of secondary poisoning from scavenging and a maximum of 350 birds have been reported on Lehua July 2002. These birds are known to take unattended seabird chicks, thus there would be potential for scavenging or predation of rats that are dead or dying from ingestion of rodenticide. However, several factors reduce the risk of frigatebirds preying or scavenging on intoxicated rats. First, exposure risk would be relatively low because most rats dying from anticoagulant rodenticide do so in areas inaccessible to avian predators (Lindsey and Mosher 1994). Second, while the behavior of foraging on land (i.e, preying on chicks) is documented, it does not appear to be normal (Megyesi and Griffin 1996).

Black noddies forage within a few meters of the shore and are at risk of secondary poisoning if small intoxicated reef fish are consumed. Surveys indicate approximately 400 birds could be present in July.

Primary poisoning would be a potential risk for some species of seabird chicks. Eight species of seabirds have recently nested on the island: Laysan albatross (*Phoebastria immutabilis*), black-footed albatross (*Phoebastria* nigripes), Bulwer's petrel (*Bulweria bulwerii*), wedge-tailed shearwater (*Puffinus pacificus*), red-tailed tropicbird (*Phaethon rubricauda*), brown booby (*Sula leucogaster*), red-footed booby (S. sula), and black noddy. Of these eight reported breeders, all except black-footed albatrosses are likely to have young in the nest during the period when bait would be on the ground; however, only Laysan albatrosses and red-tailed tropicbirds are at risk ingesting bait pellets. In July, the maximum number of albatross chicks reported was four and active tropicbird nests were 200. By August, no albatross chicks have been reported to be present and active nests of tropicbirds declined to 40.These species nest on the ground and their chicks are known to peck at or eat objects found on the ground such as rocks, sticks, and foreign objects (i.e., pica behavior). The other species are either not known to exhibit pica or their nest locations (e.g., in trees/shrubs or burrows) minimize the likelihood chicks would access bait pellets.

Although, there would be potential for black noddies to forage on fish exposed to rodenticide, the overall potential that this would occur is low. The relatively small quantity of bait that would enter the water and rapid degradation and dispersion of the rodenticide would combine to greatly reduce the probability of a noddy being exposed to an intoxicated marine fish or invertebrate. This is supported by results from post-application sampling of the near shore marine environment from two eradication projects in Hawai‘i. They found no detectable levels of diphacinone in fish, invertebrates, or seawater (Gale, Tanner, and Orazio 2008; Orazio et al. 2009). For brodifacoum, the amount of exposed fish to cause toxic effects would be much lower, but still would require consuming approximately ¼ of the body weight of a seabird ingesting intoxicated prey in a single day. During rat eradication on Palmyra Atoll, the carcasses of 12 seabirds were recovered (two sooty terns [*Onychoprion fuscatus*], six red-footed boobies, and one black noddy). None of these were confirmed to have died from ingesting brodifacoum, which is noteworthy considering the permitted application rate was six times higher than normal and what is proposed for Lehua (Pitt et al. 2015). Finally, in the event a bird foraged on intoxicated prey in the near

shore environment, it would need to consume about 9 times its normal daily intake for several days to receive the lowest lethal dose (LLD) of diphacinone (Table 1).

For secondary risks associated with pica, objects within about 1 meter of the nest would be accessible to a Laysan albatross chick. In that 2.6 m^2 area, about 8 g (5 pellets) of diphacinone bait and about 5 g (5 pellets) of brodifacoum bait would be available under the proposed application rate. A chick weighing 2,000 g would have to ingest about 95 g (63 pellets) of diphacinone bait per day for three days to receive an LLD. To receive a sublethal dose of diphacinone an albatross chick would need to ingest about 10 g (6.5 pellets) per day for three days. For brodifacoum, an albatross would need to ingest about 16 g (16 pellets) for a lethal dose and about 2 g (2 pellets) for a sublethal dose.

For a red-tailed tropicbird, objects within 0.6 m of its nest center would be within its reach. In that 1.4 m^2 area, up to 4 g (3 pellets) of diphacinone bait or about 3g (3 pellets) of brodifacoum bait would be available under the proposed application rate. A chick weighing 660 g would have to ingest about 31 g (21 pellets) of diphacinone bait each day for three days to receive an LLD. To receive a sublethal dose of diphacinone a tropicbird chick would need to ingest about 3 g (2 pellets) every day for three days. For brodifacoum, a tropicbird would need to ingest about 5 g (5 pellets) for a lethal dose and about 0.5 g (½ pellet) for a sublethal dose.

The above risk of primary exposure for both albatrosses and tropicbirds would likely be an over-estimate primarily because most bait pellets from the first application would be rapidly consumed or cached by rats. Also, not all birds would pick up the bait and of those not all would ingest significant amounts. Furthermore, mitigation efforts (see section 5.2 Mitigation Measures) for albatross and tropicbird chicks would reduce exposure to almost zero.

While there would be potential for primary or secondary poisoning of Laysan albatross, red-tailed tropicbird, black noddy, and great frigatebirds, that risk would be low. No nontarget mortalities were documented in association with the rat eradication projects using broadcast application of diphacinone on Mōkapu (2008) and Lehua (2009) (Dunlevy and Swift 2010). During the rat eradication on Palmyra Atoll, the carcasses of five sooty terns (*Onychoprion fuscatus*), six red-footed boobies, and on black noddy were found. Of these,

Table 1: Primary and secondary toxicity of diphacinone and brodifacoum to seabirds on Lehua. Primary toxicity presented as grams of bait and secondary as grams of fish. "na" indicates that there is no feeding behavior for this pathway and no risk from a poisoning pathway. Active ingredient is represented as a.i.

Species	Body Wt (g)	Daily Food Intake (g)[1]	Diphacinone				Brodifacoum			
			LLD[2] (mg/kg)	LLD (mg of a.i.)	LLD[3] (g of bait)	LLD 2°[3] (g of fish)	LLD[4] (mg/kg)	LLD (mg of a.i.)	LLD (g of bait)	LLD 2°[4] (g of fish)
Black Noddy	130	29	7.1	0.92	na	793	0.2	0.026	na	22.4
Laysan Albatross Chick	2000	203	7.1	14.2	284	na	0.2	0.4	16	na
Red-tailed Tropicbird Chick[6]	660	87	7.1	4.7	94	na	0.2	0.13	5.2	na

[1]Daily food intake calculated from allometric equation (Bird Feeding Rate = 0.059 x (W)0.67)(EPA 1995).
[2]Lowest lethal dose (LLD) of diphacinone based on the mortality of a single duckling in a 3-day feeding trial at 7.1mg/kg bwt (Long et al. 1992).
[3]Fish contamination based on highest reported values of mullet consuming bait pellets in Palmyra Atoll lagoon, 1.16mg/kg in whole fish (Pitt et al. 2015)..
[4]LLD of brodifacoum based on mortality of mallard ducklings at the lowest dose, 0.2mg/kg bwt (Ross, Roberts, and Fairley 1980).

only one tern and one booby were found to be contaminated with brodifacoum (Pitt et al. 2015) and the mode of exposure was unclear. The authors speculated that was the pathway of rodenticide contamination resulted from the collision and not ingestion. The tern was found in the bait hopper and the liver of the booby had no residues (the tern's liver could not be recovered), which indicates the bait was not eaten.

Based on the above analysis, it would be unlikely that any black noddies or great frigatebirds would be killed or sublethally affected by secondary exposure to either diphacinone or brodifacoum from Alternative 2. It would also be unlikely any Laysan albatrosses or red-tailed tropicbirds would be killed or sublethally affected by primary poisoning from diphacinone or brodifacoum.

In 2002, there were an estimated 23,000 wedge-tailed shearwater nests on Lehua. More recently, active shearwater nests have numbered around 2,000. While exposure to rodenticide would not be a concern, there would be potential for ground operations to impact shearwater adults, chicks, or eggs by accidentally collapsing burrows or disturbing adults or chicks. During months of pre-planning surveys on Lehua, field crews have observed that most nesting

seabirds do not visibly react to the presence of ground personnel. During night activities, shearwaters have been observed to react to personnel by moving a few feet away from the person. Ground crews have been very successful at minimizing impacts to shearwater nests using the protocols described in section 5.2 Mitigation Measures. By adhering to these protocols during ground operations it would be likely that 10 or fewer shearwater burrows would be collapsed, which would then be cleared and repaired as described above (see section 5.2 Mitigation Measures). All other seabirds on the Lehua nest in trees or shurbs, or are easily visible, thus avoidable, and are not vulnerable to trampling. Based on these data, ground operations are not likely to impact any species of seabird.

During the 2015 aerial bait trials on Lehua (Mazurek 2015), field crews noted that seabirds were not disturbed (e.g., flushing) due to helicopter operations, thus impacts from disturbance would not be likely to impact seabirds. However, air operations would be expected to kill some seabirds. Nocturnal seabirds would not be at risk. Based on the data from the eradication operation on Palmyra, there would be a low likelihood that 6 species of seabirds would be killed from helicopter collisions under Alternative 2: 2 black noddies (1-diphacinone application/1-brodifacoum application), 7 brown boobies (4/3), 2 red-footed boobies (1/1), 3 red-tailed tropicbirds, 8 white-tailed tropicbirds (5/3), and 8 great frigatebirds (5/3) (Appendix I, Table 1). These numbers represent a worst-case scenario based on maximum numbers of birds documented on Lehua and high probabilities of collision with the helicopter.

Due to the low number of anticipated mortalities relative to their overall population levels, Alternative 2 would be unlikely to directly impact seabird populations on Lehua. Mitigation measures would not be a factor in reducing the significance of the impact. Eradication of rats would be expected to indirectly benefit several species of seabirds. Predation from rats on Lehua is thought to be suppressing reproduction of small ground-nesting species such as Bulwer's petrel, brown noddy (*Anous stolidus*), gray-backed tern *(Onychoprion lunatus*), and sooty tern (*Onychoprion fuscatus*). Elimination of predation from invasive mammals would allow these species, and others, to return to the island and increase their population sizes. The eventual population-level benefits to seabirds from eradication of rodents on Lehua far outweigh the small number of potential mortalities that might occur through implementation of Alternative 2.

5.5.3.2 Shorebirds

Of the five species of shorebirds documented on Lehua, only three are considered in the affects analysis. The bristle-thigh curlew and red phalarope have only been recorded once each in surveys spanning from 1931 to 2016 and because of their relative rarity are not at risk from Alternative 2.
The Pacific golden-plover, wandering tattler, and ruddy turnstone are regularly seen on Lehua. The highest recorded numbers for each of these species during July and August is 5 Pacific golden-plovers, 9 ruddy turnstones, and 3 wandering tattlers. Higher numbers of plovers have been recorded in October (19) and April (20) and 59 turnstones were recorded in April. The lower numbers of birds seen in summer is due to the majority of individuals of these species departing Hawai‘i for their breeding grounds in late spring and returning late summer.

These three species primarily consume a wide range of invertebrate and possibly vertebrate prey, which makes secondary poisoning a potential risk. Each is also documented to consume foods comprised of vegetable matter (natural and man-made); however, this is usually a minor component of the diet, making primary poisoning a relatively low risk.

Table 2 indicates that none of these three species of shorebirds would be at lethal risk from secondary poisoning from diphacinone. Plovers, which are the smallest of the shorebirds, would need to eat about 85 g of contaminated insect prey per day for three days to ingest a lethal dose. Turnstones and tattlers would require 101 and 93 g, respectively. These values are three to four times the normal daily intake for these species (Table 2). However, to ingest a lethal dose of brodifacoum, any of the three shorebirds would only need to eat between 7 to 9 g of contaminated invertebrates on a single day.

The data in Table 2 indicate that each species of shorebird would only need to consume 5 to 6 g (3 to 4 pellets) of diphacinone bait per day for three days to ingest a lethal dose. This would amount to approximately 25% of its daily food intake, which greatly exceeds the normal intake of non-animal matter.The lack of non-target deaths of birds from the unsuccessful rat eradication on Lehua supports the analysis that indicates impacts to shorebirds from diphacinone may not be significant (Dunlevy and Swift 2010); however, carcasses could have gone undetected.

For brodifacoum, a lethal dose for primary poisoning for plovers and tattlers would require less than 1 g (<1 pellet) of bait in a single day. Results from

Table 2: Primary and secondary toxicity of diphacinone and brodifacoum to shorbirds on Lehua. Primary toxicity presented as grams of bait and secondary as grams of invertebrate prey. Active ingredient is presented as a.i.

Species	Body Wt (g)	Daily Food Intake (g)[1]	Diphacinone				Brodifacoum			
			LLD[2] (mg/kg)	LLD (mg of a.i.)	LLD (g of bait)	LLD $2^{o(3)}$ (g of prey)	LLD[4] (mg/kg)	LLD (mg/bird)	LLD (g of bait)	LLD $2^{o(3)}$ (g of prey)
Pacific Golden Plover	110	22	7.1	0.78	15.6	256	0.2	0.022	0.88	7.2
Ruddy Turnstone	130	23	7.1	0.92	18.4	302	0.2	0.026	1.04	8.5
Wandering Tattler	120	22	7.1	0.85	17.0	279	0.2	0.024	0.96	7.6

[1]Daily food intake calculated from allometric equation (Bird Feeding Rate = 0.059 x (W)0.67) (EPA 1995).
[2]Lowest lethal dose (LLD) of diphacinone based on the mortality of a single duckling in a 3-day feeding trial at 7.1mg/kg bwt (Long et al. 1992).
[3]Cockroach contamination based on highest reported value of 3.05 mg/kg(Pitt et al. 2015).
[4]LLD of brodifacoum based on mortality of mallard ducklings at the lowest dose, 0.2mg/kg bwt (Ross, Roberts, and Fairley 1980).

Palmyra Atoll indicate that non-target deaths of shorebirds are a concern (Pitt et al. 2015). Carcasses of four species of shorebirds were found during the operation and high levels of brodifacoum residues were found in the whole body tissues and livers of all specimens, the latter indicating rodenticide ingestion.

Based on the above analysis, it would be unlikely any shorebirds would be sublethally impacted or killed by secondary poisoning from diphacinone. However, there would be a low likelihood that 1 to 10 plovers, 1 to 2 tattlers, and 1 to 5 turnstones would be sublethally impacted by direct ingestion of diphacinone. If diphacinone failed to eradicate rats and it was necessary to apply brodifacoum in the following year then it would be likely that 19 plovers, 3 tattlers, and 9 turnstones would be sublethally impacted or killed by either primary or secondary poisoning from brodifacoum during the operational window. There would also be a potential that brodifacoum would persist in the environment for at least a year and have impacts beyond the proposed operational window (Rueda et al. 2016; Pitt et al. 2015), such that any returning shorebirds would be at risk from secondary poisoning. Therefore, it would be a low likelihood that 1 plover and 50 turnstones would be killed in the three to six months following the application of brodifacoum. However, because of the high degree of site fidelity for birds on their

wintering grounds it would be likely that mortality of shorebirds from rodenticide poisoning would decline in subsequent months.

It would be unlikely ground operations associated with Alternative 2 would impact any shorebirds since no nesting occurs on the island. Air operations have the potential to disturb shorebirds, but observations from field personnel during pre-project surveys indicate this disturbance would be minor and may cause birds to temporarily flush from their location. Based on the data from the eradication operation on Palmyra, there would be a low likelihood that 2 species of shorebirds would be killed from helicopter collisions under Alternative 2: 2 golden plovers (1-diphacinone application/1-brodifacoum application) and 2 ruddy turnstones (1/1). (Appendix I, Table 1).

The potential numbers of shorebirds that could be killed from either rodenticide poisoning or aircraft collisions are not cumulative. Calculations are based on the maximum number of birds observed; therefore if an individual died from collision it would no longer be at risk from rodenticide exposure. These potential mortalities represent insignificantly small numbers relative to overall populations of these species represent a worst-case scenario based on maximum numbers of birds documented on Lehua, upper extremes of toxicity, and high probabilities of collision with the helicopter. Mitigation measures would not be expected to influence the significance of the action. Indirect effects from Alternative 2 would not be expected.

5.5.3.3 Passerines

Of the 12 species of passerines documented on Lehua (Appendix A, Table 4), only 6 would be considered in the affects analysis (Table 3). The spotted dove, northern cardinal, red avadavat, and sky lark have not been observed on Lehua in 7, 5, 7, and 70 years, respectively. The rock pigeon is an infrequent visitor and only one individual has been observed in the operational window. Because of their relative rarity these species would not be at risk from the Alternative 2.

In contrast, the zebra dove, mourning dove, house finch, house sparrow, African silverbill, and scaly-breasted munia are seen more regularly or in much higher numbers. Though more regular, only one to four house finches or mourning and zebra doves have been recently recorded during the operational window. More numerous are house sparrows, silverbills, and munias, with up to 72, 180, and 85 birds, respectively, seen during the operational window. No breeding of passerines on Lehua has been reported.

Mourning doves, finches, silverbills, and munias are primarily granivorous, while zebra doves and sparrows are both granivorous and insectivorous (primarily nestlings). Therefore, all six species are at risk of primary exposure and the latter two of secondary exposure. The data in Table 3 indicate that all species of passerines would be at risk of primary poisoning from both diphacinone and brodifacoum since birds would only need to eat a fraction of their normal daily food intake of bait to receive a lethal dose. With regard to secondary poisoning, diphacinone would not present a lethal risk to the zebra dove and sparrow, but brodifacoum would. Based on the above data, it would be possible that 1 to 2 mourning doves, 3 to 7 zebra doves, 45 house finches, 72 house sparrows, 85 scaly-breasted munias, and 180 silverbills could be killed by ingestion of diphacinone. If diphacinone failed to eradicate rats and it was necessary to apply brodifacoum in the following year then it would be likely that 1 zebra dove, 1 to 2 house finches, 1 to 3 house sparrows, 2 to 4 scaly-breasted munias, and 5 to 9 silverbills would be killed by either primary

Table 3: Primary and secondary toxicity of diphacinone and brodifacoum to passerines on Lehua. Primary toxicity presented as grams of bait and secondary as grams of invertebrate prey. "na" indicates that there is no feeding behavior for this pathway and no risk from a poisoning pathway. Active ingredient is represented as a.i.

Species	Body Wt (g)	Daily Food Intake (g)[1]	Diphacinone				Brodifacoum			
			LLD[2] (mg/kg)	LLD (mg of a.i.)	LLD (g of bait)	LLD 2°[3] (g of prey)	LLD[2] (mg/kg)	LLD (mg of a.i.)	LLD (g of bait)	LLD 2°[4] (g of prey)
Mourning Dove	128	19	7.1	0.91	18.2	na	0.2	0.032	1.3	na
Zebra Dove	72	12	7.1	0.51	10.2	27.8	0.2	0.014	0.56	4.6
House Sparrow	32	5.8	7.1	0.23	4.6	75	0.2	0.006	0.24	2
House Finch	21	4.4	7.1	0.15	3	na	0.2	0.0042	0.17	na
Scaly-breasted Munia	9.5	2	7.1	0.067	1.34	na	0.2	0.002	0.08	na
African Silverbill	10	2.1	7.1	0.071	1.42	na	0.2	0.002	0.08	na

[1]Daily food intake calculated from allometric equation (Bird Feeding Rate = 0.059 x (W)0.67)(EPA 1995).
[2]Lowest lethal dose (LLD) of diphacinone based on the mortality of a single duckling in a 3-day feeding trial at 7.1mg/kg bwt (Long et al. 1992).
[3]LLD based on lowest reported avian toxicity (Erickson and Urban 2004).
[4] LLD of brodifacoum based on mortality of mallard ducklings at the lowest dose, 0.2mg/kg bwt (Ross, Roberts, and Fairley 1980).

or secondary poisoning from brodifacoum. These numbers represent worst-case scenarios based on maximum numbers of birds documented on Lehua and upper extremes of toxicity.
It would be unlikely ground operations associated with Alternative 2 would impact any passerines. While no nesting of these species has been recorded, all, either exclusively or preferentially, nest in trees or shrubs, so trampling of nests would not be a concern. Air operations have the potential to disturb passerines, but observations from field personnel during pre-project surveys indicate this disturbance would be minor and may cause birds temporarily flush from their location. It would also be unlikely helicopter operations would cause any impact (Appendix I, Table 1). During the operations on Palmyra, all collisions were with seabirds and shorebirds.

The potential mortalities that would be expected to result from Alternative 2 represent insignificantly small numbers relative to overall populations of these species. Mitigation measures would not be expected to influence the significance of the action. Indirect effects from Alternative 2 would not be expected.

5.5.3.4 Predatory Birds

Predatory birds documented on Lehua include two non-natives, the barn owl (*Tyto alba*) and cattle egret (*Bulbucus ibis*), and three natives, the peregrine falcon (*Falco peregrinus*), black-crowned night-heron (*Nycticorax nycticorax*), and great blue heron (*Ardea herodius*). One falcon was observed in February 2002 and one great blue heron in 2000 and because their rarity are not considered in the effects analysis. The remaining three birds have been observed relatively frequently since 2002. Maximum numbers for the owl and heron are three and two, respectively. Whereas, 130 egrets have been observed during the operational window and nesting has been documented.

The likelihood of primary exposure to rodenticides would be very low. These birds are predators of animals. The relative importance varies with species all three predatory birds would consume, small mammals, birds, lizards, and invertebrates. They would also likely scavenge animals that succumbed to rodenticide. Because of their diets, secondary exposure would be a risk to these birds. The data in Table 4 indicate that each of these species would need to eat less than 50% of their normal daily food intake per day for three days to receive a lethal dose of diphacinone. For brodifacoum, that value would be less than 5% for one day.

Table 4: Secondary toxicity of diphacinone and brodifacoum to predatory birds on Lehua. Toxicity toxicity presented as grams of grams of rat liver. Active ingredient is represented as a.i.

Species	Body Wt (g)	Daily Food Intake (g)[1]	Diphacinone			Brodifacoum		
			LLD[2] (mg/kg)	LLD (mg of a.i.)	LLD 2°[3] (g of rat liver)	LLD[4] (mg/kg)	LLD (mg of a.i.)	LLD 2°[5] (g of rat liver)
Black-crowned night heron	730	110	7.1	5.2	142	0.2	0.146	5.03
Barn Owl	530	80	7.1	3.8	103	0.2	0.106	3.65
Cattle Egret	370	56	7.1	2.6	72	0.2	0.074	2.55

[1]Daily food intake calculated from allometric equation (Bird Feeding Rate = 0.059 x (W)0.67)(EPA 1995).
[2]Lowest lethal dose (LLD) of diphacinone based on the mortality of a single duckling in a 3-day feeding trial at 7.1mg/kg bwt (Long et al. 1992).
[34]Rat liver contamination based on residues in liver from carcasses (0.029mg/g liver) (Pitt et al. 2015).
[4]LLD based on lowest reported avian toxicity (Erickson and Urban 2004).
[5]Rat contamination based on residues in liver from carcasses (Pitt et al 2015).

Based on the above data, it would be likely that 1 owl, and up to 33 egrets would be killed or receive sublethal doses by consuming diphacinone intoxicated prey. If diphacinone failed to eradicate rats and it was necessary to apply brodifacoum in the following year then it would be likely that 2 herons, 3 owls, and 130 cattle egrets would be sublethally affected or killed by either primary or secondary poisoning from brodifacoum. There would also be a potential that brodifacoum would persist in the environment for at least a year and have impacts beyond the proposed operational window (Rueda et al. 2016; Pitt et al. 2015), such that any returning predatory birds may be at risk from secondary poisoning.

It would be unlikely ground operations would impact any predatory birds. Only egrets are known to breed on the island and none of the species nests on the ground. Air operations have the potential to disturb any of the predatory birds, but observations from field personnel during pre-project surveys indicate this disturbance would be minor and may cause birds to temporarily flush from their location. It would also be unlikely air operations would impact herons or owls due to their low numbers, but it would be likely that 5 cattle egrets (3 diphacinone application/2 brodifacoum application) would be killed or injured by collision with the helicopter (Appendix I, Table 1). These numbers represent a worst-case scenario based on maximum numbers of birds documented on Lehua, upper extremes of toxicity, and high probabilities of collision with the helicopter.

The potential numbers of predatory birds that could be killed from either rodenticide poisoning or aircraft collisions are not cumulative. Calculations are based on the maximum number of birds observed; therefore if an individual died from collision it would no longer be at risk from rodenticide exposure. Eradication of rats would eliminate the major prey item of barn owls, which indirectly would likely reduce their numbers and frequency of occurrence on Lehua. The potential mortalities that would be expected to result from Alternative 2 represent insignificantly small numbers relative to overall populations of these species. Mitigation measures would not be expected influence the significance of the action. Indirect effects from Alternative 2 would not be expected.

5.5.3.5 Herpetofauna

The only known terrestrial reptiles or amphibians present on Lehua Island are non-native: the snake-eyed skink and house gecko. Caum (1936) observed that geckos were scarce and skinks were common, whereas recent anecdotal observations from field personnel indicate that the population numbers are low. However, the diurnal skink is cryptic and the nocturnal gecko could go unobserved if night surveys were not conducted.

No mortality of herpetofauna associated with the use of diphacinone has been recorded to date and one study indicates reptiles appear to be relatively insensitive to anticoagulant rodenticides (e.g., brodifacoum) compared to birds or mammals (Weir et al. 2015). This finding is supported by evidence from New Zealand, where brodifacoum has been extensively used in areas occupied by a wide range of herpetofauna, with no reports of reptiles or amphibians poisoned with brodifacoum (Eason and Spurr 1995). However, on Round Island Mauritius, Telfair's skinks (*Leiolopisma telfairii*) that ate rain-softened brodifacoum pellets broadcast in an eradication project were found dead (Merton 1987 in Eason and Spurr 1995). Telfairs's skinks are known to eat seeds and fruit. Analyses of the skink carcasses revealed brodifacoum concentrations in the liver of 0.6 mg / kg. Neither the snake-eyed skink nor the house gecko on Lehua would be likely to consume pellets. Both species eat invertebrates and the gecko also consumes sap or nectar.
Because of the apparent relative insensitivity of reptiles to anticoagulants and low toxicity of dipahcinone, it would be unlikely skinks or geckos would be killed by diphacinone poisoning. The situation with brodifacoum is more unclear. However, when the above data are taken *in toto*, the risk of killing skinks or geckos from brodifacoum poisoning would be unlikely. If any mortality were to occur, population level effects are highly unlikely. Removal

of rats from Lehua would eliminate rat predation on both skinks and lizards and likely lead to an increase in their numbers on the island. In New Zealand and Round Island, lizard numbers have increased following eradication efforts (Eason and Spurr 1995 and references therein).
While negative impacts to the lizards are unlikely, it would be likely lizards would consume invertebrates feeding on the pellets, which would then pose a secondary poisoning risk to birds on Lehua that may eat the lizard (see sections 5.5.3.2, 5.5.3.4, and 5.5.3.6). Because of reptiles' relative insensitivity to anticoagulant rodenticide they may be able to accumulate relatively high sublethal residues. On Pinzon Island, native lava lizards (*Microlophus duncanensis*) were found to maintain brodifacoum residues in their liver more than 800 days after the last application of a rat eradication project (Rueda et al. 2016). This resulted in the deaths of some raptors.

Alternative 2 would be unlikely to impact the lizard fauna on the island and mitigation measures are not a factor in this determination. Removal of rats from Lehua would indirectly eliminate rat predation on lizards and potentially lead to an increase in their numbers on the island.

5.5.3.6 Invertebrates

Terrestrial invertebrates can accumulate anticoagulant rodenticide residues. It has been suggested that anticoagulant rodenticides, such as diphacinone and brodifacoum, are not likely to affect invertebrates because their blood clotting mechanisms are different from those of vertebrates (Shirer 1992 in Eason and Spurr 1995). However, the toxicity of anticoagulants may differ across of groups of invertebrates. Brodifacoum is highly toxic to *Daphnia magna*, an aquatic invertebrate, with an EC_{50} of 0.98 ppm after 48 hours (US EPA 1998). Most hard-bodied terrestrial invertebrates (e.g., crabs, cockroaches, beetles) appear to be relatively insensitive (Booth et al. 2003, references therein; Morgan et al. 1996; but see Pitt et al. 2015). There is evidence that brodifacoum may be more toxic to soft-bodied terrestrial invertebrates than hard-bodied species (Booth et al. 2003 and references therein). In a laboratory study, two species of land snail (*Pachnodus silhouettanus, Achatina fulica*) died in 72 hours when exposed to doses ranging from 0.01 to 0.04 mg (Gerlach and Florens unpubl. in Booth et al. 2003). In another lab study, brodifacoum equivalent to 5 and 10 mg a.i. / kg was found to cause 100% mortality of earthworms (*Apporectodea calignosa*) (Booth et al. 2003). However, to affect this level of mortality it was necessary to grind pellets and mix with the soil, a scenario that would be unlikely to occur in the field. In general, most invertebrate species are not known to be susceptible to toxic

effects from the use of brodifacoum in the field (Booth et al. 2003; Hoare and Hare 2006).

Alternative 2 would be unlikely to directly affect any terrestrial invertebrates on the island and mitigation measures are not a factor in this determination. Removal of rats from Lehua would indirectly eliminate rat predation on invertebrates and potentially lead to an increase in their numbers on the island.

5.5.3.7 Plants

There are 22 native plant species on Lehua. No protected species of plants are known to be established. However, in 2007/8, fruiting was observed in outplanted adults of the federally-listed *Canavalia napaliensis* prior to their dying; therefore, viable seeds may be present in the soil (Michael DeMotta, personal communication, NTGB, 2016).

Plants are not known to be susceptible to toxic effects from rodenticides, nor are they anticipated to be affected by helicopter operations. However, there would be potential for trampling of some plants as a result of ground-based operations. Trampling of *Canavalia napaliensis*, if was to sprout from the seedbank and be present on Lehua during the operation would be mitigated (see section 5.2 Mitigation Measures). Therefore, no direct effects would be likely to occur from the proposed operation. Positive indirect effects from Alternative 2 would be expected. Rat removal would be expected to result in an increase in the number and diversity of native plants growing on Lehua. The nature of the changes to the plant composition would be complex and it is uncertain how native plants would respond compared to non-native plants under potentially increased competition and reduced predation (Eijzenga 2011).

5.5.4 Impacts to Marine Biota

5.5.4.1 Hawaiian Monk Seals

Around 15 monk seals could be present on Lehua during the proposed operation. They forage entirely at sea in offshore areas and at depths of up to 500 meters in coral beds (NMFS and NOAA 2007). Monk seals sometimes spend days at sea before returning to the islands where they sleep and digest their food. Spiny lobster, eels, flatfish, scorpaenids, larval fishes, and octopus are the most commonly consumed prey. Because they do not forage on land, direct consumption of bait pellets from the ground would not be a risk. Bait pellets that drift into the water would fall close to the shoreline far from the

typical foraging area of monk seals. Monk seals were found not to interact with pellets during a placebo trial on Lehua in 2015 (Mazurek 2015). Moreover, bait pellets degrade quickly in water and fragments sink to the bottom, so would only be available to monk seals for a very short period of time.

Fish have been demonstrated to be intoxicated with anticoagulant rodenticide that has entered the ocean directly or indirectly from spills and eradication projects (Primus, Wright, and Fisher 2005; Pitt et al. 2015). In the 2015 placebo trial, 19 species of fish in the near shore environment consumed the baits (Mazurek 2015). However, post-application sampling of the near shore marine environment from two eradication projects in Hawai‘i found no detectable levels of diphacinone in fish, invertebrates, or seawater (Orazio et al. 2009; Gale, Tanner, and Orazio 2008). Furthermore, because monk seals forage in offshore areas it would be unlikely they would prey on any fish that may have consumed rodenticide pellets. In the unlikely event a seal did forage in the near shore environment there would be a low probability it would encounter a fish that had consumed rodenticide.

Monk seals would only be at risk of secondary exposure to either diphacinone or brodifacoum in the unlikely event that a very large quantity of bait was accidently dropped into the ocean and fish were able to consume it before ocean currents dissipated the spilled bait. However, a 100 kg juvenile seal would have to eat 10-40 kg (22-88 lbs) of intoxicated fish to receive the calculated lethal doses. Monk seals normally consume 5.8 to 12.9% of their body weight per day. For a 100 kg juvenile that would correspond to around 6 to 13 kg / day, which would require that almost the entire daily food ration be comprised of intoxicated fish.

Based on the above data, it would be unlikely that Alternative 2 would primarily or secondarily expose monk seals to a sufficient quantity of rodenticide to have any negative effects. There have been no documented cases of impacts to seals or sea lions after aerial bait application, including the 2009 bait application on Lehua Island. Air and ground-based operations have the potential to cause monk seals move or to flush into the ocean. These impacts would be short-lived and negligible and have been determined as “not likely to adversely affect”. Mitigation measures (section 5.2) would be a factor in reducing impacts on monk seals. Indirect effects from Alternative 2 would be unlikely.

5.5.4.2 Sea Turtles

The federally protected green sea turtle is rarely observed around Lehua. On 10 visits from 2001 to 2004, one individual was spotted swimming in the surrounding waters (Wood et al. 2004). There are no records of sea turtles nesting on Lehua or hauling-out onto shore. This is likely due to the absence of nesting habitat (i.e., sandy shores) and lack of loafing sites.

Adult green sea turtles are herbivores, feeding on seaweeds, seagrasses, and algae (NMFS and USFWS 1998). Juveniles are omnivores, eating a range of insects, crustaceans, worms, and seagrasses. Sea turtles are also reported to feed on marine debris (Schuyler et al. 2014).

Green sea turtles could potentially eat baits that drift into the water. However, it would be very unlikely this would occur given the uncommon occurrence of green sea turtles around Lehua, the low probability of bait entering the water, the rapid decomposition of bait in water, and evidence that reptiles are relatively insensitive to rodenticides. Therefore, there would likely be "no affect" sea turtles from Alternative 2. Mitigation measures are not a factor in this determination. Indirect effects to sea turtles also would be very unlikely.

5.5.4.3 Fish, including Essential Fish Habitat

The likely pathways for contamination of fish would be through primary and secondary exposure. A potential, but unlikely, pathway would be absorption through skin or gills (Empson and Miskelly 1999). Bait pellets dissolve quickly in the near shore environment, often within 15 to 30 minutes (see section 5.5.2.1) and the concentration of rodenticide in sea water would be at undetectable levels and would pose no risk to fish. Of the 48 species of fish documented to occur around Lehua, 29 were found to consume inert bait pellets and another 7 species made contact with the bait, but did not consume it (Mazurek 2015). In this trial with inert baits, pellets were applied at a rate of equivalent to 733 kg / ha, which is more than 24 times higher than the maximum rate proposed for this eradication project. In a similar trial, in New Zealand, three species of fish were seen to eat non-toxic baits (Empson and Miskelly 1999).

While the 2015 bait trial demonstrated that fish would consume inert bait, a recent laboratory studies showed that black triggerfish (*Rhinecanthus aculeatus*), smallmouth bass (*Micropterus dolomieu*) and fathead minnows (*Pimephales promelas*) refuse to eat bait pellets containing diphacinone (USGS Columbia Environmental Research Center). When diphacinone (bait

or a.i.) is administered by gavage, the fish rapidly regurgitate the material (R. Riegerix, personal communication, USGS/University of Missouri-Columbia, 2016), which indicates that some fish species can detect and avoid bait containing diphacinone. Results from aquarium trials associated with the Kapiti Island, New Zealand, rat eradication found similar results using brodifacoum (Empson and Miskelly 1999). Three species of fish, variable triplefin (*Forsterygion varium*, 24 individuals), spotty (*Notolabrus celidotus*, 30), and blue cod (*Parapercis colias*, 6) were presented with bait pellets containing 0.002% brodifacoum. Of the 60 total fish, only 6 spotties were seen to eat the bait, with one dying from brodifacoum poisoning. Several fish died that did not eat the baits, and no brodifacoum residues were found in their livers. The authors speculated the fish may have absorbed the chemical through their skins or gills. When small quantities of brodifacoum bait entered the marine environment during aerial application operations on Anacapa Island and Isabel Island, Mexico no marine organisms (fish or invertebrates) were observed to consume the bait (Howald et al. 2009; Samaniego-Herrera et al. 2014). In the Kapiti Island trials, three species of fish were seen to eat the non-toxic bait within 15 minutes of entering the marine environment (Empson and Miskelly 1999)

Given the relatively small amount of bait that would be expected to enter the marine environment, the rapid dissolving of pellets, and that fish appear to avoid diphacinone, it appears consumption of rodenticide baits would be unlikely. In the unlikely event of fish ingesting diphacinone, the study on black triggerfish, smallmouth bass, and fathead minnows indicate that they are relatively insensitive to the effects of diphacinone (R. Riegerix, personal communication, USGS/University of Missouri-Columbia, 2016); however, diphacinone is considered moderately toxic to rainbow trout (*Oncorynchus mykiss*, 96 hour LC_{50} 2.6 µg/g) and bluegill sunfish (*Lepomis macrochirus*, 7.5 µg/g) (US EPA 1998).

Secondary exposure of fish to diphacinone around Lehua would be a potential risk; however, two studies conducted in conjunction with the 2008 Mōkapu and 2009 Lehua rat eradication projects indicate that the risk would be extremely low (Orazio et al. 2009; Gale, Tanner, and Orazio 2008). Within days of the last aerial broadcast of diphacinone pellets, samples were collected of fish, invertebrates, and seawater and none of the species sampled showed detectable levels of diphacinone in their tissues. On the Anacapa Island project, 6 species of intertidal organisms (fish and invertebrates) were

sampled 15, 30, 90 days post-application and all samples tested negative for brodifacoum residues (Howald et al. 2009).

Brodifacoum residues have been found in fish tissues after rat eradications. A review of rat eradication projects using brodifacoum found marine residue monitoring and analysis had been conducted in 10 applications between 1997 and 2011 (Masuda, Fisher, and Beaven 2015). Of the 10 applications, 1 detected brodifacoum residues in fish. Two of 65 fish sampled had residues, with concentrations 0.026 and 0.092 µg/g in the liver, which exceeded the 96 hour LC_{50} for rainbow trout (0.015 µg/g) and bluegill sunfish (0.026 µg/g) (US EPA 1998). Following the rat eradication on Palmyra Atoll, rodenticide residues were detected in all fish samples collected which included mullet fishes (*Moolgarda engeli* and *Liza vaigiensis*) and one puffer fish. Fish were found dead and collected opportunistically for this study (Pitt et al. 2015). Mullet fish contamination ranged from 0.058–1.160 µg/g (mean=0.337 µg/g) and the single puffer fish sample had 0.438 µg/g of brodifacoum in homogenized tissue.

The above examples demonstrate that marine fish can be contaminated during an aerial application of brodifacoum. However, it also demonstrates it is an infrequent occurrence. Furthermore, the environmental conditions related to above examples are not analogous to Lehua. The 3 New Zealand islands in Masuda et al. (2015) where brodifacoum residues were detected (Motuihe, Ulva, and Urupukpuka) are all surrounded by relatively shallow waters compared to Lehua (Appendix J) and land comprising Palmyra surrounds a relatively shallow lagoon. Additionally, the waters immediately surrounding these 4 islands are relatively calm, with the three New Zealand situated in protected bays and Palmrya enclosed by a fringing reef. In contrast, near shore environment of Lehua is exposed to the open ocean and experiences high wave action and strong currents (Appendix J). It is also noteworthy that the very large amount of brodifacoum used on Palmyra Atoll at 80 Kg/ha and 75 Kg/ha for the first and second application respectively, was unprecedented, which likely influenced the available brodifacoum residues consumed by non-target species. Following the accidental brodifacoum spill in New Zealand, with a higher energy coast, more like that found on Lehua Island, fish samples were collected and only one individual fish had detectable rodenticide residues (Primus, Wright, and Fisher 2005). In the above cases involving brodifacoum, it is unclear whether the fish exposure was primary or secondary.

Based on the above data, it would be unlikely a sufficient quantity of diphacinone or brodifacoum would enter the water or the pellets would remain intact, and in the environment, long enough to present an absorption or primary poisoning risk to any fish. It also would be unlikely that either rodenticide would contaminate sufficient prey of fish to pose a secondary poisoning risk to any fish. Mitigation measures are not a factor in this determination. Therefore, it would be unlikely that the Alternative 2 would directly or indirectly impact any fish. Alternative 2 would also be not "likely to adversely affect" essential fish habitat.

5.5.4.4 Algae

There are no known effects (or pathways) of anticoagulant rodenticides on marine algae and operations would not extend into the marine environment. Therefore, Alternative 2 would be unlikely to directly or indirectly impact marine algae.

5.5.4.5 Invertebrates and Corals

A variety of corals and marine invertebrates inhabit the waters around Lehua and there would be potential for these organisms to graze on or scavenge pellets, or to prey on animals that had done so. However the level of bait entering the near shore environment would be very low, pellets would dissolve quickly in the near shore environment, often within 15-30 minutes, and the rodenticide would be diluted rapidly (see section 5.5.2.1).

As noted above (see section 5.5.4.3) samples of fish, invertebrates (crabs and limpets), and seawater collected days after aerial application of diphacinone on Mōkapu and Lehua showed no detectable levels of diphacinone in their tissues (Orazio et al. 2009; Gale, Tanner, and Orazio 2008). Brodifacoum residues have been found in invertebrate tissues after rat eradications. A review of rat eradication projects using brodifacoum found marine residue monitoring and analysis had been conducted in 10 applications between 1997 and 2011 (Masuda, Fisher, and Beaven 2015). Of the 10 applications, 3 detected brodifacoum residues in invertebrates. Of the 196 invertebrates sampled, 11 had residues detected in their tissue, with concentrations ranging from 0.001 to 0.022 µg/g (mean =0.008 µg/g). On Palmyra, brodifacoum residues were found in fiddler crabs (*Uca tetragonon*) (Pitt et al. 2015).

In general, invertebrates appear to be relatively insensitive to anticoagulant rodenticides (Pain et al. 2000; Hoare and Hare 2006). However, on Palmyra Atoll some fiddler crabs may have died from as a result from brodifacoum

poisoning in conjunction with the rat eradication (Pitt et al. 2015). This would likely be an extreme situation given the six-fold increase in the normal application rate and the lagoon environment on Palmyra is not analogous to the conditions on Lehua, which experiences a high level of wave action. Primus et al. (2005) suggest mortality of marine invertebrates may have occurred as a result of a large spill of rodenticide containing brodifacoum. However, this situation would not be representative of how bait might enter and interact with the near shore environment in Alternative 2.

There are no data to indicate corals have been impacted by anticoagulant rodenticides from previous eradication projects. On Palmyra Atoll, no impact to corals was documented after the application of bait containing brodifacoum applied at the rate of 155 kg/ha (two applications) which greatly exceeds the rate of 27kg/ha proposed for Lehua (Wegmann 2017).

Based on the above data, it would be unlikely a sufficient quantity of diphacinone or brodifacoum would enter, or the pellets would remain intact, to present an absorption or primary poisoning risk to any marine invertebrates or corals. It also would be unlikely that either rodenticide would contaminate sufficient prey of marine invertebrates to pose a secondary poisoning risk to any fish. Therefore, it would be unlikely that Alternative 2 would impact any marine invertebrates or corals. Mitigation measures are not a factor in this determination. Indirect effects of Alternative 2 are unlikely as well.

5.5.5 Impacts on Cultural Resources

Aerial broadcast of bait pellets would have no negative effect on cultural sites due to the small size (about 1 to 2 g each) of the bait pellets. To ensure ground-based operations would have no impact on cultural sites mitigations would be implemented (see section 5.2 Mitigation Measures).

5.5.6 Impacts on Human Health and Safety

Implementation of Alternative 2 would not be expected to affect field personnel. Any rodenticide application would be done in strict accordance with EPA and Hawai‘i Department of Agriculture label guidelines. Applications would be carried out under the supervision of a certified pesticide applicator. Because access to the island is restricted, it would be unlikely the public would be directly exposed to the rodenticide pellets. Additionally, bait would degrade in a few weeks. As discussed above (see section 5.5.2.1), contamination of the marine environment from rodenticide would be unlikely.

There would be an increase in noise level from Alternative 2 associated with the use of the helicopter and the nearest community on Niʻihau is more than 10 km where helicopter operations would occur. During the operation signs would be placed on the island alerting visitors (e.g., fisherman, opihi harvesters, divers, and other recreationists) of the operation and the presence of rodenticide on the land and potentially in the near shore. However, there would be no moratorium imposed on harvesting marine organisms (see Section 5.2). This decision is based on a several factors. First, very little bait would be likely to enter the marine environment during operations, and that which enter the water did would rapidly break down and be dispersed by the waves and currents (see Section 5.5.2.1). Second, when bait does enter the water fish appear reluctanct to consume it in sufficient quantities to accumulate detectable residue levels (see Section 5.5.4.3). Third, when fish and invertebrates have been found to be exposed to bait drift into the marine environment, brodifacoum residue levels are at, or below the NOAEL for the most sensitive mammals tested, which would be protective of humans (i.e., a dose or exposure level of a toxicant that produces no measureable toxic effects on the test group of animals, see Section 5.5.4.3). During periods when aerial operations are scheduled on Lehua and Niʻihau, the USCG will release a notice to mariners advising them to remain clear of the area to prevent hazardous interactions with operational crew and boaters.

Based on the above information, it would be unlikely for human health to be directly or indirectly impacted by Alternative 2. Mitigation measures would be factor reducing the quantity of bait entering the marine environment. Alternative 2 may have a minor impact on human recreation opportunities; however, this would be short-lived and insignificant.

5.5.7 Environmental Justice

Implementation of Alternative 2 would not be expected to adversely affect minority or low-income populations. There would be a minor disruption of activities immediately around Lehua during aerial operations, but this would only limit access to the waters around Lehua for a few days. Additionally, the project would provide short-term economic opportunity for members of the Niʻihau community since some would be hired to assist with logistics in the staging of the operation.

5.5.8 Introduction of Non-Native Species

5.5.8.1 Rat Eradication

The action of moving people, equipment, and supplies onto Lehua presents inherent risks of introducing non-native weeds, insects, rodents and other

vertebrates to the island. Although the island has introduced insects, plants, and rats, the introduction of new species or individuals of the same species should be avoided at all possible costs to prevent the further degradation of the island ecosystem. Adherence to strict biosecurity protocols (see Section 5.2 and Appendix H) would minimize the potential for introduction of non-native species to Lehua.

5.6 Alternative 3 - Rat Eradication with Brodifacoum

5.6.1 Restoration Efficacy

5.6.1.1 Rat Eradication

The restoration efficacy from Alternative 3 would be the same as under Alternative 2 (see Secton 5.5.1.1).

5.6.2 Impacts to the Physical Environment

5.6.2.1 Environmental Fate of Brodifacoum in Soil and Water

The environmental fate of brodifacoum in the soil and water from Alternative 3 would be the same as Alternative 2 (see Section 5.5.2.1).

5.6.3 Impacts to Terrestrial Biota

5.6.3.1 Seabirds

The impacts to seabirds from Alternative 3 would be similar to those under Alternative 2 (see Sectionn 5.5.3.1), with the exception that bird mortalities would be lower due to fewer bait applications, thus fewer flight hours and because under Alternative 2, seabirds would be killed under both the proposed diphacinone operation and a follow-up brodifacoum operation.. Because of this, there would be a low likelihood that 6 species of seabirds would be killed from helicopter collisions under Alternative 3: 1 black noddy, 3 brown boobiesred-footed boobies, 1 red-tailed tropicbird, 3 white-tailed tropicbirds, and 3 great frigatebirds (Appendix I, Table 1). These numbers represent a worst-case scenario based on maximum numbers of birds documented on Lehua and high probabilities of collision with the helicopter.

Due to the low number of anticipated mortalities relative to their overall population levels, Alternative 3 would be unlikely to directly impact seabird populations on Lehua. Mitigation measures would not be a factor in reducing the significance of the impact. Eradication of rats would be expected to indirectly benefit several species of seabirds. Predation from rats on Lehua is

thought to be suppressing reproduction of small ground-nesting species such as Bulwer's petrel, brown noddy (*Anous stolidus*), gray-backed tern *(Onychoprion lunatus),* and sooty tern (*Onychoprion fuscatus*). Elimination of predation from invasive mammals would allow these species, and others, to return to the island and increase their population sizes. The eventual population-level benefits to seabirds from eradication of rodents on Lehua far outweigh the small number of potential mortalities that might occur through implementation of Alternative 3.

5.6.3.2 Shorebirds

The impacts to shorebirds from Alternative 3 would be similar to those under Alternative 2 (see Section 5.5.3.2), with the exception that bird mortalities would be lower. This is because under Alternative 2, shorebirds would be sublethally affected or killed under both the proposed diphacinone operation and a follow-up brodifacoum operation.

As with Alternative 2, there would be a low likelihood that 2 species of shorebirds would be killed from helicopter collisions under Alternative 3: 1 golden plover and 1. (Appendix I, Table 1). These numbers represent a worst-case scenario based on maximum numbers of birds documented on Lehua, upper extremes of toxicity, and high probabilities of collision with the helicopter.

Under Alternative 3, it would be likely that 19 plovers, 3 tattlers, and 9 turnstones would be sublethally impacted or killed by either primary or secondary poisoning from brodifacoum during the operational window. There would also be a potential that brodifacoum would persist in the environment for at least a year and have impacts beyond the proposed operational window (Rueda et al. 2016; Pitt et al. 2015), such that any returning shorebirds would be at risk from secondary poisoning. Therefore, it would be a low likelihood that 1 plover and 50 turnstones would be killed in the three to six months following the application of brodifacoum. However, because of the high degree of site fidelity for birds on their wintering grounds it would be likely that mortality of shorebirds from rodenticide poisoning would decline in subsequent months.

The potential numbers of shorebirds that could be killed from either rodenticide poisoning or aircraft collisions are not cumulative. Calculations are based on the maximum number of birds observed; therefore if an individual died from collision it would no longer be at risk from rodenticide

exposure. These potential mortalities represent insignificantly small numbers relative to overall populations of these species. Mitigation measures would not be expected influence the significance of the action. Indirect effects from Alternative 3 would not be expected.

5.6.3.3 Passerines

The impacts to passerines from Alternative 3 would be similar to those under Alternative 2 (see Section 5.5.3.3), with the exception that bird mortalities would be lower. This is because under Alternative 2, passerines would be sublethally affected or killed under both the proposed diphacinone operation and a follow-up brodifacoum operation.

Under Alternative 3, it would be likely that 1 zebra dove, 1 to 2 house finches, 1 to 3 house sparrows, 2 to 4 scaly-breasted munias, and 5 to 9 silverbills would be killed by either primary or secondary poisoning from brodifacoum. These numbers represent a worst-case scenario based on maximum numbers of birds documented on Lehua and upper extremes of toxicity.

The potential mortalities that would be expected to result from Alternative 3 represent insignificantly small numbers relative to overall populations of these species. Mitigation measures would not be expected influence the significance of the action. Indirect effects from Alternative 2 would not be expected.

5.6.3.4 Predatory Birds

The impacts to predatory birds from Alternative 3 would be similar to those under Alternative 2 (see Section 5.5.3.4), with the exception that bird mortalities would be lower. This is because under Alternative 2, passerines would be sublethally affected or killed under both the proposed diphacinone operation and a follow-up brodifacoum operation.

Under Alternative 3, it would be likely that 2 herons, 3 owls, and 130 cattle egrets would be sublethally affected or killed by either secondary poisoning from brodifacoum. There would also be a potential that brodifacoum would persist in the environment for at least a year and have impacts beyond the proposed operational window (Rueda et al. 2016; Pitt et al. 2015), such that any returning predatory birds may be at risk from secondary poisoning. It would be likely that 2 cattle egrets would be killed or injured by collision with the helicopter (Appendix I, Table 1). These numbers represent a worst-case scenario based on maximum numbers of birds documented on Lehua, upper extremes of toxicity, and high probabilities of collision with the helicopter.

The potential numbers of predatory birds that could be killed from either rodenticide poisoning or aircraft collisions are not cumulative. Calculations are based on the maximum number of birds observed; therefore if an individual died from collision it would no longer be at risk from rodenticide exposure. These potential mortalities represent insignificantly small numbers relative to overall populations of these species. Eradication of rats would eliminate the major prey item of barn owls, which indirectly would likely reduce their numbers and frequency of occurrence on Lehua.

5.6.3.5 Herpetofauna

The impact on herpetofauna from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.3.5).

5.6.3.6 Invertebrates

The impact on terrestrial invertebrates from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.3.6).

5.6.3.7 Plants

The impact on terrestrial plants from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.3.7).

5.6.4 Impacts to Marine Biota

5.6.4.1 Hawaiian Monk Seals

The impact on monk seals from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.4.1).

5.6.4.2 Sea Turtles

The impact on sea turtles from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.4.2).

5.6.4.3 Fish, including Essential Fish Habitat

The impact on fish, including Essential Fish Habitat from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.4.3).

5.6.4.4 Algae

The impact on algae from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.4.4).

5.6.4.5 Invertebrates and Corals

The impact on marine invertebrates and corals from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.4.5).

5.6.5 Impacts on Cultural Resources

The impact on cultural resources from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.5).

5.6.6 Impacts on Human Health and Safety

The impact on cultural resources from Alternative 3 would be the same as under Alternative 2 (see Section 5.5.6).

5.6.7 Environmental Justice

The impact on cultural resources from Alternative 3 would potentially be greater under Alternative 2 (see Section 5.5.7). This is because there would be fewer applications, which may result in the Niʻihau community receiving less monetary compensation for their assistance with logistics in the staging of the operation.

5.6.8 Introduction of Non-Native Species

5.6.8.1 Rat Eradication

The impact on introduction of non-native species from Alternative 3 would potentially be less under Alternative 2 (see Section 5.5.8.1). While the biosecurity, protocols established for the proposed project are robust, the reduced number of applications under Alternative 3 inherently translates into a reduced risk of non-native species introduction.

6. Cumulative Effects

6.1 Consequences: Cumulative Impacts

6.1.1 Assessing Cumulative Impacts

The NEPA regulations require federal agencies to consider not just the direct and indirect impacts of an action but also the cumulative impacts to which an action would contribute. Analyzing cumulative impacts at Lehua requires consideration of other, unrelated impacts that are occurring simultaneously to those resources, impacts that have occurred in the past, or impacts that are likely to occur in the foreseeable future. The continued presence of rats is likely affecting many of the species on the atoll and the biogeochemical cycles that those species drive, but there are no other clear localized impacts known to be occurring today. Furthermore, there are no foreseeable future human actions on the atoll that are likely to negatively affect the island's environment, because the land is being managed in perpetuity as a seabird sanctuary. However, many of the species on Lehua may still be recovering from severe past impacts. Also, many of the species that use Lehua have large ranges. These far-ranging populations may have been affected in the past, may be currently experiencing unrelated impacts, or may be at risk of impacts from foreseeable consequences elsewhere in their ranges.

The following is a breakdown of the past, present, and foreseeable future actions that would likely contribute to the cumulative impacts associated with the three identified alternatives. Direct and indirect impacts from each alternative would be analyzed with the following list of activities to determine the cumulative impacts for the given alternative.

6.1.1.1 Past Actions

Past actions are actions that occurred in the past but have lasting impacts that could contribute to the impacts associated with the proposed action.

- Eradication of rabbits – In 2005 and 2006, rabbits were removed from Lehua by hunting and trapping. Because this operation did not use toxicants, cumulative effects of this previous operation and the proposed Pacific rat eradication are not expected.
- Failed rat eradication – In 2009, there was an attempt to eradicate rats from Lehua with the using aerial broadcast of diphacinone bait. Given the short half-life of diphacinone in soil (30-60 days), cumulative effects of the previous attempt are not expected. However, with the failure of the previous attempt and the impact of the rats on the island continued. Alternatives 2 or 3 would counter this impact from the

previous eradication attempt and would not negatively contribute to the impacts from the proposed action.

6.1.1.2 Current Actions

Current actions are actions that are occurring within the same timeframe as the proposed action, or within the planning and compliance phase of the proposed action, and could contribute to the impacts from the proposed action.

- Anthropogenic climate change - The areas of impact linked to global climate change that may have the potential to effect Lehua are warmer air temperatures and declines in rainfall *(University of Hawaii 2014)*.

6.1.1.3 Future Actions

Actions that are reasonably foreseeable in the future that could contribute to the cumulative impacts from the proposed action.

- Plant restoration – The State of Hawai‘i and NTBG may coordinate efforts to restore native plants to Lehua. This action could positively contribute to the cumulative impacts of the proposed action by improving habitat for native species and contributing to the overall restoration of the atoll.
- Anthropogenic climate change - The areas of impact linked to global climate change that may have the potential to effect Lehua are warmer air temperatures and declines in rainfall *(University of Hawaii 2014)*.

6.1.2 Cumulative Impacts under Alternative 1 – No-Action

Under the no-action alternative, the negative impacts that rats have on Lehua’s terrestrial system would continue in perpetuity. These impacts could be additive to other, unrelated future impacts on Lehua’s resources. The minor impacts that ongoing projects (primarily conservation related related) would have on the biological, physical, and cultural resources of Lehua are not likely to contribute to rat-related impacts. If rats persist on Lehua, the biological resources of the island would continue to be negatively affected.

6.1.3 Cumulative Impacts under Alternative 2 (Proposed Action) – Rat Eradication with Diphacinone, Followed by Brodifacoum (25ppm) if Necessary

There would be no major negative impacts to the biological, physical, or cultural resources of Lehua under Alternative 2. The minor negative impacts to biological, physical, and cultural resources as a result of Alternative 2 would not contribute to the impacts related to any separate, current, or future projects. Similarly, the expected positive impacts of Alternative 2 to Lehua's biological resources could contribute to the cumulative, positive impacts from separate, current, or future projects.

While the mitigation measures are important factors in reducing the number of individual species impacted by the operation, the non-significant determination is not reliant on the mitigation measures.

6.1.4 Cumulative Impacts under Alternative 3 – Same as Alternative 2, except using Brodifacoum alone

The impacts und Alternative 3 would be the less than those under Alternative 2. This is because Alternative proposes two distinct eradication operations, each with its separate impacts. If both operations were necessary, then the cumulative impacts from both would exceed the impacts from Alternative 3.

While the mitigation measures are important factors in reducing the number of individual species impacted by the operation, the non-significant determination is not reliant on the mitigation measures.

7. Determination

7.1 Evaluation of Significance

This EA has been evaluated for whether the proposed action will have a significant impact on the environment, DLNR considered the phases of the proposed action, the expected consequences, both primary and secondary, and the cumulative as well as short and long-term effects of the action. In addition, DLNR specifically evaluated the project under the following 13 significance criteria, as provided in HAR § 11-200-12:

The proposed actions do not involve an irrevocable commitment to loss or destruction of any natural or cultural resource. The actions will contribute to the restoration of a healthy native ecosystem on Lehua by eradicating nonnative rats.

The proposed actions will not curtail the range of beneficial uses of the environment. The activities proposed are intended to contribute to ecological restoration of the island and improve habitat for the native plants and nesting seabirds that inhabit or historically inhabited the island, prior to its degradation by invasive rats. Restoration of Lehua will thus improve the range of beneficial uses of the environment, including for endangered seabirds, Hawaiian monk seals and sea turtles.

The proposed actions will not conflict with the State's long-term environmental policies. The proposed actions will not conflict with the environmental policies set forth in HRS Chapter 343, the State's written and enforceable policies, and other statutes and regulations, since the proposed actions will not damage sensitive natural resources. Instead, they will improve the environment of Lehua.

The proposed actions will not substantially adversely affect the economic and social welfare of the community. The proposed activities utilize the most effective strategies to eradicate invasive rats as well as mitigating potential adverse impacts, thus contributing to the restoration of the ecosystem of Lehua. With ecosystem restoration, seabird populations will most likely increase and additional species will most likely return to Lehua, increasing its value as a State Seabird Sanctuary. Therefore, the proposed project will result in an improved environment, thus supporting eco-tourism and enhancing economic and social welfare.

The proposed actions will not substantially adversely affect the public health of the community. The rodenticides in the proposed action have been found to not have substantial impacts on water quality or on marine life that might be consumed by people.

The proposed actions will not involve substantial secondary impacts, such as population changes or effects on public facilities. Lehua is a small island designated as a State Seabird Sanctuary and is uninhabited and undeveloped. The project does not propose construction of public facilities or involve establishing a human population. Thus, the proposed actions will not affect any public recreational facilities and will not induce population growth or decline in the area.

The proposed actions will not involve a substantial degradation of environmental quality. The proposed action will not degrade Lehua Island. The restoration project will increase the environmental quality of the ecosystems of Lehua for its flora and fauna.

The proposed actions will not affect a rare, threatened or endangered species or its habitat. The operation will benefit native plant and animal species protected under the Federal and state endangered species laws. The limited and temporary human activities associated with the operation will have a negligible impact on listed species because either they will not be present or project actions combined with mitigation will result in no adverse impacts.

The proposed actions will not have cumulative impacts or involve a commitment for larger actions. The analyses show that the modified operation and mitigation measures integrated into the proposed actions, such as the use of diphacinone and conducting operations during the winter when presence of non-target and listed species is minimal, will result in no cumulative impacts. No other known or potential actions would contribute to or cause any cumulative impacts.

The proposed actions will not substantially affect air or water quality or ambient noise levels. The proposed actions are fully consistent with both Federal and State water quality laws and regulations. The helicopter will cause temporary noise for a period of up to six non-consecutive days during aerial application of rodenticides on Lehua, but the effect will be highly temporary and no people not associated with the operation are anticipated to be present during the operation.

The proposed project is not located in an environmentally sensitive area (e.g. flood plain, tsunami zone and coastal zone). Although the site is in a State Seabird Sanctuary, the proposed actions are in accordance with HAR 13-125, as well as Federal and State Coastal Zone Management policies and enforceable policies. All actions will protect sensitive resources, including the coastal zone while meeting ecological management objectives.

The proposed actions will not substantially affect scenic vistas and view planes identified or State plans or studies. The project does not involve construction of any permanent structures or alteration of landscapes. Thus, it will not affect any sites or vistas.

The proposed project will not require substantial energy consumption. The main affected area of Lehua Island is not on a local power grid. The only energy uses will be using motorized vehicles for accessing points of departure to the island and for applying bait via helicopter. Most work will be conducted during daylight hours.

7.2 Determination

Based on these findings and the assessment of potential impacts for the proposed project, the DLNR does not foresee that the proposed project will have any significant adverse impact on the existing natural, physical, or human environment, and has determined a finding of no significant impact (FONSI).

8. List of Preparers and Contributors

8.1 Preparers

U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
Reese Brand Phillips, PhD
Michael Fry, PhD
Ryan Peʻa
James Stanford

Hawaiʻi Department of Land and Natural Resources, Division of Forestry and Wildlife
Patrick Chee, JD

Island Conservation
Patty Baio

8.2 Contributors

U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office
Gregory Koob
U.S. Fish and Wildlife Service, Region 1
Kathleen Moynan

Hawaiʻi Department of Land and Natural Resources, Division of Forestry and Wildlife
Josh Atwood, PhD

Island Conservation
Greg Howald, PhD
Mele Khalsa

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Appendix A. Lehua Island Species Lists

Table 1. Vascular Plants on Lehua (adapted from Wood et al. 2004)
Symbols: Nat = Native V = Vulnerable P = Present
End = Endemic H = Historical (no longer present)
Int = Introduced

Group	Family	Species	Status	Presence
Angiosperms - Dicots	Aizoaceae	*Sesuvium portulacastrum*	Nat	P
	Asclepiadaceae	*Asclepias curassavica*	Int	P
	Asteraceae	*Ageratum conyzoides*	Int	P
		Artemisia australis	End	P
		Cirsium vulgare	Int	P
		Conyza bonariensis	Int	P
		Gamochaeta purpurea	Int	P
		Pluchea carolinensis	Int	P
		Pluchea indica	Int	P
	Portulacaceae	*Portulaca oleracea*	Int	P
		Portulaca pilosa	Int	P
		Portulaca villosa	End, V	H
	Primulaceae	*Anagallis arvensis*	Int	P
	Goodeniaceae	*Scaevola sericea*	Nat	P
	Solanaceae	*Solanum americanum*	Nat	P
	Sterculiaceae	*Waltheria indica*	Nat	P
	Urticaceae	*Pilea peploides*	Nat	P
	Verbenaceae	*Pluchea xfosbergii*	Int	P
		Sonchus oleraceus	Int	P
		Verbesina encelioides	Int	P
		Xanthium strumarium	Int	P
	Boraginaceae	*Heliotropium anomalum* var. *argenteum*	End	H
		Heliotropium curassavicum	Nat	P
	Cactaceae	*Opuntia ficus-indica*	Int	H
	Chenopodiaceae	*Chenopodium murale* L.	Int	P
	Convolvulaceae	*Ipomoea pes-caprae* subsp. *Brasiliensis*	Nat	H
		Jacquemontia ovalifolia subsp. *Sandwicensis*	Nat	P
	Cucurbitaceae	*Sicyos maximowiczii*	End	H
	Euphorbiaceae	*Chamaesyce hirta*	Int	P
	Fabaceae	*Prosopis pallida*	Int	P

Group	Family	Species	Status	Presence
		Lantana camara	Int	H
	Zygophyllaceae	*Tribulus cistoides*	Nat	P
Angiosperms - Monocots	Cyperaceae	*Cyperus javanicus*	Nat	P
		Cyperus polystachyos	Nat	H
		Fimbristylis cymosa subsp. *umbellato-capitata*	Nat	P
	Poaceae	*Cenchrus ciliaris*	Int	P
		Cenchrus echinatus	Int	P
		Chloris radiate	Int	P
	Poaceae	*Chloris virgata* Sw.	Int	P
		Digitaria ciliaris	Int	P
		Digitaria insularis	Int	P
		Eragrostis amabilis	Int	P
		Eragrostis variabilis	End	P
		Panicum fauriei var. *latius*	End	P
		Panicum pellitum	End	P
		Panicum torridum	End	P
	Malvaceae	*Abutilon grandifolium*	Int	P
		Sida fallax	Nat	P
	Nyctaginaceae	*Boerhavia repens*	Nat	P
	Oxalidaceae	*Oxalis corniculata* L.	Nat	P
	Papaveraceae	*Argemone glauca* var. *glauca*	End	P
		Heteropogon contortus	Nat	P
		Lepturus repens	Nat	P
		Setaria verticillata	Int	P
Pteridophytes	Dryopteridaceae	*Nephrolepis multiflora*	Int	P
	Pteridaceae	*Doryopteris decipiens*	End	P

Table 2. Lehua's Marine Algae (adapted from Wood *et al*. 2004)

Order	**Family**	**Species**
Cyanophyta	Oscillatoriaceae	*Lyngbya majuscule*
		Lyngbya semiplena
Chlorophyta	Anadyomenaceae	*Microdictyon setchellianum*
	Caulerpaceae	*Caulerpa racemosa* var. *peltata*
	Cladophoraceae	*Cladophora laetevirens*
	Codiaceae	*Codium edule*
	Dasycladaceae	*Neomeris vanbosseae*
Phaeophyta	Chordariaceae	*Chonospora minima*
		Hydroclathrus clathratus
	Dictyotaceae	*Dictyota bartayresiana*
		Dictyota sandvicensis
		Lobophora variegate
		Padina sanctae-crucis
		Padina sp.
	Sargassaceae	*Sargassum echinocarpim*
		Turbinaria ornate
	Scytosiphonaceae	*Colpomenia sinuosa*
	Scytothamnaceae	*Asteronema breviarticulatum*
	Sphacelariaceae	*Sphacelaria tribuloides*
Rhodophyta	Bonnemaisoniaceae	*Asparagopsis taxiformis*
		Falkenbergia hillebrandii
	Ceramiaceae	*Aglaothamnion boergesenii*
		Antithamnion antillanum
		Ceramium fimbriatum
		Ceramium flaccidum
		Griffithsia subcylindrica
		Gymnothamnion elegans
	Champiaceae	*Champia parvula*
	Corallinaceae	*Amphiroa rigida*
		Jania sp.
	Dasyaceae	*Dasya iridescens*
		Dasya murrayana
	Faucheaceae	*Halichrysis coalescens*
	Gelidiellaceae	*Gelidiella machrisiana*
	Phyllophoraceae	*Ahnfeltiopsis concinna*
	Plocamiaceae	*Plocamium sandvicense*
	Rhodomelaceae	*Amansia glomerata*
		Herposiphonia variabilis

Order	Family	Species
	Rhodymeniaceae	*Laurencia* sp. *Botryocladia skottsbergii* *Chrysymenia* sp.

Table 3. Lehua's Terrestrial Arthropods (adapted from Wood *et al*. 2004)
Symbols: Nat = Native End = Endemic Int = Introduced Unk = Unknown

Order	Family	Species	Status
Araneae	Clubionidae	*Chiracanthium mordax*	Int
	Lycosidae	Lycosid spider (*Lycos sp.*)	End
Blattodea	Blattellidae	*Simploce pallens*	Int
Collembola	Entomobryidae	*Entomobrya marginata*	Int
	Caribidae	*Aephinidius opaculus*	Int
		Gnathaphanus picipes	Int
	Coccinellidae	*Cryptolamus montrouzier*	Int
	Chrysomelidae	*Systena blanda*	Int
Coleoptera	Curculionidae	*Hypurus bertrandi*	Int
	Dermestidae	Carnivorous Beetle (*Dermestes frischi)*	Int
	Dytiscidae	*Rhantus psuedopacificus*	End
	Phalacridae	*Phalacrus sp.*	Int
	Scarabeidae	*Adoretus sinicus*	Int
		Aphodius lividus	Int
		Pollen Beetle (*Protaetia fusca*)	Int
	Tenebrionidae	*Gonocephalum adpressiforme*	Int
Dermaptera	Carcinophoridae	*Euborellia eteronoma*	Int
Diptera	Chloropidae	*Siphunculina striolata*	Int
	Ephydridae	Shore Fly (*Hecamede granifera*)	Int
		Shore Fly (*Ephydra gracilis*)	Int
		Shore Fly (*Scatella sexnotata*)	Nat
	Dolichopodidae	Long-legged Fly (*Hydrophorus pacificus*)	End
	Canacidae	Beach Fly (*Canaceoides hawaiiensis*)	End
		Beach Fly (*Canaceoides angulatus*)	Int
		Beach Fly (*Canaceoides sp.*	Unk
Heteroptera	Anthocoridae	*Orius sp.*)	Int
	Lygaeidae	*Graptostethus manillensis*	Int
		Seed Bug (*Nysius kinbergi*)	End
	Nabidae	*Nabis capisiformis*	Int
Homoptera	Cicadellidae	*Acinopterus angulatus*	Int
		Balclutha sp.	Unk
	Delphacidae	*Perkinsiella saccharicida*	Int
	Membracidae	*Vanduzeea segmentata*	Int
Hymoneptera	Braconidae	*Chelonus blackburni*	Int
	Colletidae	Yellow-faced Bee (*Hylaeus flavifrons*)	End

Order	Family	Species	Status
	Vespidae	Potter Wasp (*Pachyodynerus nasidens*)	Int
	Formicidae	*Camponotus variegatus*	Int
		Ochetellus glaber	Int
		Big-headed Ant (*Pheidole megacephala*)	Int
		Tetramorium simillimum	Int
Lepidoptera	Carmbidae	*Omiodes localis*	End
		Salbia haemorrhoidalis	Int
		Spoladea recurvalis	Int
		Tamsica floricolens	End
	Gelechiidae	*Dichomeris acuminata*	Int
	Geometridae	*Anacamptodes fragilaria*	Int
	Lycaenidae	*Lampides boeticus*	Int
	Noctuiidae	*Amyna natalis*	Int
		Eublemma accedens	Int
		Heliothis virescens	Int
	Oecophoridae	*Thyrocopa sp.*	End
	Olethreutidae	*Crocidosema sp.*	End
	Sphingidae	*Hipotion rosetta*	Int
Mantodea	Mantidae	Mantis (*Heirodula patellifera*)	Int
Orthoptera	Acrididae	Grasshopper (*Schistocerca nitens*)	Int
	Gryllidae	Grasshopper (*Gryllodes signallatus*)	Int
		Caconemobius sp.	End
		Trigonidomorpha sjostedti	Int
	Tettigoniidae	*Conocephalus saltator*	Int
		Euconocephalus nasutus	Int

Table 4. Bird Species on Lehua (Adapted from VanderWerf *et al*. 2007 and (ebird 2017)

Symbols: Nat = Native C = Critically Endangered P = Present
End = Endemic E = Endangered H = Historical
Int = Introduced T = Threatened
Win = Winter visitor

Species	**Category**	**Status**	**Presence**
Black-footed Albatross (*Phoebastria nigripes*)	Seabird	Nat	P
Laysan Albatross (*Phoebastria immutabilis*)	Seabird	Nat	P
Wedge-tailed Shearwater (*Puffinus pacificus*)	Seabird	Nat	P
Christmas Shearwater (*Puffinus nativitatus*)	Seabird	Nat	P
Newell's Shearwater (*Puffinus auricularis newelli*)	Seabird	End, T	P
Bulwer's Petrel (*Bulweria bulwerii*)	Seabird	Nat	P
Hawaiian Petrel (*Pterodroma sandwichensis*)	Seabird	End, E	P
Band-rumped Storm-petrel (*Oceanodroma castro*)	Seabird	Nat, C	P
Red-tailed Tropicbird (*Phaethon rubricauda*)	Seabird	Nat	P
White-tailed Tropicbird (*Phaethon lepturus*)	Seabird	Nat	H
Masked Booby (*Sula dactylatra*)	Seabird	Nat	H
Brown Booby (*Sula leucogaster*)	Seabird	Nat	P
Red-footed Booby (*Sula sula*)	Seabird	Nat	P
Great Frigatebird (*Fregata minor*)	Seabird	Nat	P
Glaucous-winged Gull (*Larus glaucescens*)	Seabird	Win	P
Ring-billed Gull (*Larus delawarensis*)	Seabird	Nat	P
Pomarine Jaeger (*Stercorarius pomarinus*)	Seabird	Nat	P
Gray-backed Tern (*Sterna lunata*)	Seabird	Nat	P
White Tern (*Gygis alba*)	Seabird	Nat	P
Sooty Tern (*Sterna fuscata*)	Seabird	Nat	P
Blue-gray Noddy (*Procelsterna cerulean*)	Seabird	Nat	P
Brown Noddy (*Anous stolidus*)	Seabird	Nat	P
Hawaiian Black Noddy (*Anous minutus melanogenys*)	Seabird	End	P
Great Blue Heron (*Ardea herodias*)	Predatory	Nat	P
Black-crowned Night-heron (*Nycticorax nycticorax*)	Predatory	Nat	P
Barn Owl (*Tyto alba*)	Predatory	Int	P
Cattle Egret (*Bubulcus ibis*)	Predatory	Int	P
Peregrine Falcon (*Falco peregrinus*)	Predatory	Win	P

Species	Category	Status	Presence
Pacific Golden-plover (*Pluvialis fulva*)	Shorebird	Win	P
Wandering Tattler (*Heteroscelus incanus*)	Shorebird	Win	P
Ruddy Turnstone (*Arenaria interpres*)	Shorebird	Win	P
Bristle-thighed Curlew (*Numenius tahitiensis*)	Shorebird	Win	P
Red Phalarope (*Phalaropus fulicarius*)	Shorebird	Win	P
Rock Dove (*Columba livia*)	Passerine	Int	P
Spotted Dove (*Spilopelia chinensis*)	Passerine	Int	P
Zebra Dove (*Geopelia striata*)	Passerine	Int	P
Mourning Dove (*Zenaida macroura*)	Passerine	Int	P
Red Avadavat (*Amandava amandava*)	Passerine	Int	P
African Silverbill (*Lonchura cantans*)	Passerine	Int	P
Sky Lark (*Alauda arvensis*)	Passerine	Int	H
Northern Cardinal (*Cardinalis cardinalis*)	Passerine	Int	H
House Finch (*Carpodacus mexicanus*)	Passerine	Int	P
Nutmeg Mannikin (*Lonchura punctulata*)	Passerine	Int	P
House Sparrow (*Passer domesticus*)	Passerine	Int	H
White-rumped Shama (*Copsychus malabaricus*)	Passerine	Int	P

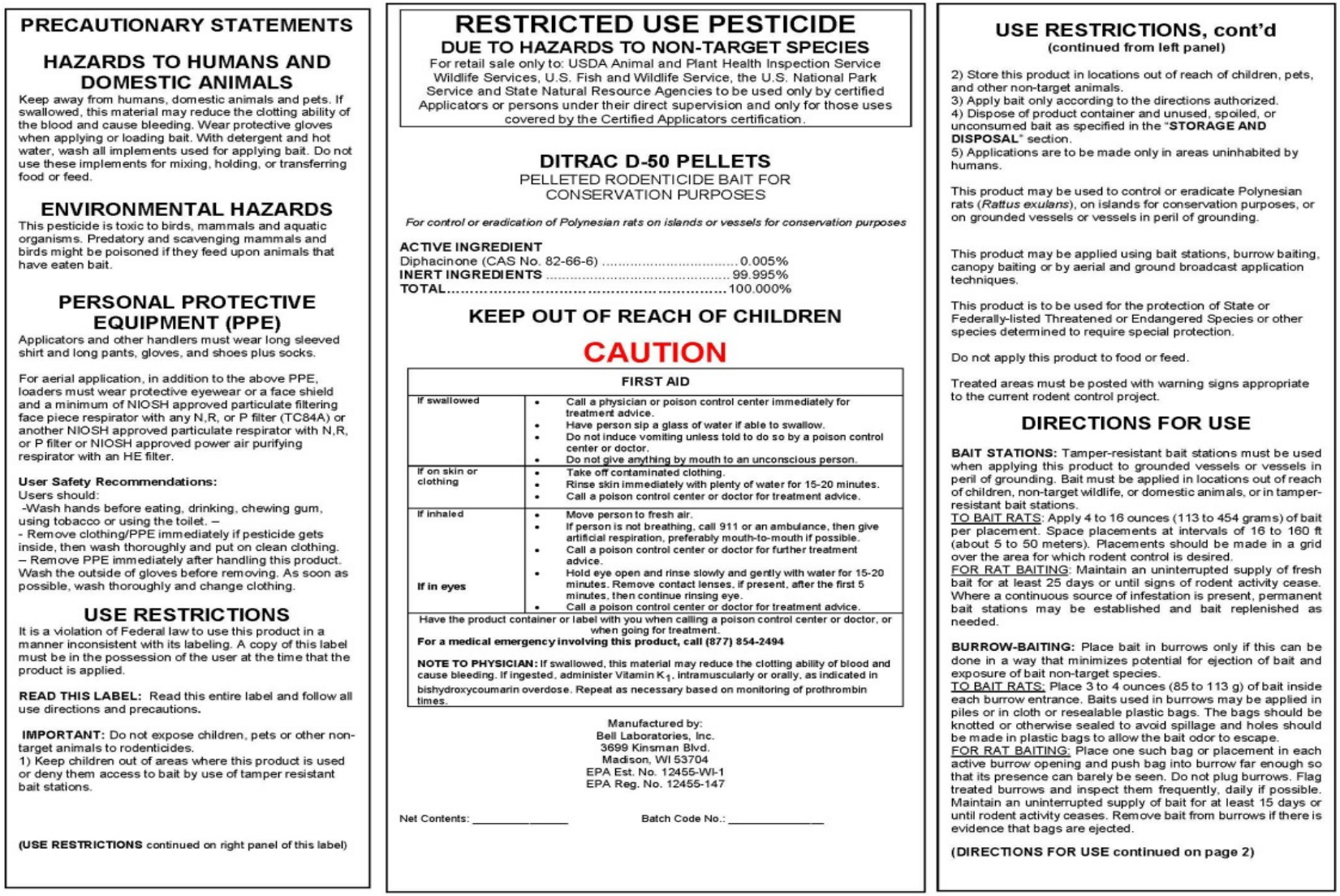
Table 5. Near shore fish species on Lehua (USFWS unpubl. data 2004)
Symbols: Nat = Native End = Endemic Int = Introduced

Species	**Status**
Orangespine Unicornfish (*Naso literatus*)	Nat
Convict Tang (*Acanthurus triostegus sandvicensis*)	End subspecies
Whitebar Surgeonfish (*Ancanthurs leucopareius*)	Nat
Orangeband Surgeonfish (*Ancanthurus olivaceous*)	Nat
Achilles Tang (*Ancanthurus achilles*)	Nat
Ringtail Surgeonfish (*Ancanthurus blochii*)	Nat
Eyestripe Surgeonfish (*Ancanthurus dussumieri*)	Nat
Lagoon Triggerfish (*Rhinecanthus aculeatus*)	Nat
Reef Triggerfish (*Rhinecanthus aculeatus*)	Nat
Black Durgon (*Melichthys niger*)	Nat
Pinktail Durgon (*Melichthys vidua*)	Nat
Gray Chub (*Kyphosus biggibus*)	Nat
Highfin Chub (*Kyphosus cinerascens*)	Nat
Bigeye Emperor (*Monotaxis grandoculis*)	Nat
Yellowstriped Coris (*Coris flavovittata*)	End
Blacktail Wrasse (*Hinalea lauhine*)	End
Christmas Wrasse (*Thalassoma lauhine*)	Nat
Saddle Wrasse (*Thalassoma duperrey*)	End
Hawaiian Hogfish (*Bodianus bilunulatus*)	Nat
Moorish Idol (*Zanclus cornutus*)	Nat
Ornate Butterflyfish (*Chaetodon ornatissimus*)	Nat
Longnose Butterflyfish (*Forcipiger longirostris*)	Nat
Cornetfish (*Fistularia commersonnii*)	Nat
Manybar Goatfish (*Parupeneus multifasciatus*)	Nat
Blue Goatfish (*Parupeneus cyclostomus*)	Nat
Yellowstripe Goatfish (*Mulloidichthys flavolineatus*)	Nat
Yellowfin Goatfish (*Mulloidichthys vanicolensis*)	Nat
Manta Ray (*Manta birostris*)	Nat
Gray Reef Shark (*Carcharhinus amblyrynchos*)	Nat
Blackspot Seargant (*Abudefduf sordidus*)	Nat
Bluefin Trevally (*Carynx melampygus*)	Nat

Smalltooth Jobfish (*Aphareus furca*)	Nat
Bluestripe Snapper (*Lutjanus kasmira*)	Int
Hawaiian Flagtail (*Kuhlia sandvicensis*)	End
Parrotfish spp. (Family *Scaridae*)	Nat or End

Appendix B. Rodenticide Labels

Figure 1. Diphacinone Ditrac D-50 label.



PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Keep away from humans, domestic animals and pets. If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. Wear protective gloves when applying or loading bait. With detergent and hot water, wash all implements used for applying bait. Do not use these implements for mixing, holding, or transferring food or feed.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to birds, mammals and aquatic organisms. Predatory and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten bait.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear long sleeved shirt and long pants, gloves, and shoes plus socks.

For aerial application, in addition to the above PPE, loaders must wear protective eyewear or a face shield and a minimum of NIOSH approved particulate filtering face piece respirator with any N,R, or P filter (TC84A) or another NIOSH approved particulate respirator with N,R, or P filter or NIOSH approved power air purifying respirator with an HE filter.

User Safety Recommendations:
Users should:
-Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. –
- Remove clothing/PPE immediately if pesticide gets inside, then wash thoroughly and put on clean clothing.
– Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change clothing.

USE RESTRICTIONS

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. A copy of this label must be in the possession of the user at the time that the product is applied.

READ THIS LABEL: Read this entire label and follow all use directions and precautions.

IMPORTANT: Do not expose children, pets or other non-target animals to rodenticides.
1) Keep children out of areas where this product is used or deny them access to bait by use of tamper resistant bait stations.

(USE RESTRICTIONS continued on right panel of this label)

RESTRICTED USE PESTICIDE

DUE TO HAZARDS TO NON-TARGET SPECIES

For retail sale only to: USDA Animal and Plant Health Inspection Service Wildlife Services, U.S. Fish and Wildlife Service, the U.S. National Park Service and State Natural Resource Agencies to be used only by certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

DITRAC D-50 PELLETS

PELLETED RODENTICIDE BAIT FOR CONSERVATION PURPOSES

For control or eradication of Polynesian rats on islands or vessels for conservation purposes

ACTIVE INGREDIENT	
Diphacinone (CAS No. 82-66-6)	0.005%
INERT INGREDIENTS	99.995%
TOTAL	100.000%

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
If swallowed	• Call a physician or poison control center immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by a poison control center or doctor. • Do not give anything by mouth to an unconscious person.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. • Call a poison control center or doctor for further treatment advice.
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.

Have the product container or label with you when calling a poison control center or doctor, or when going for treatment.

For a medical emergency involving this product, call (877) 854-2494

NOTE TO PHYSICIAN: If swallowed, this material may reduce the clotting ability of blood and cause bleeding. If ingested, administer Vitamin K_1, intramuscularly or orally, as indicated in bishydroxycoumarin overdose. Repeat as necessary based on monitoring of prothrombin times.

Manufactured by:
Bell Laboratories, Inc.
3699 Kinsman Blvd.
Madison, WI 53704
EPA Est. No. 12455-WI-1
EPA Reg. No. 12455-147

Net Contents: _____ Batch Code No.: _____

USE RESTRICTIONS, cont'd

(continued from left panel)

2) Store this product in locations out of reach of children, pets, and other non-target animals.
3) Apply bait only according to the directions authorized.
4) Dispose of product container and unused, spoiled, or unconsumed bait as specified in the "**STORAGE AND DISPOSAL**" section.
5) Applications are to be made only in areas uninhabited by humans.

This product may be used to control or eradicate Polynesian rats (*Rattus exulans*), on islands for conservation purposes, or on grounded vessels or vessels in peril of grounding.

This product may be applied using bait stations, burrow baiting, canopy baiting or by aerial and ground broadcast application techniques.

This product is to be used for the protection of State or Federally-listed Threatened or Endangered Species or other species determined to require special protection.

Do not apply this product to food or feed.

Treated areas must be posted with warning signs appropriate to the current rodent control project.

DIRECTIONS FOR USE

BAIT STATIONS: Tamper-resistant bait stations must be used when applying this product to grounded vessels or vessels in peril of grounding. Bait must be applied in locations out of reach of children, non-target wildlife, or domestic animals, or in tamper-resistant bait stations.
TO BAIT RATS: Apply 4 to 16 ounces (113 to 454 grams) of bait per placement. Space placements at intervals of 16 to 160 ft (about 5 to 50 meters). Placements should be made in a grid over the area for which rodent control is desired.
FOR RAT BAITING: Maintain an uninterrupted supply of fresh bait for at least 25 days or until signs of rodent activity cease. Where a continuous source of infestation is present, permanent bait stations may be established and bait replenished as needed.

BURROW-BAITING: Place bait in burrows only if this can be done in a way that minimizes potential for ejection of bait and exposure of bait non-target species.
TO BAIT RATS: Place 3 to 4 ounces (85 to 113 g) of bait inside each burrow entrance. Baits used in burrows may be applied in piles or in cloth or resealable plastic bags. The bags should be knotted or otherwise sealed to avoid spillage and holes should be made in plastic bags to allow the bait odor to escape.
FOR RAT BAITING: Place one such bag or placement in each active burrow opening and push bag into burrow far enough so that its presence can barely be seen. Do not plug burrows. Flag treated burrows and inspect them frequently, daily if possible. Maintain an uninterrupted supply of bait for at least 15 days or until rodent activity ceases. Remove bait from burrows if there is evidence that bags are ejected.

(DIRECTIONS FOR USE continued on page 2)

DIRECTIONS FOR USE, continued

CANOPY BAITING (bait placement in the canopy of trees and shrubs): In areas where sufficient food and cover are available to harbor populations of rodents in canopies of trees and shrubs, canopy baiting should be included in the baiting strategy. Approximately 4 to 7 ounces (113 to 200 grams) of bait should be placed in a cloth or resealable plastic bag. The bags should be knotted or otherwise sealed to avoid spillage and holes should be made in plastic bags to allow the bait odor to escape. Using long poles (or other devices) or by hand, bait filled bags should be placed in the canopy of trees or shrubs. Baits should be placed in the canopy at intervals of 160 ft (about 50 meters) or less, depending upon the level of rodent infestation in these habitats. In some vegetation types, bait stations may need to be used to ensure bait will stay in the canopy.

BROADCAST APPLICATION: Broadcast applications are prohibited on vessels, and all applications (including broadcast applications) are prohibited in areas of human habitation. Broadcast bait using aircraft, ground-based mechanical equipment, or by gloved hand application. Set the target application rate and number of applications according to the extent of the infestation and apparent population density. Maintain an uninterrupted supply of fresh bait for at least 25 days or until signs of rodent activity ceases. For eradication operations, treat entire land masses.

Each application should be applied at a rate no greater than 27 lbs. of bait per acre (30 kg bait/hectare) If necessary to maintain the supply of fresh bait, make additional applications, typically 5 to 7 days after the previous application, depending on local weather conditions, at a rate no higher than 27 lbs. of bait per acre (30 kg bait/hectare). No more than 3 broadcast applications should be conducted in this manner to maintain the supply of fresh bait. In situations where weather or logistics only allow one bait application, a single application may be made at a rate no higher than 27 lbs. bait per acre (30 kg/ha).

The application rates above specify the amount of bait delivered on the ground or 3-dimensional surface area. For aerial application, the bucket calibration (sowing) rate should be set accordingly to achieve the target application rate on the ground.

At points where flight lines overlap, the amount of bait applied might locally exceed the prescribed application rate. This could occur along adjacent borders of parallel swaths, at the end of swaths where they intercept the swaths created by shoreline baiting, or adjacent to areas missed during the initial baiting operations and subsequently rebaited, as indicated by the GPS flight path data. Minimize areas where the allowable application rate is exceeded as much as possible while ensuring that all areas are baited sufficiently.

If a bait application is interrupted due to poor weather conditions and cannot be completed on that day, "back baiting" of previously baited swaths is permitted.

(DIRECTIONS FOR USE continued on center panel)

DIRECTIONS FOR USE, continued

This ensures that rats migrating into the treated site following the interruption are exposed to sufficient bait. Use the following rules to determine the extent of back baiting.

Application delay	Resume baiting strategy
1 day	At drop boundary
2-3 days	2-4 swath widths behind the drop boundary
> 3 days	4-6 swath widths behind the drop boundary

Aerial (helicopter) applications may not be made in winds higher than 35 mph (30 knots). Pilot in command has final authority for determining safe flying conditions.

Assess baited areas for signs of residual rodent activity (typically 7 to 10 days post-treatment). If rodent activity persists, set up and maintain tamper-resistant bait stations or apply bait directly to rodent burrows in areas where rodents remain active. If terrain does not permit use of bait stations or burrow baiting, continue with broadcast baiting, limiting such treatments to areas where active signs of rodents are seen. Maintain treatments for as long as rodent activity is evident in the area and rodents appear to be accepting bait.

For all methods of baiting, monitor the baited area periodically and, using gloves, collect and dispose of any dead animals and spilled bait properly.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

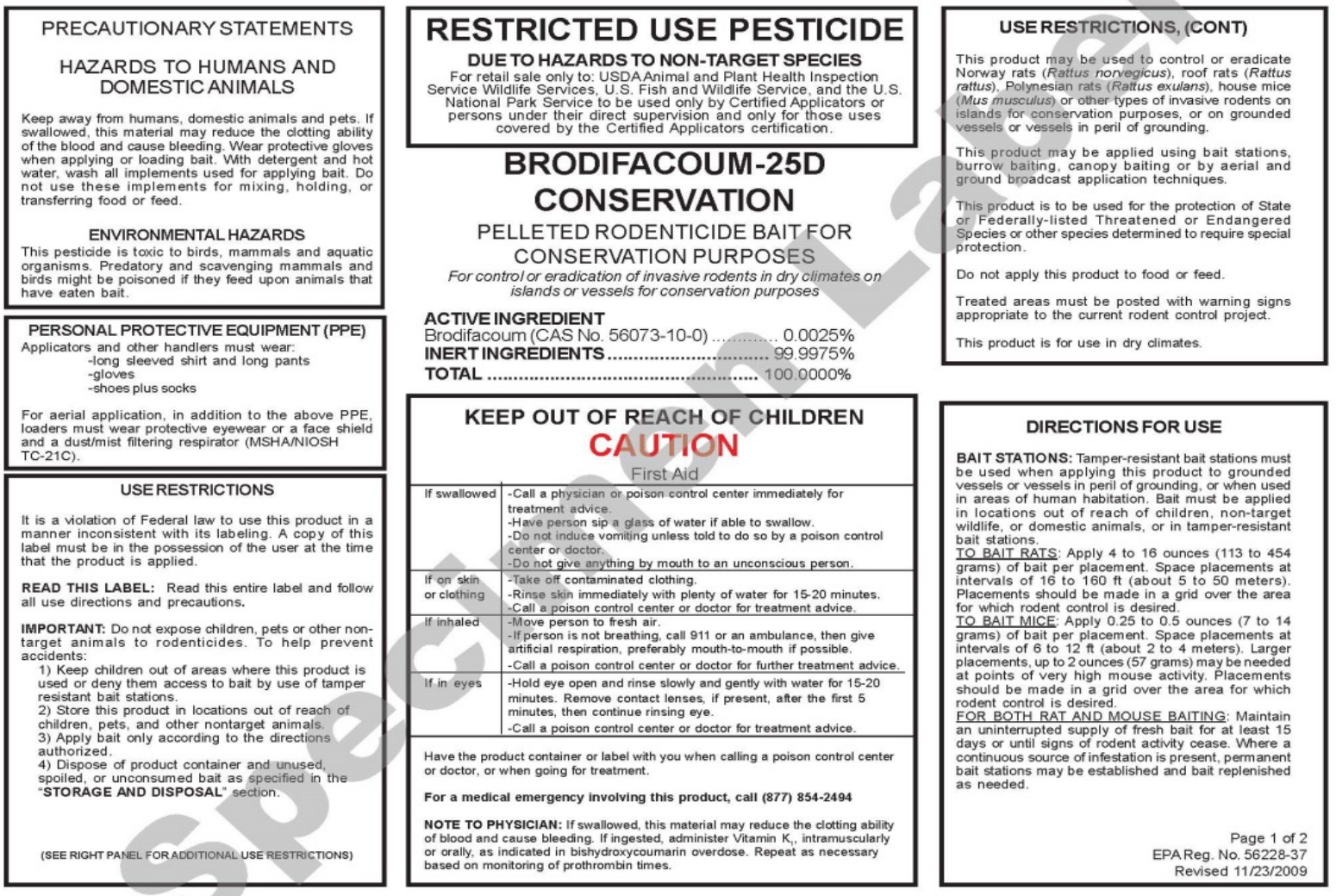
STORAGE: Store only in original closed container in a cool, dry place inaccessible to unauthorized people, children and pets. Store separately from fertilizer and away from products with strong odors, which may contaminate the bait and reduce acceptability. Spillage should be carefully swept up and collected for disposal.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of at an approved waste disposal facility.

CONTAINER DISPOSAL: Non-refillable container. Do not reuse or refill this container. Offer for recycling, if available. Otherwise, dispose of empty container in sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

NOTICE: Buyer assumes all risks of use, storage, or handling of the material not in strict accordance with directions given herewith. The efficacy of the product may be reduced under high moisture conditions.

Figure 2. Brodifacoum-25D Conservation label.



PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Keep away from humans, domestic animals and pets. If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. Wear protective gloves when applying or loading bait. With detergent and hot water, wash all implements used for applying bait. Do not use these implements for mixing, holding, or transferring food or feed.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to birds, mammals and aquatic organisms. Predatory and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten bait.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear:
-long sleeved shirt and long pants
-gloves
-shoes plus socks

For aerial application, in addition to the above PPE, loaders must wear protective eyewear or a face shield and a dust/mist filtering respirator (MSHA/NIOSH TC-21C).

USE RESTRICTIONS

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. A copy of this label must be in the possession of the user at the time that the product is applied.

READ THIS LABEL: Read this entire label and follow all use directions and precautions.

IMPORTANT: Do not expose children, pets or other non-target animals to rodenticides. To help prevent accidents:
1) Keep children out of areas where this product is used or deny them access to bait by use of tamper resistant bait stations.
2) Store this product in locations out of reach of children, pets, and other nontarget animals.
3) Apply bait only according to the directions authorized.
4) Dispose of product container and unused, spoiled, or unconsumed bait as specified in the "**STORAGE AND DISPOSAL**" section.

(SEE RIGHT PANEL FOR ADDITIONAL USE RESTRICTIONS)

RESTRICTED USE PESTICIDE

DUE TO HAZARDS TO NON-TARGET SPECIES

For retail sale only to: USDA Animal and Plant Health Inspection Service Wildlife Services, U.S. Fish and Wildlife Service, and the U.S. National Park Service to be used only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

BRODIFACOUM-25D CONSERVATION

PELLETED RODENTICIDE BAIT FOR CONSERVATION PURPOSES

For control or eradication of invasive rodents in dry climates on islands or vessels for conservation purposes

ACTIVE INGREDIENT
Brodifacoum (CAS No. 56073-10-0) 0.0025%
INERT INGREDIENTS 99.9975%
TOTAL 100.0000%

KEEP OUT OF REACH OF CHILDREN

CAUTION

First Aid

If swallowed	-Call a physician or poison control center immediately for treatment advice. -Have person sip a glass of water if able to swallow. -Do not induce vomiting unless told to do so by a poison control center or doctor. -Do not give anything by mouth to an unconscious person.
If on skin or clothing	-Take off contaminated clothing. -Rinse skin immediately with plenty of water for 15-20 minutes. -Call a poison control center or doctor for treatment advice.
If inhaled	-Move person to fresh air. -If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. -Call a poison control center or doctor for further treatment advice.
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.

Have the product container or label with you when calling a poison control center or doctor, or when going for treatment.

For a medical emergency involving this product, call (877) 854-2494

NOTE TO PHYSICIAN: If swallowed, this material may reduce the clotting ability of blood and cause bleeding. If ingested, administer Vitamin K_1, intramuscularly or orally, as indicated in bishydroxycoumarin overdose. Repeat as necessary based on monitoring of prothrombin times.

USE RESTRICTIONS, (CONT)

This product may be used to control or eradicate Norway rats (*Rattus norvegicus*), roof rats (*Rattus rattus*), Polynesian rats (*Rattus exulans*), house mice (*Mus musculus*) or other types of invasive rodents on islands for conservation purposes, or on grounded vessels or vessels in peril of grounding.

This product may be applied using bait stations, burrow baiting, canopy baiting or by aerial and ground broadcast application techniques.

This product is to be used for the protection of State or Federally-listed Threatened or Endangered Species or other species determined to require special protection.

Do not apply this product to food or feed.

Treated areas must be posted with warning signs appropriate to the current rodent control project.

This product is for use in dry climates.

DIRECTIONS FOR USE

BAIT STATIONS: Tamper-resistant bait stations must be used when applying this product to grounded vessels or vessels in peril of grounding, or when used in areas of human habitation. Bait must be applied in locations out of reach of children, non-target wildlife, or domestic animals, or in tamper-resistant bait stations.
TO BAIT RATS: Apply 4 to 16 ounces (113 to 454 grams) of bait per placement. Space placements at intervals of 16 to 160 ft (about 5 to 50 meters). Placements should be made in a grid over the area for which rodent control is desired.
TO BAIT MICE: Apply 0.25 to 0.5 ounces (7 to 14 grams) of bait per placement. Space placements at intervals of 6 to 12 ft (about 2 to 4 meters). Larger placements, up to 2 ounces (57 grams) may be needed at points of very high mouse activity. Placements should be made in a grid over the area for which rodent control is desired.
FOR BOTH RAT AND MOUSE BAITING: Maintain an uninterrupted supply of fresh bait for at least 15 days or until signs of rodent activity cease. Where a continuous source of infestation is present, permanent bait stations may be established and bait replenished as needed.

Page 1 of 2
EPA Reg. No. 56228-37
Revised 11/23/2009

DIRECTIONS FOR USE (CONT.)

BURROW-BAITING: Place bait in burrows only if this can be done in a way that minimizes potential for ejection of bait and exposure of bait non-target species.
TO BAIT RATS: Place 3 to 4 ounces (85 to 113 g) of bait inside each burrow entrance. Baits used in burrows may be applied in piles or in cloth or resealable plastic bags. The bags should be knotted or otherwise sealed to avoid spillage and holes should be made in plastic bags to allow the bait odor to escape.
TO BAIT MICE: Place approximately 0.25 ounces (7 grams) of bait in a cloth or resealable bag in each active burrow.
FOR BOTH RAT AND MOUSE BAITING: Place one such bag or placement in each active burrow opening and push bag into burrow far enough so that its presence can barely be seen. Do not plug burrows. Flag treated burrows and inspect them frequently, daily if possible. Maintain an uninterrupted supply of bait for at least 15 days or until rodent activity ceases. Remove bait from burrows if there is evidence that bags are ejected.

CANOPY BAITING (bait placement in the canopy of trees and shrubs): In areas where sufficient food and cover are available to harbor populations of rodents in canopies of trees and shrubs, canopy baiting should be included in the baiting strategy. Approximately 4 to 7 ounces (113 to 200 grams) of bait should be placed in a cloth or resealable plastic bag. The bags should be knotted or otherwise sealed to avoid spillage and holes should be made in plastic bags to allow the bait odor to escape. Using long poles (or other devices) or by hand, bait filled bags should be placed in the canopy of trees or shrubs. Baits should be placed in the canopy at intervals of 160 ft (about 50 meters) or less, depending upon the level of rodent infestation in these habitats. In some vegetation types, bait stations may need to be used to ensure bait will stay in the canopy.

DIRECTIONS FOR USE (CONT.)

BROADCAST APPLICATION: Broadcast applications are prohibited on vessels or in areas of human habitation. Broadcast bait using aircraft, ground-based mechanical equipment, or by gloved hand at a rate no greater than 16 lbs of bait per acre (18 kg bait/hectare) per application. Make a second broadcast application, typically 5 to 7 days after the first application, depending on local weather conditions, at a rate no higher than 8 lbs. of bait per acre (9 kg bait/hectare). In situations where weather or logistics only allow one bait application, a single application may be made at a rate no higher than 16 lbs. bait per acre (18 kg/ha).

Aerial (helicopter) applications may not be made in winds higher than 35 mph (30 knots). Pilot in command has final authority for determining safe flying conditions. However, aerial applications will be terminated when the following conditions are present:

> Windspeed in excess of 25 knots with an evaluation of the terrain and impact of the wind conditions and not to exceed a steady wind velocity of 30 knots.

Set the application rate according to the extent of the infestation and apparent population density. For eradication operations, treat entire land masses.

Assess baited areas for signs of residual rodent activity (typically 7 to 10 days post-treatment). If rodent activity persists, set up and maintain tamper-resistant bait stations or apply bait directly to rodent burrows in areas where rodents remain active. If terrain does not permit use of bait stations or burrow baiting, continue with broadcast baiting, limiting such treatments to areas where active signs of rodents are seen. Maintain treatments for as long as rodent activity is evident in the area and rodents appear to be accepting bait.

For all methods of baiting, monitor the baited area periodically and, using gloves, collect and dispose of any dead animals and spilled bait properly.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original closed container in a cool, dry place inaccessible to unauthorized people, children and pets. Store separately from fertilizer and away from products with strong odors, which may contaminate the bait and reduce acceptability. Spillage should be carefully swept up and collected for disposal.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of at an approved waste disposal facility.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Otherwise, dispose of empty container in sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

NOTICE: Buyer assumes all risks of use, storage, or handling of the material not in strict accordance with directions given herewith. The efficacy of the product may be reduced under high moisture conditions.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
Riverdale, MD 20737-1237
EPA Est. No. 56228-ID-1
EPA Reg. No. 56228-37

Net Weight _____

Batch Code No.: _____

Page 2 of 2
EPA Reg. No. 56228-37
Revised 11/23/2009

Appendix C. Public comments received and responses to comments.

Figure 1. Public comments to the draft Environmental Assessment.

Friday, April 21, 2017 at 4:07:19 PM Hawaii-Aleutian Standard Time

Subject: Fully support
Date: Thursday, March 16, 2017 at 12:17:17 PM Hawaii-Aleutian Standard Time
From: anne earhart
To: DLNR.FW.LehuaRestoration
CC: anne earhart

Dear Friends,

I fully support the rat eradication on Lehua Island. This non native species has decimated seabirds across the globe and we now are getting good at eradicating them on islands. And Island Conservation has many successful projects across the globe which has enabled seabirds to greatly increase their numbers.

Thank you very much,
Anne Earhart, Kauai

Friday, April 21, 2017 at 4:08:30 PM Hawaii-Aleutian Standard Time

Subject: Lehua Restoration: Additionalk Reference
Date: Sunday, March 12, 2017 at 4:08:22 AM Hawaii-Aleutian Standard Time
From: carlcc@hawaii.rr.com
To: DLNR.FW.LehuaRestoration

In the interest of completeness, the description of the fauna of Lehua should cite the following work which reported the presence of four species of land snails on the island of Lehua: Cowie, R.H., & Wood, K.R. 2008. The land snails of the island of Lehua, Hawaiian Islands. Bishop Museum Occasional Papers no. 100: 50-52.

Carl C. Christensen

Patrick Chee
Division of Forestry and Wildlife
Department of Land and Natural Resources
1151 Punchbowl St., Rm 325
Honolulu, HI 96813

April 6, 2017

RE: Lehua Island Ecosystem Restoration Project – Public Comments

Dear Mr. Chee and DOFAW staff;

American Bird Conservancy wishes to submit the following comments to the Hawai'i Department of Land and Natural Resources', Division of Forestry and Wildlife on the Draft Environmental Assessment for the Lehua Island Ecosystem Restoration Project (dated March 8, 2017).

American Bird Conservancy (ABC) is a 501(c)(3), not-for-profit organization whose mission is to conserve native birds and their habitats by working throughout the Americas to safeguard the rarest bird species, restore habitats, and reduce threats. ABC recognizes the severe and pervasive threat of non-native mammals to 35 federally and state listed Hawaiian birds, particularly the ground-nesting fresh water birds and seabirds.

Actions such as the Lehua Restoration Project are critical in reducing impacts to species such as Laysan Albatross and Black-footed Albatross, which face multiple threats, including fisheries bycatch (Eich et al. 2015)[i] and of loss of predator-free nesting habitat due to increasing sea level rise (Hatfield et al. 2014)[ii]. Importantly, eradicating the rat population would also benefit eight additional species of seabirds, endemic plants, and the entire island ecosystem. The potential future translocation of endangered Hawaiian Petrel ('Ua'u) to the site could add additional benefits. When done correctly, non-native pest eradications have proven beneficial to island conservation worldwide (Jones et al. 2016)[iii]. Eradicating rodents from Lehua will be a landmark achievement for conservation throughout the Hawaiian Islands.

ABC strongly supports the management objective of eradicating rats from Lehua because of the many conservation benefits for the seabird populations (as detailed in the EA). A decision of "Alternative 1: No action" would result in the continuing loss of seabird eggs,

4249 Loudoun Ave. ● P.O. Box 249 ● The Plains, VA 20198
Tel: 540-253-5780 ● Fax: 540-253-57822 ● abc@abcbirds.org ● www.abcbirds.org

chicks, and adults to rats, and a further degradation of the native vegetation of Lehua. **ABC does not support this alternative.**

We support the goal of eradicating rodents from Lehua, but as currently written we have substantial concerns and comments on the EA. The EA needs to provide more information on many critical aspects of this project:

- The decision thresholds for the number of diphacinone applications and the potential shift to brodifacoum in Alternative 2.
- Detailed monitoring protocols for assessing the lethal and sub-lethal impacts on non-target species.
- Cost/benefit analysis and justification for selecting Alternative 2 vs. Alternative 3.
- Greater detail on the biosecurity measures during and after the toxicant applications.
- Expanded discussion on alternatives considered and reasons they were rejected, such as trapping and contraception.
- An explanation of the communications strategy and transparency measures taken before, during, and after the eradication.

A detailed explanation of these main concerns and comments are as follows:

- **There is no explicit threshold for additional diphacinone applications or shifting to brodifacoum. Related to this, there is no mention of rodent monitoring post-application to determine the toxicant applications or shift.** The EA says there will be at least 3 diphacinone applications and 1–2 brodifacoum applications (pg. 44), but the decision matrix and how the exact number of toxicant applications will be determined is not stated. Presumably, these decisions will be based on the continuing presence of rats on Lehua, but they must be explicitly stated in the EA. These are critical pieces of information, and must be included to determine the total, cumulative toxic load on the environment and the actual risk to non-target animals.

- **As a bird-focused conservation organization, we are highly supportive of reducing non-target impacts to native birds.** ABC fully acknowledges the importance of landscape-level use of toxicants as a tool in addressing specific island conservation needs, but minimizing and monitoring non-target effects is vital. Toxicants are an integral tool in the eradication or control of non-native species that pose significant

4249 Loudoun Ave. • P.O. Box 249 • The Plains, VA 20198
Tel: 540-253-5780 • Fax: 540-253-57822 • abc@abcbirds.org • www.abcbirds.org

KEKAHA HAWAIIAN HOMESTEAD ASSOCIATION
A not-for-profit 501(c)3 corporation formed under laws of the State of Hawai'i
PO Box 1292 Kekaha, HI 96752 www.KekahaHomelands.org (808) 639-0752

Suzanne Case, Chair
David Smith, Administrator (Responsible Official)
Department of Land and Natural Resources (DLNR)
Division of Forestry and Wildlife (DoFAW)
1151 Punchbowl Street
Honolulu, HI 96813

April 3, 2017

Re: Lehua Island Rodenticide Project:
Draft Environmental Assessment (Publication Date: March 8, 2017) (DEA)

Dear Chair Case and Mr. Smith,

Kekaha Hawaiian Homestead Association, a Hawaii not-for-profit organization (KHHA), addresses the needs and concerns of native Hawaiian beneficiaries in west Kaua'i and Ni'ihau, including many that are active fishermen and/or engage in the cultural practices of limu, ama crab, wana and opihi gathering.

As described in the DEA's item 5 (p. 14) fundamental eradication principles require that the proposed eradication be acceptable to stakeholders and local communities.

Our Ni'ihauan community bears the greatest and most direct impact of the intended activities described in the DLNR/DoFAW-proposed rodenticide-based eradication project on Lehua. As you know, Ni'ihau lies approximately ¾ mile from Lehua and shares common aspects in its water ecosystems. Because our Ni'ihauan members (and/or their extended ohana) reside on a privately-owned island where raising challenging questions may result in personal repercussions, we have made efforts to understand and discuss their concerns about the Lehua project. Their feedback is included in our review comments below.

KHHA Review of the DEA. After reviewing the DEA, KHHA is not convinced that an adequate, fact-based premise specific to Lehua has been established to justify the risks and unforeseen consequences of a Lehua-wide helicopter broadcast of rodenticide that may impact our ecosystems and communities. Nor are we convinced that a Finding of No Significant Impact is appropriate at this time. Instead we encourage a next phase of in-depth baseline research and further investigation that could lead to a conclusion that a poison drop is absolutely warranted.

We note, for example, that the current 2017 DEA relies heavily on Lehua species inventories conducted 12 to 15 years ago (see Wood and Vanderwerf reports, 2004 and 2007, describing Lehua inventories conducted from 2002 to 2005). Additionally, the DEA contains no specific counts or current estimates, seasonal or otherwise, of the rat population on Lehua.

While the DEA contains many general statements on the use of rat eradication in the name of island conservation, there is very little Lehua-specific data that explains 1. why this eradication project is relevant at all at this time, 2. whether a self-balancing coexistence is possible so that

poison application is avoidable, or 3. that any particular bird species on Lehua are presently threatened specifically and primarily by rat predation on Lehua. The DEA, for example, contains only one reference to rat egg destruction specifically on Lehua. That reference listed a total of four rat-predated eggs from nearly 300 nests of three selected bird species over a three-month observation period.

It is not clear then why DLNR and DoFAW have prioritized this eradication project, especially given the limited availability of research on Lehua-specific ecosystem effects and the high risk health status of the Ni'ihauan community generally.

Other areas of insufficient data include current counts of coral species, ama crab, opihi, wana and limu, risk analysis study citations and specific rodenticide application areas and rates.

As Lehua island is a Hawaii State Wildlife Sanctuary the law requires that "disturbance of flora and fauna shall be avoided as much as possible" and makes no distinction with regard to species. HAR 13-126-9(b)(2). DLNR and DoFAW are therefore urged to first consider native Hawaiian-based and community-led solutions and participation in solving conservation problems before resorting to using toxic substances in Lehua's ecosystems. Principles of integrated pest management (IPM) also dictate that systems-oriented, site-specific research on environmental factors first be conducted, and that pesticides be used only after monitoring indicates that they are clearly needed. Many of the statements included in the current DEA do not meet this threshold of proof.

We request that DLNR and DoFAW conduct and include the results of formal research studies specific to Lehua on the following issues. The Final EA should not be issued, a FONSI should not be determined, and the proposed activities should not proceed until DLNR/DoFAW generates the following data and provides it to the public:

1) **Baseline numbers for the rat population on Lehua**, seasonal if relevant, confirmed through independently commissioned research. Scientists and the public need access to actual numbers based on documented, site-specific counting protocols before they can provide meaningful input on this rodenticide-based eradication project. Anecdotal statements on the benefits of rat eradication generally are insufficient.

2) **Scientifically-derived correlation between rat predation and declining bird populations on Lehua, and/or experiment-based confirmation that specific bird species survival is currently threatened primarily by the rats (vs. other possible causes) on Lehua.** A clear reason for the helicopter rodenticide drop must be scientifically established (in order to rule out using less drastic, perhaps more labor-intensive and gradual rat control methods to address the problem on Lehua). Please state in the DEA that IPM methods encourage avoiding the use of chemical pesticides if research can show that rat and bird species are able to live in self-correcting balance within Lehua's ecosystem with less toxic approaches. Initial groundwork cited in the current DEA (such as placing decoy eggs, records of bird carcasses observed over a decade ago, etc.) is insufficient to establish the premise for the proposed island-wide rodenticide drop.

3) **Updated, scientifically reported numbers and specific species lists for Lehua**, seasonal if relevant. The premise of the project cannot rely so heavily on species inventories conducted 12 to 15 years ago. Scientifically-conducted counts of bird species are important, especially since the eradication project is being proposed to protect them. What species and how many birds will be protected? Updated

information, for example, on the Newells' Shearwaters activity and numbers on Lehua, a key protected species, should be included.

4) **Food chain issues must be studied and described more in-depth in the DEA,** especially as the aerial drop of rodenticide will occur in shoreline areas previously excluded in the 2009 rodenticide drop. We suggest a particular focus on rodenticide uptake and persistence in ama crab, opihi, wana and limu, and the possible effects on humans ingesting them, especially if they are in specific high health risk categories. Specific research results on toxin persistence in fish tissues, ama crab and limu should be included in the DEA. Statements generalizing possible toxicity or harmlessness to humans, ama crab, opihi, wana and limu are insufficient.

5) **It is scientifically established that the rodenticide brodifacoum is very lethal to marine life.** As acknowledged in the DEA, a helicopter drop, no matter how much precaution is taken, will result in toxins in the waters and likelihood of collateral kill. Please state this more prominently in the DEA, with research and past project citations. Please also include the scientific method and data backup used by DLNR/DoFAW to estimate the deaths of non-target species described in the DEA. Please also include DoFAW's estimated collateral deaths of pu'eo, fish, crab and other marine life kills, and possible "worst case" damage to limu and coral. Please include the maximum total volume of intended rodenticide use, not only active ingredient and not only a kg per hectare and lb. per acre statement.

6) **Please include a synopsis of any research on the effects of helicopter disturbance on nesting birds.** Are there reported instances of "flushing" of nesting chicks and mothers from helicopter presence? If so, what are DoFAW's projected estimates of aborted nests, abandoned fledglings and fledgling mortality of specific bird populations?

7) **The DEA should include supporting research that enables DLNR/DoFAW to "rule out" a conclusion that the 2009 rodenticide drop on Lehua may have had some indirect involvement in the triggerfish and whale deaths (ie, research on immunosuppressive or autoimmune effects of brodifacoum and diphacinol, and their combined sequential use, on marine life).** In other words, the DEA should expressly deny, citing any prior research, that the 2009 rodenticide drop had any relationship, even if indirect, to the triggerfish and whales deaths. In the DEA, please cite how long after their discovery the triggerfish and whale specimens were tested in 2009; describe the tests performed, with process details; and include the chain of custody documents and related notes.

We hope that these comments assist DLNR and DoFAW with the regulatory processes related to the EA's proposed activities.

Mahalo,

Harold Vidinha
President
Kekaha Hawaiian Homestead Association

Cc: Office of Hawaiian Affairs (OHA)

3

Friday, April 21, 2017 at 3:33:09 PM Hawaii-Aleutian Standard Time

Subject: Draft EA for Lehua Island (Rat Eradication)
Date: Friday, April 7, 2017 at 3:09:48 PM Hawaii-Aleutian Standard Time
From: Kaliko
To: DLNR.FW.LehuaRestoration

I attended the community informational meeting at Kekaha Neighborhood Center on 4/3/17.

As we were told by Sheri Mann/DLNR all comments had to be submitted in writting 'to be legal' and nothing said verbally at this meeting meant anything, I am submitting this comment so that comments shared by community kupuna are not lost.

Continued community outreach is critical and mana'o in any form is vital and proven for the success of any project. Kauai is a "rural" community and its populoua appreciates face-to-face interactions that concern and surrounds our community.

The discussion on Monday was valuable to perculate concerns/questions regarding the rat eradication project.

As one person shared--"I believe we are saying pretty much the same thing in our own different ways".

The community favored an integrated approach with both aerial & hand broadcasting. Various type and application of rodenticide to be used, were also discussed.

Adverse and consequential issues relating to the Rat etadication process were also discussed on behalf of both Kauai and Niihau residents. Discussion regarding to inclemental weather, air drifts, effects to marine life, near shore impact on the coral reef ecosystem, impact on tourist based ocean activities, impact on commercial fishing economy, impact on recreational fishing community, flexibility and timing of rodenticide application, consequential issues and adverse effect on health and wellness were just a part of what was discussed.

This plan should include more small community group discussion throughout this process in addition to more modern forms of outreach.

Sincerely,

D. Kaliko Santos
Na Kuleana O Kanaka 'Oiwi

Page 1 of 1

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:
EPO 17-063

March 17, 2017

MEMORANDUM

TO: Patrick Chee

FROM: Laura McIntyre, AICP, Planner VI

SUBJECT: Lehua Island Ecosystem Restoration Project
TMK: 1-1-01:2

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of information regarding the Restoration Project to our office via the OEQC link.

Additional environmental health related land use information is available at:
http://health.hawaii.gov/epo/landuse and http://health.hawaii.gov/epo/egis

Thank you for the opportunity to comment.

LM:nn

Friday, April 21, 2017 at 4:03:12 PM Hawaii-Aleutian Standard Time

Subject: effective natural suggestion for rat control
Date: Monday, April 3, 2017 at 11:05:42 AM Hawaii-Aleutian Standard Time
From: Laurel_Baldridge/KAPAAH/HIDOE@notes.k12.hi.us
To: DLNR.FW.LehuaRestoration
CC: delphakauai@yahoo.com

Aloha -thanks for requesting our input. We wrote an article in the Garden Island editorials last week - perhaps you saw ? T It was about an effective natural and now widely used natural product to combat rats through fertility control ! PLEASE LOOK UP THE PRODUCT CALLED "CONTRAPEST" by SENES TECH - MAHALO ! !!!! :)

Friday, April 21, 2017 at 4:01:32 PM Hawaii-Aleutian Standard Time

Subject: Lehua Island Ecosystem Restoration Project
Date: Wednesday, April 5, 2017 at 6:15:15 PM Hawaii-Aleutian Standard Time
From: Robert Boesch
To: DLNR.FW.LehuaRestoration
CC: Enright, Scott, CleanWaterBranch, oeqc@doh.hawaii.gov, theresadawson@hawaiiantel.net

Thank you for the opportunity to comment on the Lehua Island Ecosystem Restoration Project. The project is an ambitious undertaking that, if successful, and does not need to be repeated with each new rat introduction will be well worth the effort. Unfortunately, the DEA does not adequately address issues concerning "coincidental" or collateral damage. The aerial application of rodenticide baits has been tried three (3) times in Hawaii. Each application resulted in "coincidental" or collateral damage.

Not Detected Does not Mean No Death - Just Inadequate Methods

In 2003, KSBE aerially applied diphacinone rodenticide to the Keahou Ranch. Pigs in the area were tracked by the National Wildlife Research Center. Most of the pigs that were tracked were killed and some had diphacinone detected in their livers most had no diphacinone detected in their muscle tissue. Method limits of detection ranged from 30 to 50 parts per billion. The attitude of the applicator was "We just killed a few pigs." (Pigs are not one of the more vulnerable species to diphacinone poisoning).

Anticoagulants are Imprecise. Toxic Doses are Different Species and Individuals within Species Groups

Cattle have been injected with diphacinone to kill vampire bats. The cattle were not harmed, but the vampire bats were "controlled". Where do marine mammals and fin fish fit in?

In February 2008, USDA aerially applied diphacinone rodenticide to Mokapu Island. Weeks later (within the window of toxicity for diphacinone) a juvenile whale was discovered moribund on a Maui Beach. USGS tested the whale for diphacinone and reported that diphacinone concentrations in the liver samples from the beached juvenile whale were below the limits of detection for the matrix and method (15 parts per billion).

Testing for the Correct Chemical?

Was the lab still looking for diphacinone weeks after the application? Poisons are metabolized and change structure and composition. Methods must be able to detect metabolites of diphacinone.

What are the method limits of detection for diphacinone, hydroxylated diphacinone, and brodifacoum and its metabolites?

What Happens if Coincidental or Collateral Damage Occurs?

Coincidental with treatment of Lehua Island in 2009, fish kills and dead juvenile whales were reported. Citizens of Kauai and Niihau sought the assistance from the Hawaii Department of Health to determine when it would be safe to consume fish. Assistance in determining a safe level was requested, but never provided from the U.S. Environmental Protection Agency (no level of anticoagulant is considered "safe").

A New Zealand study suggests that pigs should not be hunted within 160 days of a diphacinone bait application to reduce residues. What should be the interval in a marine environment? Are predatory fish to be sampled? Or will the project continue to sample limpets, herbivorous fish and water to show no detectable residues?

Anticoagulants bioaccumulate. Higher level predators are at greatest risk at lower doses. What happens if a pregnant Hawaiian woman eats a predatory fish?

Page 1 of 2

Robert Boesch
Visiting Colleague

Comment on EA for Rat Eradication at Lehua

From:
Soma Grismaijer
P.O. Box 1880
Pahoa, Hawaii 96778
808-640-3836

I would like to comment on this proposed eradication using rodenticides on Lehua island. This was attempted in 2009 and failed. The EA mentions possible causes of the failure, but does not mention the most obvious, which is that rodenticide cannot be effectively distributed on the cliffs of Lehua. The pellets will roll downhill, leaving a density of pellets on the cliffs that is too low to ensure lethal dosage to all rodents in those steep areas.

This means Lehua island may be too steep in terrain to ensure complete eradication of rats. This issue was not addressed in your EA. The steep hills were mentioned, along with discussion of dispersed pellets entering the ocean, but no mitigation was offered. Indeed, using rodenticide, there is no solution to steep cliffs.

If eradication is not feasible on Lehua, then control is the next best thing. Birth control measures may be effective for rat control. This method would also have much less chance of harming non-target species.

I hope you address this issue and I suggest it be addressed in an EIS, since this is a seabird sanctuary with endangered and protected species.

Thank you for your consideration of these comments.

Soma Grismaijer

Good Shepherd Foundation

P.O. Box 1880

Pahoa, Hawaii 96778

Comment on Draft Environmental Assessment Lehua Island Ecosystem Restoration Project, March 2017

April 6, 2017

Thank you for this opportunity to comment on this EA for the eradication of rats from Lehua island. We believe the No Action alternative is best, for the following reasons.

1. **An EIS should be required for this proposed action, for several reasons.**

A. **The proposed action will be in a State Seabird Sanctuary.** HAR 11-200-12(B) states, "In most instances, an action shall be determined to have a significant effect on the environment if it: (11)Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;"

The EA rationalizes, "Although the site is in a State Seabird Sanctuary, the proposed actions are in accordance with HAR 13-125, as well as Federal and State Coastal Zone Management policies and enforceable policies. All actions will protect sensitive resources, including the coastal zone while meeting ecological management objectives." p 86

However, HAR 13-125 and Federal and State Coastal Zone Management policies are not an automatic exemption from HRS 343 and the need to prepare an EIS.

B. **The proposed action will substantially affect rare, threatened, or endangered species, and their habitat.** HAR 11-200-12(B) (9) states an action may be significant if it, "Substantially affects a rare, threatened, or endangered species, or its habitat;"

Significant affects to a habitat could be negative or positive. According to this EA, the proposed eradication will result in a significant change to the Lehua plant, invertebrate, mammal, and bird populations, altering these populations in unpredictable ways. There may be an increase in alien

plants, as happened with rabbit eradication on Lehua. "Rabbit eradication was followed by a roughly 60% increase in vegetation cover that was made up mostly of non-native grasses (83.3% cover) and shrubs (79% cover) (Eijzenga 2011). Plant diversity increased by 31.7 %. Ten new species of herbaceous flowering plants (forbs) and grasses were recorded after rabbit eradication, with one forb being indigenous. (Eijzenga 2011)" p 37

This EA also states, "An increase in the number and diversity of native plants growing on Lehua is expected as a direct impact of rat removal. An additional impact, however, could be an increase in abundance and growth of non-native plants and weeds. The nature of the changes to the vegetation composition may be complex. **Although it is not clear what plants rats prefer, the weed response may be a detriment to the productivity of native plant species** (Eijzenga 2011)." p 79 [Bold added.]

In addition, chicks of several endangered and protected species will be exposed to sub-lethal doses of anticoagulant poison. While this EA assumes that all chicks with sublethal doses of poison will survive, the fact is that sub-lethal poisoning with anticoagulant poisons is known to reduce the viability of an animal, cause it pain and suffering, and may result in death from other causes, including from starvation.

C. **There are cumulative impacts.** According to HAR 11-200-12(b)(8), there may be significant impacts if a project, "Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;" In addition, §11-200-7 states, "Multiple or phased applicant or agency actions. A group of actions proposed by an agency or an applicant shall be treated as a single action when: (1) The component actions are phases or increments of a larger total undertaking; (2) An individual project is a necessary precedent for a larger project;"

This EA for rat eradication is part of a larger Lehua restoration project, which began in 2005. As this project has advanced, rabbits have been eradicated, resulting in unpredicted vegetation and weed growth, followed by a failed rat eradication attempt, to be followed by this proposed eradication re-attempt, to be followed by future weed management. "DOFAW and USFWS have established a monitoring program for Lehua and would implement a weed control program, as necessary, for the benefit of the native ecosystem. The implementation of the weed management program would be implemented under the current programs and policies of the DOFAW and USFWS, subject to availability of funds. All personale visiting or working on Lehua will also

adhere to the Lehua Island Protocols and Procedures (LIPP) to prevent new alien species from becoming established on Lehua (Appendix F)" p 79 [However] It is also stated that, "A native plant restoration project is planned for Lehua once the Pacific rats have been eradicated. Cumulative effects of this future activity and the proposed Pacific rat eradication are not expected." p 84

It is clear that this is a multi-stage plan to alter the flora and fauna of Lehua island. Numerous poisons will be used, including rodenticides and herbicides, resulting in unknown impacts. While all phases may be carried out with LIPP and other management procedures, these cumulatively will result in significant impacts to the island. Again, it matters not whether these are considered positive or negative impacts of there to be significant impacts and an EIS to be triggered.

2. **There may be other rodents on Lehua island besides the Pacific rat (*R. exulans*).**

This EA is for the eradication of the Pacific rat from Lehua island. However, if there are other rodents, including mice, targeting Pacific rats alone may result in unexpected shifts in rodent populations instead of achieving eradication of all rodents. The EA states that different species of rats have different bait preferences, different behaviors, and affect different types of birds, so eradicating one species of rodent may simply shift the rodent population to other rodent species and alter the pressure to different bird species. The EA also states that, "the population density of rats on Lehua is not known,…" p 25. In addition, the presence of *R. rattus* should be suspect. "The first positive documentation of rodents on the island, however, was in 1960 with the discovery of a carcass, thought to be *R. rattus* but never positively identified (Richardson 1963, Tomich 1986)." p 25

The rodent population should be better characterized to ascertain that removal of *R. exulans* does not increase other rodent populations.

This is also mandated by EO 13751 (a)(2) (iii) "**monitor invasive species populations accurately and reliably".** Not knowing the population density of rats on Lehua is not accurate or reliable monitoring.

3. **Aerial applications will enter the ocean.**

"Aerial Bait Application: Bait will be distributed over the entire surface of the island, up to, but not including the intertidal zone, primarily using an aerial broadcast approach modeled after other similar projects conducted in the United States, Canada, Mexico and internationally." p 42

And, "*Aerial application of rodenticide without coastline buffer*
Improved effectiveness of bait distribution to all rats on Lehua will be achieved by not excluding areas adjacent to coastlines for bait application, thus ensuring a uniform and complete distribution of bait in shoreline areas used by rats." p 20

"No intentional baiting will occur over the marine environment." p 43

To achieve this, "The hopper would be fitted with a deflector that spreads bait out to only one side, in an approximately 120-degree pattern, to minimize the risk of bait application directly into the ocean when flying along vertical cliffs and shoreline." p 44

"Possible mechanisms for rodenticide to reach the ocean include pellets bouncing off or rolling down steep slopes, being blown off course by high winds, or being washed into the ocean by heavy rains before they are eaten by rats. To minimize bait application directly into the water, the hopper would be fitted with a deflector that spreads bait out to only one side, in an approximately 120-degree pattern. The last two potential pathways will be minimized by not applying bait pellets in high winds (greater than 35 mph) or when heavy rains are forecast." p 55

What is not mitigated is the application to steep slopes, which will result in pellets bouncing off and rolling down the slopes, concentrating at the bottom and not affecting rats along the slopes. This may be a contributing factor in the failed eradication attempt in 2009. Rats along the slopes may survive.

This also means that some poison will enter the water from steep slope applications.

4. **Seabird populations have risen while rodents have been on Lehua island.**

"Seabird populations on Lehua have changed somewhat over the period of occasional monitoring from 1931 to the present. Specifically, the colony of Wedge-tailed Shearwaters has probably grown, and colonies of Laysan and Black-footed Albatross have recently appeared, while the historical colony of Brown Noddies has disappeared (Wood *et al.* 2004)." p 35

If the rodents are such a problem, it needs to be explained why there was an increase in Shearwaters, and the arrival of Albatrosses. It seems some bird species are better able to tolerate the rodents than others, and/or that there are different reasons for the appearance and disappearance of species from Lehua other than rodents. This should be addressed in an EIS.

5. **Rodents may play a positive role in reducing harmful, alien invertebrate populations.**

"Among the non-native species identified, the most important is the Big- headed Ant, which has been shown to have a negative impact on arthropod fauna native to Hawai`i (Liebherr and Polhemus 1997; LaPolla *et al.* 2000; Jahn and Beardsley 2000). An alien grasshopper, *Schistocerca nitens*, which has impacted native vegetation on Nihoa Island, was also found on Lehua." p 37

Rodents prey on ants and grasshoppers, and eradication of rats may result in greater populations of these pest invertebrates. Ants are also known to attack chicks and eggs, and may become a worse problem without rodent control of these pests. There has been no analysis of the harm caused by rodents versus the harm caused by ants.

6. **The use of chemosterilants or hormonal treatments to prevent rodent breeding has not be adequately addressed or considered.**

According to the EA, "The use of hormonal treatments for the eradication of rats on Lehua Island was considered and dismissed because the current available treatments have been designed and tested for population control in urban areas and have never been used to achieve complete eradication." p 48

Just because hormonal treatments have not been designed for this application, it does not follow that they would not be useful at Lehua. Birth control may lower rodent numbers enough to mitigate rodent impacts on Lehua. Total eradication may not be necessary if rodent populations are too low to harm the environment. It has not been proven that total eradication is necessary, especially since some birds seem to have no major problem from rodents, as mentioned above. And eradication of rodents may result in new environmental problems as ants, grasshoppers, and other rodent prey lose their main predator. Vegetative changes may also result from rodent eradication, as with the rabbit eradication, in increased invasive plant species and higher invasive plant densities on Lehua.

Ecologists are reluctant to admit that invasive species may provide some environmental benefits, so the notion that a few rats is better than none may seem unfathomable. However, this EA states that invasive grasses that proliferated after rabbit eradication actually help prevent erosion. So invasive species can be beneficial. The same reasoning may apply to the rat, which in the current environment on Lehua, serves some environmental service in controlling invertebrates, including invasive ants, and in controlling some weed species. These services would be lost with eradication.

7. **The impact of the anticoagulant poisons on fish and birds is underestimated.**

According to the EA, "The sampling program conducted at Mokapu Island, following aerial application of diphacinone bait, did not detect diphacinone residues in any of the tissue samples collected from three fish species (Primus, 2009, Gael et al., 2008) (Appendix E)." p 57

"Furthermore, studies being conducted by USGS have shown that Triggerfish are some of the least sensitive species to diphacinone (R. Riegerix, *pers. comm.*) which means that they would need to consume very large amounts of bait to receive lethal doses of the toxicant. p 58 In the unlikely event of fish contamination by diphacinone, recent studies using three fish species, indicate that they are amongst the least sensitive animals to the effects of diphacinone (R. Riegerix, *pers. comm.*). Therefore, there are no expected adverse effects to marine fish populations." p 58

However, not all species respond to diphacinone and brodifacoum in the same way. Small surveys on a few species of fish does not prove that other species of fish will not be affected.

The EA claims, "There is no evidence of lethal secondary exposure of seabirds to diphacinone. No seabird carcasses were found following the aerial broadcast of diphacinone on Mokapu and Lehua (Gale et al., 2008; Orazio et al., 2009). Sub-lethal contamination by diphacinone in seabirds has not been documented following eradication attempts." p60

It would be very difficult to find all the carcasses of affected birds, especially for seabirds which fly from the site of the poisoning. Days can transpire between the time of primary or secondary ingestion of the poison and the death of the bird. There is also no consideration given to non-lethal doses and its impact on bird survival.

Indeed, this EA optimistically claims, "(Black-footed albatross) Chicks consuming either diphacinone or brodifacoum will experience reduced blood clotting ability, but will recover within a few days." p 63 "(Laysan albatross)Chicks consuming either diphacinone or brodifacoum will experience reduced blood clotting ability, but will recover within a few days." p 63

Where is the research that shows that all chicks will recover within a few days from sub-lethal poisoning with anticoagulants? These poisons cause pain and internal bleeding in joints and other internal structures. It is absurd to assume that all chicks exposed to poison will survive. The poison may not be the cause of death, but chicks in pain and suffering may not eat or successfully leave the nest following this trauma.

Many of the chicks that will be affected are either endangered, threatened, or otherwise protected species. Frankly, I am shocked at the insistence, stated several times in the EA, that all sub-lethally poisoned chicks will survive. The author of this EA cannot seriously believe this is true.

Again, "Birds consuming sublethal doses of either diphacinone or brodifacoum will experience reduced blood clotting ability, but will recover within a few days." p 71 Nonsense!

This denial of the obvious reality that chicks exposed to the poison may die as a result is necessary for the justification of the statement that, "*The proposed actions will not affect a rare, threatened or endangered species or its habitat*. The operation will benefit native plant and animal species protected under the Federal and state endangered species laws. The limited and temporary human activities associated with the operation will have a negligible impact on listed species because either they will not be present or project actions combined with mitigation will result in no adverse impacts." p 86

Clearly, this rationalization is needed to avoid an EIS and a ESA take permit. However, both of these should be required.

In conclusion, this EA has claimed that rodents are a problem on Lehua, but no Pacific rat population densities are given or known, and the presence of other rodent species has not been determined; some seabird species have colonized Lehua despite rodent populations; and invasive plants and invertebrates may proliferate without the predatory pressure from rodents.

It is assumed that rodent eradication is preferable to control, but no evidence is given that this would be the case at Lehua island.

Aerial applications will include the shoreline, and bait will be distributed along steep cliffs where it will bounce and roll down to high levels of poison at the base of the cliffs and little poison along the cliffs.

Endangered and protected bird chicks will consume sub-lethal doses of bait that can result in death from other causes.

Non-poison alternatives, such as birth control, have been dismissed as non-applicable without proper review and consideration.

And, while it was not mentioned above, the proximity of Lehua island to Niihau (3/4 mile) makes it possible that new rodents will be recruited to the island following any eradication, and

since, according to this EA, rodent populations can explode within a few months following the introduction of a few rats, this eradication may be only temporary.

Finally, this proposed action requires an EIS for its affect on protected species and a protected environment, and for its cumulative impacts along with other phases of Lehua island restoration, which, taken together, clearly requires an EIS.

I hope these comments are helpful in protecting seabirds from this rodent eradication effort. In the final analysis, rodent eradication is not guaranteed, environmental improvement is not guaranteed, but harm to non-target species is guaranteed, which is why we encourage the No Action alternative.

Sydney Ross Singer

Environmental Anthropologist

Director, Good Shepherd Foundation

Friday, April 21, 2017 at 4:07:46 PM Hawaii-Aleutian Standard Time

Subject: Rat Eradication
Date: Monday, March 13, 2017 at 1:16:28 AM Hawaii-Aleutian Standard Time
From: Taurie Kinoshita
To: DLNR.FW.LehuaRestoration

Aloha,

While I do not relish the idea of hurting a living creature, it seems the priority is ensuring the survival of indigenous and threatened birds.

However, is there no other way to rid the island of the rats? (Poison seems dangerous and might have many negative side effects.)

If there is another option besides poison, please look at it!

Thank you for your consideration!

Mahalo and Cheers,

Taurie Kinoshita
Theatre Lecturer, Windward Community College, UH
Faculty, University of Phoenix
Artistic Director, Cruel Theatre
(808) 779 - 3456
taurie@hawaii.edu
taurie@crueltheater.com

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The Nature Conservancy
Hawai'i Program
923 Nu'uanu Avenue
Honolulu, HI 96817

Tel(808) 537-4508
Fax(808) 545-2019
nature.org/hawaii

Comments by The Nature Conservancy of Hawai'i
Supporting the Proposed Lehua Island Ecosystem Restoration Project and
Associated Draft Environmental Assessment
March 24, 2017

The Nature Conservancy of Hawai'i is a private non-profit conservation organization dedicated to the preservation of the lands and waters upon which life depends. The Conservancy has helped to protect nearly 200,000 acres of natural lands in Hawai'i. We manage 40,000 acres in 14 preserves and work in 19 coastal communities to help protect the near-shore reefs and waters of the main Hawaiian Islands. We forge partnerships with government, private parties and communities to protect Hawai'i's important watershed forests and coral reefs.

The Nature Conservancy supports the Lehua Island Ecosystem Restoration Project and the associated Draft Environmental Assessment.

Rats have infiltrated island systems and places all around the world, including Lehua Island. They are fierce predators where predators did not historically exist.

Islands and atolls are havens for species diversity and are extremely vulnerable to invasions by introduced species such as rats. They are also home to more endangered, rare and threatened species than anywhere else in the world. No longer so geographically isolated, islands face many global threats and often show effects more rapidly than larger land masses. These sensitive islands and atolls are biological gems that require action to ensure that the threats they face are reduced or eliminated to ensure their biological integrity.

Rats are the single largest threat to seabirds worldwide. About a third of all seabird species (102 of 328 species) are listed as threatened or endangered by the World Conservation Union. Birds, including petrels and shearwaters, that nest in burrows or crevices on islands are more vulnerable to rats. Rats have been observed preying on a quarter of all seabird species. The birds are genetically programmed to return to breed where they were born; they don't shift their breeding locations to different islands to escape danger such as rats.

The proposed eradication on Lehua is putting back the ecosystem closer to the way it's supposed to be. The standard method for removal uses a rodenticide, distributed in a way that is least likely to impact the environment or other wildlife such as birds, crabs and marine animals. In recent years, eradication efforts have been a proven effective conservation tool on islands as diverse as Palmyra atoll 1,000 miles south of Hawai'i, South Georgia in the Atlantic, Breaksea Island in New Zealand, Anacapa Island in the Channel Islands National Park, and Rat Island in the Alaska Maritime National Wildlife Refuge. In the Hawaiian archipelago, among the islands from which they have been successfully removed are Mōkapu Island off Moloka'i and Kure and Midway atolls at the far northwestern end of the Hawaiian Archipelago.

Thank you for the opportunity to provide our comments.

NA KI'A I KAI

A Policy Resource on Coastal Waters, Marine Ecosystems and Cultural Practices in West Kaua'i

David Smith, Administrator (Responsible Official)
Patrick Chee (Point of Contact)
Department of Land and Natural Resources (DLNR)
Division of Forestry and Wildlife (DoFAW)
1151 Punchbowl Street
Honolulu, HI 96813

April 7, 2017

Comments from Na Ki'a i Kai: Draft Environmental Assessment
TMK 1-1-01:2, in the Waimea District on the Island of Lehua (Draft EA)

Dear Mr. Smith and Mr. Chee,

Na Ki'a i Kai is comprised of Native Hawaiian fishers, gatherers and cultural practitioners committed to strengthening policies that protect the coastal waters and marine ecosystems of west Kaua'i. We do so in order to protect Native Hawaiian subsistence practices and the ecosystem resources that sustain them. Our stances are based on the input of our practitioner community, coupled with scientific, legal and policy research of peer-reviewed and academic sources.

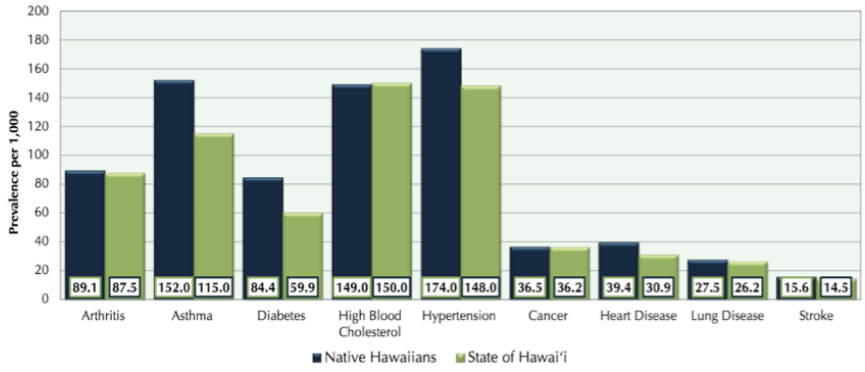
After a review of the Draft EA describing the proposed use of the rodenticides brodifacoum and diphacinone on Lehua, Na Ki'a i Kai urges DLNR and DoFAW to ultimately issue a Determination Letter recommending that **a full Environmental Impact Statement (EIS) be conducted prior to your agency's decision on the Lehua rodenticide project.**

A full EIS process is necessary, as the activities proposed in the Draft EA are not sufficiently supported in the context of Lehua. Additionally, in order to fully understand the possibility of negative effects to the environment and the potential risks that will be borne by west Kaua'i's Native Hawaiian and Ni'ihauan practitioners, their families, ecosystems and food sources, original research must be conducted and its results reviewed by the public. Lack of such site- and community-specific data is a significant factor that supports denying a Finding of No Significant Impact for this project. The communities of Na Ki'a i Kai are willing to assist DoFAW and cooperating agencies in the planning, design and implementation of such research.

We also note that the Draft EA does not acknowledge the possibility that the proposed rodenticide drop may have heightened health impacts on those in high health risk categories, and that there is little if any research to date on this possible correlation. To proceed with the proposed activities without any baseline understanding of the relationship between the proposed rodenticides and impact on those with compromised health status is unacceptable. We include this

chart from a recent report by the Office of Hawaiian Affairs with data sourced from the Hawaii State Department of Health's *Health Survey:*

Figure 3 Selected Chronic and Other Health Conditions for Native Hawaiians (age adjusted): 2010



Source. Hawai'i Department of Health, Office of Health Status Monitoring, Hawai'i Health Survey, 2010.

Disparate Impacts. The possible health impacts on Native Hawaiian communities are important in this context. We note that the State Department of Agriculture and its affiliated Agribusiness Development Corporation are currently facing Federal inquiry into violations of Title VI of the U.S. Civil Rights Act by engaging in practices that have the effect of discriminating against Native Hawaiians. Title VI prohibits a recipient of federal funds from acting in a manner that has a disparate impact on the basis of race, color, or national origin, regardless of whether the impact is intentional. The comments offered here are provided to assist DLNR/DoFAW in similar circumstances.

Possible Presumptions. As your staff have described, there is a possibility of a fishing ban of unknown duration, as well as the possibility of distributing food replacements to Ni'ihau residents following the proposed rodenticide drop in the case of water contamination that would affect food sources. We ask you to question whether such a solution would have been presumed acceptable for a more privileged demographic: for example, would DoFAW/DLNR have presumed that a nearby rodenticide drop close to the coastal waters of Princeville and a follow up distribution of food be acceptable to that population as well?

Our Community's Focus on Alternatives. We must also rectify an inaccurate staff report-back description of our community's input at a recent DLNR/DoFAW community consultation meeting on April 3, 2017 in Kekaha. While it is unclear whether such report-back was provided by agency staff or by agency contractor, Island Conservation, we are concerned that our community input was generally summarized as "Get it done, and get it done quickly." On the contrary, many in attendance shared the view that alternatives to a rodenticide drop via helicopter were not adequately explored and too readily dismissed without a full consideration. Attendees at the April 3 meeting were also informed that community input at that meeting would not be officially considered or formally accounted for "of record," which caused some frustration and led some to leave the meeting.

We urge DLNR/DoFAW to conduct a full feasibility study into the alternatives suggested at that meeting and by others, including the placement of bait silos, hand broadcast as the sole means of rodenticide placement, and other methods of rodent control that are more controllable than the proposed helicopter drop that will disregard coastal buffer zones and result in both coastal water contamination and undetermined collateral marine life kills. The coastal waters and channel between Niʻihau and Lehua are key sites for our cultural gathering of ama crab, moi and other marine life.

While each approach has its negative aspects, the proposed rodenticide drop seems to have the highest potential for widespread ecosystem harm. Issues such as immunosuppression, effects on fish reproductive cycles (particularly the fish species and marine plants consumed by our community), and fetal impact resulting in ingestion of fish by pregnant women, are currently under-researched and inadequately addressed in the Draft EA.

Baseline Rat Population Unknown. As stated by agency representatives, the rat population on Lehua is currently unknown. Until such documentation is available it is not possible to assess the actual benefits or wisdom of this proposed rodenticide drop. General descriptions of rat populations and their possible harm to birds does not replace scientifically derived, site-specific counts.

We also call your attention to statements of our Niʻihauan community, noting that rats on Lehua are of a different size (smaller) and of lesser presence as compared to the rats on Kauaʻi island. The Niʻihauan community has noted that high presence of rats generally follows human presence, and that, unless fully researched, rat populations on the uninhabited island of Lehua are therefore not necessarily a significant threat to bird life or egg predation on that island. Instead, it would be important to also look to other environmental factors to understand such threats.

2009 Fish Kill Documentation. Please include a statement in the Final Environmental Assessment that acknowledges that fish species other than triggerfish were found dead in the 2009 fish kill. Please also include a statement of a fact that is well-known to our local fishers – that triggerfish are a hardy, disease-resistant and resilient species as compared to the other species found in Hawaiʻi waters. The large-scale triggerfish die off following the 2009 rodenticide drop on Lehua is therefore notable. We would appreciate a statement from DoFAW on whether the algae bloom described in the Draft EA (that DoFAW has identified as the direct cause of death of the triggerfish) may have been partially caused or in any way encouraged by the introduction of rodenticide into their water habitat.

Mahalo for your consideration,

/s/ V. Kawai Warren

Van Kawai Warren
Na Kiʻa i Kai

Cc: Director, Hawaii Department of Health
Environmental Protection Agency (EPA) Region 9

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Table 1. Comment response matrix. Where appropriate comments are paraphrased or the comment subject line is included. In the remaining instances, sections from comment letters are included in entirety and enclosed in quotation marks.

Commenter	Comment summary/quote	DOFAW/USFWS response
Anne Earhart	Supports the project.	Comment noted.
"	Recognized non-native species have harmed seabird populations on islands.	Comment noted
"	Island Conservation has had many successful restoration projects that have enabled seabirds to increase their numbers.	DOFAW and USFWS has partnered with Island Conservation on this project because of their technical expertise in successful rodent eradications on islands. In order to make sure that the eradication of rats from Lehua goes well, DOFAW will continue to consult with Island Conservation and other experts in the field in order to make sure the restoration of Lehua Island will more likely succeed.
Carl C. Christensen	Fauna of Lehua Island should include four species of land snails	Comment noted. The documented land snails will be added to the Final Environmental Assessment (FEA).
Chris Farmer and Hannah Nevins, American Bird Conservancy	ABC strongly supports the management objective of eradicating rats from Lehua because of the many conservation benefits for the seabird populations (as detailed in the EA).	Comment noted.
"	**There is no explicit threshold for additional diphacinone applications or shifting to brodifacoum. Related to this, there is no mention of rodent monitoring post- application to determine the toxicant applications or shift.** The EA says there will be at least 3 diphacinone applications and 1–2 brodifacoum applications, but the	Once the diphacinone label is approved, more detailed information on the application rate will be provided in the FEA.

	decision matrix and how the exact number of toxicant applications will be determined is not stated. Presumably, these decisions will be based on the continuing presence of rats on Lehua, but they must be explicitly stated in the EA. These are critical pieces of information, and must be included to determine the total, cumulative toxic load on the environment and the actual risk to non-target animals.	The information on the number of applications of brodifacoum is incorrect. It should read "If necessary, one or two applications of brodifacoum would be made, approximately 7-20 days apart,". This correction will be made in the FEA
"	**Justification for Alternatives 2 vs. 3.** The current EA does not have a sufficient analysis of the biological benefits versus environmental risk for the two action alternatives, and justification for selecting the initial toxicant of choice. The EA could be improved by more clearly detailing the ecological costs and benefits of the very different approaches in Alternative 2 versus Alternative 3."	More information on the impacts of diphacinone will be provided in the FEA.
"	**As a bird-focused conservation organization, we are highly supportive of reducing non-target impacts to native birds.** Request for more details on Operational Plan, Monitoring Protocols, and anticipation of mortality of red-tailed tropicbirds, albatrosses, shearwaters or shorebirds.	The FEA will provide further detail on the Operational Plan, Monitoring (see below), and details on the anticipated impacts on the birds mentioned as well as several others.
"	**Monitoring protocols for rodents.** The commenter requests that pre-application and efficacy monitoring protocols be more explicit and that a robust biosecurity strategy be implemented.	In the FEA, the protocols related to efficacy monitoring and biosecurity will be augmented to include more detail.

“	**Monitoring protocol for non-targets.** The commenter requests that more detail be provided on the protocols designed to monitor the impacts to non-target species from the proposed action.	A project report would be completed and made available to the public. This document would provide information on the results of the project including non-target deaths. In the FEA, the protocols related monitoring of non-target impacts will be augmented to include more detail.
“	**Communication is paramount.** People are justifiably concerned about the potential impacts of toxicants to the marine and terrestrial resources. We recommend that the operations include a Communication Plan to ensure these concerns are researched, anticipated, and addressed with relevant stakeholders before, during, and after the eradication efforts. Communications with the public, particularly on Kaua‘i and Ni‘ihau, must be part of the overall management approach to highlight the need, benefits, risks, and specific activities that will occur with this conservation action. There are large knowledge gaps, misunderstandings, misinformation, and suspicion among the public about any eradication project, the methods that could be employed, the origins of Hawai‘i’s rodent problem, and the status of the State’s native species. It is critical to share information with the public about the connection between wildlife conservation needs and the severe threat of non-native rodents before the eradication project begins.	Public outreach with the community on Kaua‘i was conducted (see “External Scoping” on the Draft EA) and the owners of Ni‘ihau are members of the Lehua Island Restoration Steering Committee. An additional public meeting with the community on Kaua‘i is planned for July.

Harold Vindinha, Kekaha Hawaiian Homestead Association (KHHA)	The Niihau Community bears the greatest and most direct impact of the intended activities of this project. Because Niihauan members of KHHA and their families do not want personal repercussions for challenging the project, the KHHA has made an effort to understand and convey their comments in this letter.	DOFAW and USFWS recognized early in the process of exploring a renewed effort to continue Lehua's restoration would require participation by members of the Niihau Community. The Lehua Island Restoration Steering Committee (LIRSC) reached out to the Niihau Community and were directed to the owners of Niihau who at first appointed a community representative living on Oahu and later the owners of Niihau themselves participated in the LIRSC. We acknowledge there are additional Niihau Community voices that the KHHA represents with this comment.
"	"KHHA is not convinced that an adequate, fact-based premise specific to Lehua has been established to justify the risks and unforseen consequences of a Lehua-wide helicopter broadcast of rodenticide that may impact our ecosystems and communities."	Further facts and research with more recent information will be included in the FEA to address risks and environmental consequences.
"	Baseline numbers of rats population on Lehua is needed.	Numerous lines of evidence were presented in the DEA that support the importance of eradication of rats from Lehua. 1) There is evidence that rats have been preying on seabird adults, chicks, and eggs on Lehua for decades. 2) Several species of seabirds, which are known to be impacted by predation from rats, are notably rare on or absent from Lehua. 3) Eradication of rats from numerous islands in Hawaii, and globally, has resulted in the recovery of seabirds on these islands. This proposed project to restore Lehua’s native ecosystems is supported by the best available evidence.
"	Commenter requests scientifically-derived correlations between rat predation and declining populations on Lehua, and/or experiment-based confirmation that specific bird species survival is currently threatened primarily by the rats (vs. other possible causes) on Lehua.	See above response. Further detailed information and research will be included in the FEA.

"	Commenter requests updated numbers of species on Lehua	More recent information on species and their numbers will be included in the FEA.
"	Food chain issues must be studied and described in the EA	Studies on diphacinone do not show significant accumulation in the food web. Samples of fish, opihi, and seawater following the use of diphacinone on Mokapu and Lehua Islands showed no detectable levels of diphacinone. Studies on brodifacoum show there may be accumulation. Further details on environmental consequences for both active ingredients will be included in the FEA.
"	Add more information about brodifacoum and its effects on marine life in the EA	More information on brodifacoum's effects on marine life will be added in the FEA.
"	Add information regarding helicopter disturbance.	During a 2015 placebo bait availability study when a helicopter applied non-toxic bait to Lehua island, there were no observations of birds being flushed from their nests by the helicopter's presence or the bait falling to the ground. Nonetheless, potential bird disturbance information (using data from similar actions) will be included in the FEA.
"	Include information in the EA regarding the 2009 Lehua eradication effort that shows it did not cause the mortality of triggerfish and calf whale.	Adult humpback whales do not eat when in Hawaiian waters. Whale calves consume only their mother's milk when in Hawaiian waters. Therefore there is no pathway for the rodenticide to have been consumed by the whale calf and caused the mortality. Preliminary results of research being currently conducted by USGS show that triggerfish will actively avoid consuming food that contains diphacinone (even when they readily consume the food when does not have the diphacinone). Further information regarding the studies done on marine species related to the 2009 eradication effort will be included in the FEA.
Kaliko Santos, Na Kuleana O Kanaka 'Oiwi	Community outreach and in-person meetings are important especially on Kauai.	We agree with this comment and have made an effort to engage the community through public meetings, meetings with small groups, a call-in radio show and communications through newspaper, e-mail, television, and

		various social media. The Lehua Project is committed to another meeting with the public near the end of July.
"	The community favored an integrated approach with both aerial and hand broadcasting.	The project will be using an integrated approach using both aerial and hand broadcast in order to cover all potential rat territories on Lehua Island
"	"Discussion regarding to inclemental weather, air drifts, effects to marine life, near shore impact on the coral reef ecosystem, impact on tourist based ocean activities, impact on commercial fishing economy, impact on recreational fishing community, flexibility and timing of rodenticide application, consequential issues and adverse effect on health and wellness were just a part of what was discussed."	This comment covers a wide range of discussion points. Both DOFAW and USFWS recognize the importance of each of these topics, many of which were addressed in the DEA. The FEA will also be addressing each of these discussion points in more detail.
Laura McIntyre, Hawaii Department of Health	Acknowledged receipt of the DEA and recommended links to related Environmental Health resources.	Comment noted.
Laurel Baldridge	Commenter suggested the use of the rodent fertility control product Contrapest for the Project. Commenter also asserted the product was natural.	The rodent fertility control product Contrapest has not be sufficiently tested in field settings. As such, the product is only labeled for use in settings within direct proximity to human-made structures. Contrapest has only been tested as a method of rodent control and not eradication. This product therefore would not allow the project to reach its goal of eradication of rats from Lehua Island. Contrapest is not a natural product. One of its main active ingredients is 4-vinylcyclohexene diepoxide, a man-made organic compound that is commonly used in the production of epoxy resins.

Robert Boesch	No detection does not mean no death -- just inadequate methods. Example: Pigs mortality on KSBE Keahou Ranch.	The project will use the best available science to plan, implement, and monitor the project. Research on a variety of species show that detectable levels of anticoagulents are necessary to cause an effect on animals. Given that the commenter has not provided citation to information regarding the KSBE Keahou Ranch action, DOFAW and USFWS are unable to verify the commenter's assertions that no diphacinone was detected or whether there were other factors that may have contributed to the death of pigs in that project. Nonetheless, Lehua Island does not have pigs.
"	**Anticoagulants are Imprecise. Toxic Doses are Different Species and Individuals within Species Groups.** Cattle have been injected with diphacinone to kill vampire bats. The cattle were not harmed, but the vampire bats were "controlled". Where do marine mammals and fin fish fit in? Whale calf was found dead on a Maui beach several weeks after the 2008 aerial application of diphacinone on Mokapu.	Although there are variances of effect within individuals of a species, the best available science will guide the project in using the application necessary to complete the eradication and minimize non-target impacts. Anticoagulents such as diphacinone have been extensively studied in multiple research trials and been used in hundreds of field applications on a variety of rats and all have been effectively controlled or eradicated when used according to the label recommendations. Research indicates that at the concentrations used, both marine mammals and fish are at very low risk of being impacted from the proposed project. Humpback whale calves feed exclusively on their mother's milk when in Hawaiian waters. Adult humpback whales do not feed while in Hawaiian waters. Therefore, there is no pathway for diphacinone from the Mokapu eradication to have been consumed by the whale calf or contributed to its death. Further details on the impacts to fish and marine mammals will be discussed in the FEA.
"	Commenter suggests looking for anticoagulent metabolites.	The best available science and evidence from hundreds of successful eradications does not suggest that monitoring for metabolites of anticoagulents yields information on non-target take that would not otherwise be available from measuring detectable levels of the anticoagulent itself.

"	What Happens if Coincidental or Collateral Damage Occurs?	Due to the low concentration of active ingredient, multiple feedings necessary for diphacnone, active waters, currents, and temporary nature of the action, the project will not be recommending a moratorium on fishing unless imposed by one of the regulating agencies. Preliminary information from a current USGS study shows that diphacionone would be eliminated from fish within 24 hours or less. These results suggest that bioaccumulation of diphacinone in fish would be unlikely. Should there be a coincidental fish mortality event as occurred in 2009, tests of affected fish will be done and results shared with the public as soon as they are available. Further discussion of effects on fish will be made in the FEA
Soma Grismaijer	The steep cliffs on parts of Lehua prevent adequate availability of rodenticide bait to rats in those areas.	Aerially applied rodenticide has been used to successfully eradicate rats from numerous islands of similar terrain around the world. Studies of rodents show that areas where pellets are unlikely to stay are not preferred rodent habitat. Areas where bait is likely to accumulate (such as gullies and vegetated areas) are also areas where rodents are most likely to live and forage in.

"	Control, in particular birth control, should be considered. Birth control would have less chance of harming non-target species	Control of rats was not considered as an alternative. Most of the island is inaccessible to ground-based operations. Attempting to control rats at a spatial and temporal scale necessary to achieve recovery is not feasible and would pose an unacceptable hazard to personnel. Rodent birth control was considered and the product has not been sufficiently well tested for field application. It has been used and is labeled for use in limited areas near or within human-made structures. Lehua, is not inhabited and the label would therefore prohibit its use on much of the island. Even if there was a label for use in the field, the product itself poses logistical challenges. At the moment the product comes in the form of a liquid that is put in a bait station. This does not lend itself to being transported in to the field easily since it is both bulky and heavy. The birth control product is also acknowledged by the manufacturer as only a control tool and not as an eradication tool. On Lehua, use of the product would require staff to hike this heavy product up and around the steep and dangerous terrain in order to keep the bait stations continuously supplied. This could pose problems for both the staff and the wildlife from regular disturbances to re-supply the bait stations.
"	Commenter suggests the project should be addressed in an EIS.	Chapter 5 on page 82 of the DEA outlines the reasons why this project is anticipated to not rise to the level of significance that would require an EIS. As we draft the Final EA, DOFAW will consider the comments and other additional information to determine if the significance level has substantially changed to require a full EIS.
Sydney Singer, Good Shepherd Foundation	1. An EIS should be required for this proposed action	Chapter 5 on page 82 of the DEA outlines the reasons why this project is anticipated to not rise to the level of significance that would require an EIS. As we draft the Final EA, DOFAW will consider the comments and other

		additional information to determine if the significance level has substantially changed to require a full EIS.
"	2. There may be other rodents on Lehua besides the Pacific Rat.	Numerous surveys of Lehua Island's rodent population have resulted in no indication that rodents other than Pacific rats are populating the island. If a mix of rodents on island were the case, the eradication attempt in 2009 would likely have caused a different rodent to become dominant. Pacific rats, however, continue to be the only rodents found when monitoring for rodents on Lehua Island.
"	3. Aerial applications will enter the ocean.	DOFAW and USFWS acknowledge that some bait will unintentionally enter the marine environment.
"	4. Seabird populations have risen while rodents have been on Lehua island.	While some species of seabirds on Lehua have increased in numbers in the presence of rats, evidence indicates other species of seabirds are being impacted by rat predation. Furthermore, the increase in some species may be occurring in spite of rat predation. Other factors, such as changes in fishing practices, may be contributing to increases of seabirds.
"	5. Rodents may play a positive role in reducing harmful, alien invertebate populations.	Comment noted.
"	6. The use of chemosterilants or hormonal treatments to prevent rodent breeding has not be adequately addressed or considered.	Rodent birth control was considered and the product has not been sufficiently well tested for field application. It has been used and is labeled for use in limited areas near or within human-made structures. Lehua, is not inhabited and the label would therefore prohibit its use on much of the island. Even if there was a label for use in the field, the product itself poses logistical challenges. At the moment the product comes in the form of a liquid that is put in a bait station. This does not lend itself to being transported in to the field easily since it is both bulky and heavy. The birth control product is also acknowledged by

		the manufacturer as only a control tool and not as an eradication tool. On Lehua, use of the product would require staff to hike this heavy product up and around the steep and dangerous terrain in order to keep the bait stations continuously supplied. This could pose problems for both the staff and the wildlife from regular disturbances to re-supply the bait stations.
"	7. The impact of the anticoagulant posions on fish and birds is underestimated	DOFAW and USFWS recognize that the estimates given in the DEA regarding impacts needs to be updated. Those estimates and worst-case numbers of take will be input into the FEA and related take permits.
Taurie Kinoshita	"While I do not relish the idea of hurting a living creature, it seems the priority is ensuring the survival of indigenous and threatened birds."	Comment noted.
"	Are there ways of removing rats that do not require poisons.	Although there are ways of removing rats that do not require the use of rodenticide, the options for removal would require significantly more labor and would likely not be able to achieve full eradication. When mounting an operation where its goal is control, the project would need to have repeated control actions in perpetuity in order to maintain the reduced numbers needed to benefit the birds and plants. With eradication, (when complete) the action needs only to be done once with only temporary disturbance to a given area. With control, people would need to walk or hike through an area on a regular basis and on an island such as Lehua that could also pose injury hazards to people as well as wildlife.
The Nature Conservancy	Supports the project.	Comment noted.
"	Rats are fierce predators on islands where predators did not historically	Comment noted.

	exist.	
“	"Islands and atolls are havens for species diversity and are extremely vulnerable to invasions by introduced species such as rats. They are also home to more endangered, rare and threatened species than anywhere else in the world. No longer so geographically isolated, islands face many global threats and often show effects more rapidly than larger land masses. These sensitive islands and atolls are biological gems that require action to ensure that the threats they face are reduced or eliminated to ensure their biological integrity."	Comment noted.
“	"Rats are the single largest threat to seabirds worldwide. About a third of all seabird species (102 of 328 species) are listed as threatened or endangered by the World Conservation Union. Birds, including petrels and shearwaters, that nest in burrows or crevices on islands are more vulnerable to rats. Rats have been observed preying on a quarter of all seabird species. The birds are genetically programmed to return to breed where they were born; they don’t shift their breeding locations to different islands to escape danger such as rats."	Comment noted.

"	"The proposed eradication on Lehua is putting back the ecosystem closer to the way it's supposed to be. The standard method for removal uses a rodenticide, distributed in a way that is least likely to impact the environment or other wildlife such as birds, crabs and marine animals. In recent years, eradication efforts have been a proven effective conservation tool on islands as diverse as Palmyra atoll 1,000 miles south of Hawai'i, South Georgia in the Atlantic, Breaksea Island in New Zealand, Anacapa Island in the Channel Islands National Park, and Rat Island in the Alaska Maritime National Wildlife Refuge. In the Hawaiian archipelago, among the islands from which they have been successfully removed are Mōkapu Island off Moloka'i and Kure and Midway atolls at the far northwestern end of the Hawaiian Archipelago."	DOFAW and USFWS concur and are working towards eradicating rats from Lehua to restore the Island and give seabirds a chance to survive there even as climate change threatens to significantly reduce their habitat in the Northwestern Hawaiian Islands.
Van Kawai Warren, Na Ki'a i Kai	Commenter recommends a full EIS be conducted prior to DLNR deciding on whether the rat eradication should proceed.	Chapter 5 on page 82 of the DEA outlines the reasons why this project is anticipated to not rise to the level of significance that would require an EIS. As we draft the Final EA, DOFAW and USFWS will consider the comments and other additional information to determine if the significance level has substantially changed to require a full EIS.
"	"We also note that the Draft EA does not acknowledge the possibility that the proposed rodenticide drop may have heightened health impacts on those in high health risk categories, and that there is little if any research to date on this possible correlation."	Further information on human health impacts will be added to the FEA. Due to the low concentration of active ingredient, multi-dose requirements for activity in diphacinone, and temporary nature of the proposed action, impacts to humans are not expected. Of the hundreds of island eradications that have used rodenticides, none have recorded human health impacts.

“	Native Hawaiian communities may be disparately impacted by the LIERP.	Human health impacts will be described in more detail in the FEA. Because no human health impacts are anticipated from the project, the Native Hawaiian communities are not anticipated to be disparately impacted in their health by the project.
“	Will there be a fishing ban.	DOFAW and USFWS will not be recommending a fishing ban or moratorium for this project. We do not control requirements that might be imposed by other agencies and their permits, but DOFAW and USFWS are confident that no fishing ban is necessary or required for this action.
“	Further consideration of alternatives to use of aerial application of rodenticide should be made.	Further consideration and assessment of alternatives will be explored in the FEA.
“	Baseline numbers of rats population on Lehua is needed.	Numerous lines of evidence were presented in the DEA that support the importance of eradication of rats from Lehua. 1) There is evidence that rats have been preying on seabird adults, chicks, and eggs on Lehua for decades. 2) Several species of seabirds, which are known to be impacted by predation from rats, are notably rare on or absent from Lehua. 3) Eradication of rats from numerous islands in Hawaii, and globally, has resulted in the recovery of seabirds on these islands. This proposed project to restore Lehua’s native ecosystems is supported by the best available evidence.
“	Further documentation of the fish mortality even in 2009 needs to be included in the FEA. Could the algae that was identified as a potential reason for the fish mortality be a result of the 2009 application of diphacinone to Lehua.	Further documentation of the 2009 fish mortality event will be added to the FEA. The blue-green algae that was found in the fish is a fresh-water species. Lehua does not have any significant sources of standing fresh water. It is therefore unlikely the 2009 diphacinone application would interact with the environment to produce the algae that was found in the triggerfish.

Appendix D. Proposed bait availability and rat response monitoring during the 2017 Lehua Island rat eradication.

Background

As part of the larger Lehua Island rat eradication project, parallel activities would be carried out during and between bait applications to provide information crucial to the successful implementation of the operation, and to inform if the observed is in line with the expected outcomes as outlined in the EA. This document describes the objectives and methods (protocols) for monitoring on the ground bait coverage and availability, and impacts on target species (Pacific rats). Note that additional bait application monitoring would be carried out at the bait loading site informed by the GIS monitoring and bait loaded into and spread by the helicopter – this document does not cover that monitoring.

Although these activities are standard practice for IC rodent eradications, the case of Lehua Island would take into account two important factors:

- Challenging terrain can impact the quality of the baiting operation (i.e. complete and consistent coverage) as well as limit staff operational capacity. Despite its relatively small size (115 ha, 212 m high), Lehua is very steep, has vertical cliffs, and the sharp volcanic rocks make it difficult, unsafe or time-consuming to access certain areas even when wearing boots with micro-spikes.

- Limited infrastructure on the island, which restricts the size of the field team. The campsite (a weatherPort) is located close to the shore and is small (max capacity 4 people) in terms of both sleeping and storage capacity. Others could be present for limited periods, for example around the drop days. The monitoring proposed is then to be mainly conducted by an experienced 5-person team stationed on the island for up to 8 weeks (starting 1 week prior to baiting).

The value of continuity is recognized; therefore most if not all the team members would remain constant throughout the operation. This would help maintain any biases constant, and would also minimize down time with training or getting familiar with the island. Some activities would commence days before the implementation of the eradication, as described below. An adaptive management approach would be applied throughout; activities would be combined as much as possible to maximize efficiency.

The following descriptions assume that diphacinone 50 ppm would be used as the toxicant.

I. Bait coverage and availability

On the ground monitoring would be performed to ensure that all individual rats are at risk by the eradication strategy. Specifically, bait must be present in every rat territory in enough quantity and for long enough that all rats have access to a lethal dose. Bait availability plots would be used to evaluate the application rate (pellet density), and bait consumption/degradation over time. The data collected may inform the bait application strategy and may trigger responses to ensure adequate bait quantities or adjust the bait application on the island. Monitoring data would be one component of a complex decision making process that would include weather, logistics, and other elements.

Monitoring Protocols

Bait availability plots

The detailed bait availability monitoring, measured in plots, would provide data on bait availability. Monitoring protocols would use standardized circular bait availability plots within rat habitat areas which are representative of rat territories. Plots would be marked in advance with chalk or stakes and string across the island and would be placed in each slope, including varying altitudes and suitable rat habitat types (bush and grass). This design would allow the analysis of slope (north or south), elevation, and

habitat as potential factors influencing bait availability. The location of the plots would be selected rather than random, as large expanses of bare ground, although proportionally abundant on Lehua, would be avoided. Bare ground provides neither cover nor food for rats, and it is likely that bait availability there would be lower due to steepness of the terrain. In other words, bait would be measured where rat activity is most likely. The plots would be distributed along transects when possible (Fig. 1) to facilitate logistics. Each plot would have an individual code and would be monitored every 24 hours in a consistent order. At each plot, pellets would be collected, counted, weighed collectively using a Pesola scale and collectively assessed for bait degradation on the Craddock (2004) scale before being placed back within the same plot.

All monitoring would commence the day of the first bait application and continue daily for at least 10 days, depending on the results. By evaluating bait availability on the day of the drop the on-the-ground bait application rate can be confirmed, and the values can be used as the basis upon which to start estimating daily bait consumption. Most likely, a similar regime would be used after each bait application. All observers would be trained on the practical definition of 'pellet' to ensure systematic monitoring.

Importantly, the area covered by the plots would be only a fraction of the island. Observers would visually evaluate if the general bait density matches the density measured inside the plots. This is necessarily a subjective process, but it would allow the team to validate the extrapolation to larger areas.

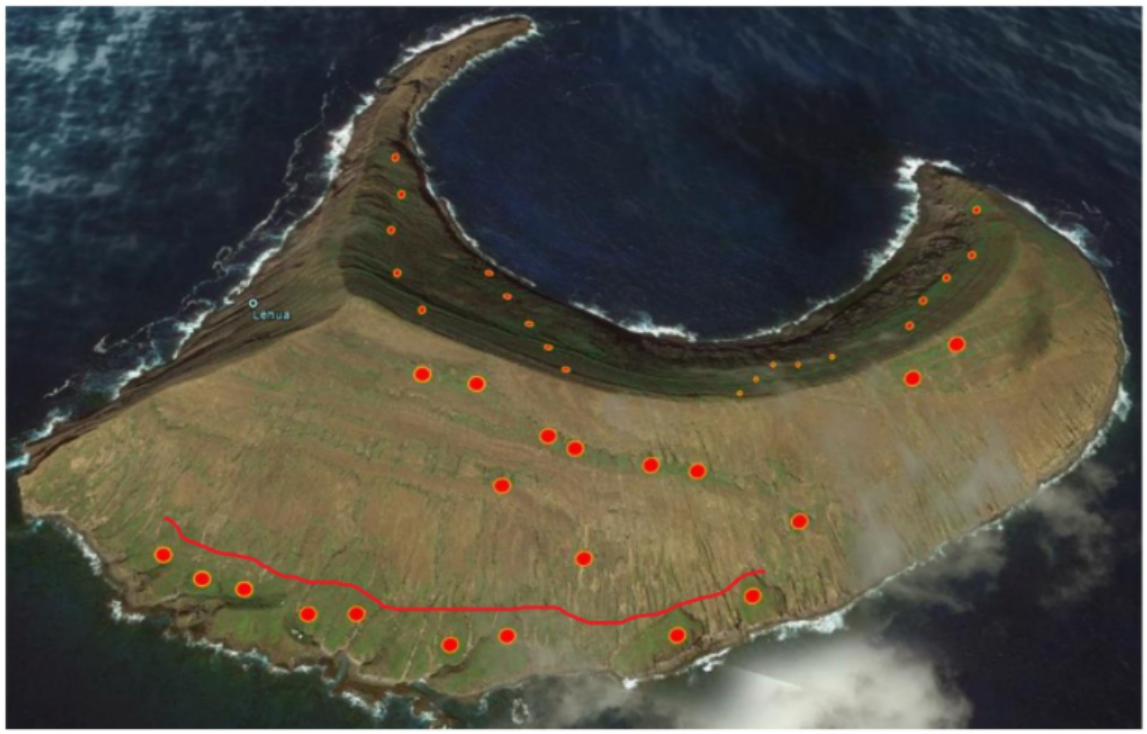


Fig. 1: Example of monitoring plots (40 circles) along the inner and outer slopes in the two main rat habitats: shrub and grass. One observer would check 10 plots per day in a set order. Actual distribution would depend on current vegetation coverage. The line indicates the transect for the live traps to be set both before and after the operation.

Analysis

The rate decrease would be monitored within bait availability plots by collecting data on the total weight of pellets in each plot over time.

II. **Impacts on target species (Pacific rat)** - Efficacy

Efficacy of the bait applications would be evaluated with a pre/post bait application monitoring protocols using multiple indicators. In the short term, efficacy of the baiting would be evaluated with radio collared rats monitored pre/post baiting until mortality (or not) is confirmed. In the longer term, rats would be monitored using direct and indirect detection tools. All tools used would have been tested on the target population on Lehua before the operation, and monitoring would be conducted every 3-9 months (depending on weather conditions for island access) for 1-2 years.

Pre-operation

One week prior to the first bait application, up to 20 rats would be fitted with radio-collars. To capture rats, approximately 30 live traps would be set and baited using coconut bait in high quality rat habitat near the camp site. Ideally, a balanced sex ratio and a range of age classes and breeding status would be targeted. However, animals in reproductive condition and juveniles would be preferentially collared because there is limited data on bait acceptance by these groups. Individuals would be fitted with the radio-collars and released at the capture site.

Capture success rates would be calculated from the live traps and would be used to assess population status prior to the eradication. Additionally, body condition, morphometrics, and phenology data would be collected from captured rats.

Radio-collared rats would be monitored for 1-2 days prior to the first application to ensure they are alive and to identify burrow locations. Motion trigger cameras would be placed at the entrance of identified burrows to document bait acceptance and social interactions as well as survival (i.e. lack of activity) during the operation.

During operation

Radio telemetry monitoring would commence five days after the first bait application and would continue until all collared rats are confirmed dead. All rats would be monitored every other day around sunset to check for movement. Once an individual is suspected to be dead, the site would be marked with GPS, and a recovery operation would be carried out as soon as possible.

Recovery may involve digging/moving rocks. Staff would be informed of all archaeological or other sensitive sites which are not to be disturbed. If dead rats are found to be within these areas, the monitoring team would only attempt to recover the radio collared individual if it does not compromise the site.

Body condition, morphometric, and phenology data would be recorded for all recovered radio collared rats. Additionally, fresh carcasses would be collected to assign cause of death and for toxicology analysis.

Post-operation

Passive detection devices that have been successfully trialed on Lehua would be deployed. This includes chew cards, wax tags, and tracking tunnels. A minimum of 50 devices would be distributed as widely as possible across the island.

Appendix E. Proposed Environmental Monitoring Plan

USDA APHIS Wildlife Services National Wildlife Research Center, Draft of 23 June 2017

On all but the smallest of islands, successful rodent eradication efforts employ the landscape-scale application of toxic baits. The rationale for such short-term contaminant inputs is that the environmental and human health risks of toxicant use are offset by the long-term ecological and societal benefits of invasive rodent removal. The maintenance of this rationale requires that we continue to test assumptions about the actual primary and secondary adverse impacts of rodenticide use.

The proposed implementation plan for the August 2017 eradication of Polynesian rats (*Rattus exulans*) from Lehua Island calls for three applications of a rodenticide bait containing 0.005% diphacinone, an anticoagulant, in a cereal-based bait matrix. The purpose of this environmental monitoring plan is to assess the potential persistence of diphacinone in various environmental compartments subsequent to this eradication action.

Previous sampling: A similar monitoring effort was implemented by the US Geological Survey in conjunction with an attempted eradication in January of 2009 (Orazio et al. 2009). During this previous testing, no diphacinone residues were detected in any seawater, soil, invertebrate, or fish samples. For the sake of comparability of results, this sampling scheme would be replicated for the proposed eradication attempt with minor modifications to increase the focus on species routinely collected for human consumption.

Analytical chemistry: Diphacinone residues would be assayed and quantified by liquid chromatography and mass spectrometry (LC-MS/MS) at the USDA APHIS WS NWRC Chemistry Lab Unit in Fort Collins, CO. Detection and quantitation limits for each sample type would be established during analysis and compared to the limits established during the previous assays that employed high performance liquid chromatography (HPLC) followed by ultraviolet-visible photodiode array absorbance (PDA) detection.

Sampling sites: During the 2009 sampling effort, high seas restricted sampling to the three locations depicted in Figure 1. These locations were the only places where the shore-based sampling crews could safely access the shoreline and where there would be potential public use of Lehua's near-shore resources. These sites also represent the most conservative circumstance for detection of residues as the largest drainage gulches occur on the south slope of the island and enter the sea in this area of greatest human use. During the proposed eradication attempt, we would consider alternative, dispersed sampling sites, depending on ocean and weather conditions and risk to human safety.

Sampling occasions: Specimens would be collected from each of the three selected sites prior to bait application (to establish a baseline), then again one to four days following each of the three planned applications, followed by a final sampling one to two weeks later, for a total of five sampling occasions. Exact location and timing of sampling would be dependent on weather and ocean conditions.

Seawater and soil sampling: Samples would be collected in 250-mL jars with Teflon-lined lids.

Limpet ('Opihi') sampling: Limpets are single-shelled marine gastropod mollusks (*Celina* spp.) and a valued human delicacy. They graze on algae growing on rocky substrates in intertidal zones. Composite samples of 5-8 whole limpets would be collected at each of the sites during each sampling period. The

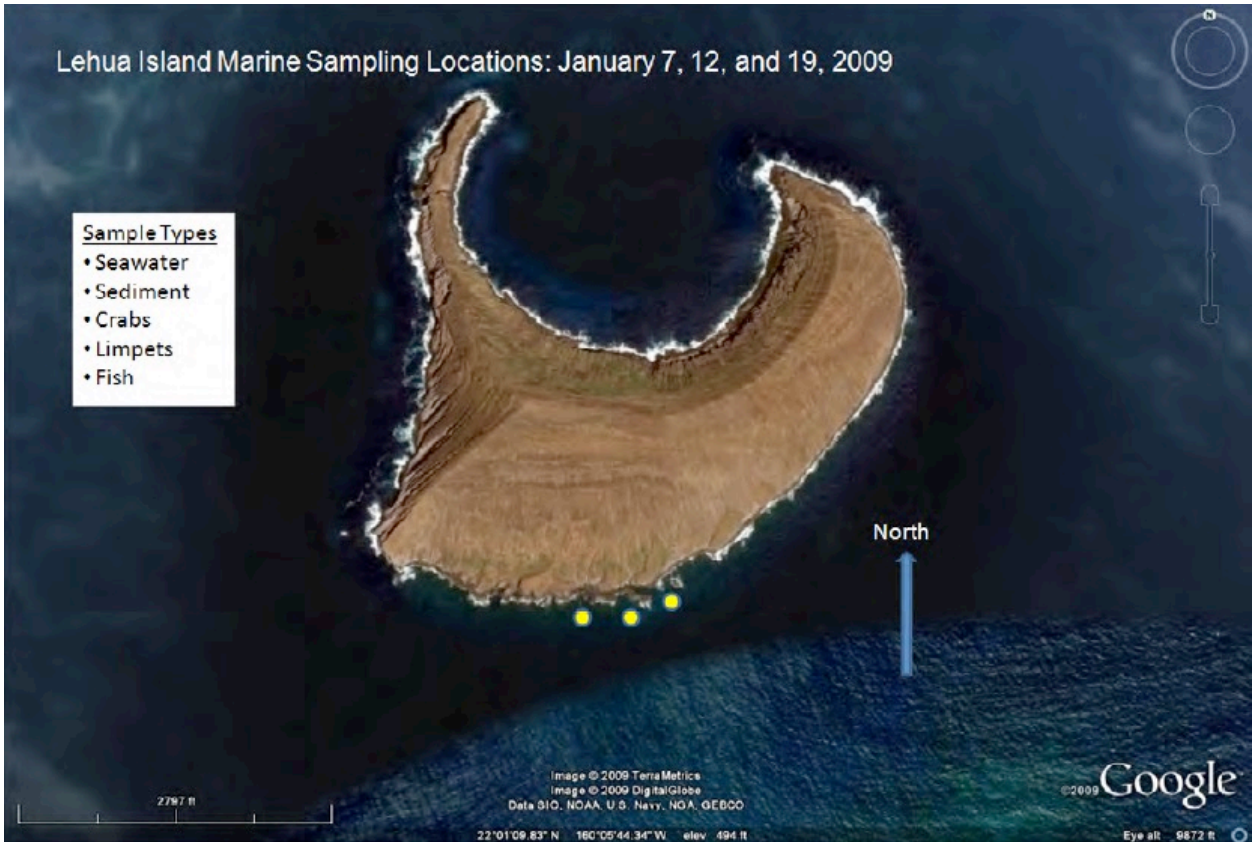


Figure 1. (From Orazio et al. 2009) Lehua Island, Niihau, Hawaii (Created from GoogleEarth© image) showing the three sampling sites (yellow dots) on the south of the island. Indicated sample types were collected at each sampling location.

intertidal habitat of limpets is inherently risky for human collection activities; successful collection during the targeted sampling interval is dependent upon tide and wave conditions and would not be conducted when human safety is at risk.

Natal lightfoot crab (''A'ama') sampling: 'A'ama (*Grapsus tenuicrustatus*) is a food source commonly eaten raw at parties. These crabs also occur in dangerous rocky intertidal zones, and are difficult to catch. Composite samples of 2-3 crabs would be collected when risk of human injury is low. These crabs can be pinned with long poles or blinded with flash lights at night and collected by hand.

Fish sampling: The potential for toxic residues in reef and game fish is the greatest public concern associated with rodenticide use on Lehua. For this reason, we would place greater emphasis on fish sampling than in the 2009 effort. We would attempt to obtain multiple samples from the following classes of fish: 1) resident (non-pelagic) reef fish that were observed interacting with placebo bait pellets during prior site visits; these are likely to constitute a 'worst case scenario' for fish likely to directly consumer higher levels of rodenticide (Table 1); 2) black triggerfish (*Rhinecanthus aculeatus*); a die-off of this species on the coast of Niihau coincident to the 2009 eradication attempt has been attributed to toxic algae, unrelated to rodenticide use, though public impression that it was caused by diphacinone poisoning persists despite a total lack of supporting evidence; 3) prized near-shore game fish, particularly higher trophic level predators more likely to bioaccumulate toxins; effort to collect predatory fish may be delayed until the later sampling periods to allow time for bioaccumulation (if any occurs). While this

would be our objective, it must be recognized that reliable and species-specific collection of fish is likely to be very difficult, and the actual samples collected would likely be highly variable. Fish would be collected by cast net, hook, and line, and spear, with sampling efforts restricted periods of safe ocean conditions. Toxic residues in vertebrates are most highly concentrated in liver tissue; however, liver comprises a small component of fish mass, and "extrapolation from liver to muscle contaminant levels is fraught with uncertainty, and [such] data are essentially useless for this purpose" (Ahmed 1991). In most cases, livers of game fish are discarded. For the sake of balancing the most extreme potential concentrations with the realistic potential for exposure, fish large enough to be filleted would have both liver and muscle tissue sampled and tested independently; smaller fish, more likely to be included in whole in soups and stews would be homogenized in the lab for a whole-body estimate of residue concentrations.

Table 1. During a 2015 inert bait trails on Lehua, bait was hand broadcast into coastal areas containing rock shelves at depths from one to three meters and into open sandy bottomed areas with depths up to six meters. Observers conducted time-constrained surveys of fish species that came into contact with, mouthed or consumed the bait. Following are the common, Hawaiian, scientific names and observations of species interacting with inert pellet bait and considered to be fish caught and eaten locally:

Common Name	Hawaiian Name	Scientific Name	Observation
Achilles Tang	Pākuiku`i	*Acanthurus achilles*	Contact
Orange-band Surgeonfish	Na`ena`e	*Acanthurus olivaceous*	Contact
Bluestripe Snapper	Taape	*Lutjanus fulvus*	Consumed bait*
Hawaiian Hog Fish	A`wa	*Bodianus albotaneniatus*	Consumed bait*

***** *It was determined during the initial survey that species mouthing pellets could not easily be distinguished from those that consumed pellets and these two categories were then combined into the single category "consumed." Therefore, whether these fish would actually consume bait is not established.*

Non-target carcass surveys: Throughout the course of field activities associated with eradication efforts, any non-target organisms (species other than rats) found dead would be collected and submitted for chemical residue analysis to assess whether the organism had been exposed to rodenticide intoxication. Passive surveillance would occur through alertness of all personnel at all times, collecting and submitting all carcasses found while conducting all other eradication monitoring activities. Active surveillance would occur through the assignment of carcass search transects throughout terrestrial habitat and along coastlines adjacent to the encampment area as ocean conditions permit. Carcass search personnel would be equipped with binoculars to extend their field of view. The level of survey effort would be balanced with other demands on field personnel time. Significant effort would be applied to pre-drop carcass searches to document natural mortality and to remove carcasses that could later be confused with mortalities due to rodenticide treatment. To the greatest extent possible, non-target carcasses would be necropsied by veterinary professionals to evaluate evidence as to whether the mortality was associated with rodenticide ingestion or not.

Chain of custody: Sample identification, date, location, and collector data would be recorded and maintained with the samples, along with a documented chain of custody between the source location and the NWRC Chemistry Lab Unit in Fort Collins. Tissue samples would not be collected on-island, to

minimize the risk of contamination of samples through contact with equipment, dust, or hands contaminated with toxin residues.

Sample analysis prioritization: Chemical residue analysis is costly. Current availability of funds is limited, and additional future funding is uncertain. We would strive for a comprehensive sampling of specimens, and have abundant samples on hand for future testing as funding becomes available. Priority would go to analysis of samples more directly related to common human consumption practices (e.g., Opihi and popular game fish) and listed non-target species. Specimens from the sample collected after the last application are likely to have the highest accumulated contaminant levels (if any), with the most valuable information for inference on the highest risk of contamination in game fish, and would be prioritized for prompt analysis. If any residues are observed in that sample, the final sample (one or two weeks post-application) would be of the next highest priority, to determine if residues still persist. It could be argued that the first and second post-application samples are of the least practical value for assessing overall project impacts and human health risks because they do not incorporate the full extent of toxin application (as the sample after the third application does) and does not inform the overall duration of residue persistence; chemical analysis of these samples could be foregone if adequate funding is not secured. It is likely that lab results would take eight weeks or longer to become available, with limited opportunity for expedited results. We recommend that if any advisories are suggested they be

Contingency sampling: Additional sampling materials and protocols would be on hand to respond to any unanticipated non-target mortalities beyond what might be expected within the action area (for example, the 2009 triggerfish die-off on Ni`ihau) to distinguish between diphacinone contamination and coincidental mortality events.

Sampling scenario example: Following is a summation of a potential sampling scheme. The total cost is based on the full-price estimate of $150 per sample. The cost of processing large groups of samples can be reduced by providing technician labor to assist in sample preparation.

SAMPLE	*Pre-app*	*App 1*	*App 2*	*App 3*	*Post-app*
Seawater	*3*	*3*	*3*	*3*	*3*
Soil	*3*	*3*	*3*	*3*	*3*
Crab	*3*	*3*	*3*	*3*	*3*
Limpet	*3*	*3*	*3*	*3*	*3*
Fish (pellet consumers)	*3*	*3*	*3*	*3*	*3*
*Fish (triggerfish)**	*6*	*6*	*6*	*6*	*6*
*Fish (larger predator)**	*0*	*0*	*0*	*0*	*18*
Non-target carcasses	*6*	*6*	*6*	*6*	*6*
TOTAL SAMPLES	*153*				
MAX LAB COST (@$150 ea.)	*$22,950*				

Rodenticide compounds: This monitoring plan is drafted under the assumption that rodent eradication would be attempted with diphacinone bait. If brodifacoum is used, this sampling strategy would be revised to account for the known increased persistence and bioaccumulation of chemical residues.

Additional post-operational sampling may be required if residues persist after the last sampling period, and additional environmental compartments (e.g., insects and lizards) may be tested.

References:

Ahmed, FE (ed.). 1991. Seafood Safety. National Academy Press, Washington, DC.

Orazio, CS, MJ Tanner, C Swenson, J Herod, P Dunlevy and RW Gale. 2009. Results of laboratory testing for diphacinone in seawater, fish, invertebrates, and soil following aerial application of rodenticide on Lehua Island, Kaua‘i County, Hawaii, January 2009. US Geological Survey Open File Report 2009–1142, 15 pp. + appendix.

Appendix F. Data on the Efficacy and Preference of Bell Lab's Formula 4 Bait at 50 ppm and 100 ppm.

Table 1. Summary statistics for *Rattus exulans* 15-day 2-choice feeding trial results for Bell Labs (0.005% Int.i. Diphacinone)

	50 ppm	100 ppm
Mortalities (% efficacy)	100%	96.10%
Mortality (days)	(4-14)	(4-17)
Bait consumption (g)	(5.7-30.3)	(1.2-41.2)
Bait acceptance2 (%)	(25.5-100)	(3.7-100)

(Siers, S.R. 2016. Efficacy and acceptance of 0.005% diphacinone experimental pellet bait on Polynesian rats (*Rattus exulans*). Unpublished Report. QA-2546. National Wildlife Research Center, Fort Collins, Colorado. 192p)

Appendix G. Bait Interaction Data from Studies Conducted at Lehua Islet.

Table 1. Attraction of near shore marine fishes to placebo Ramik Green rat bait pellets (2-3 gram size) at Lehua Island, Hawai`i, September 18-19, 2004 (USFWS unpublished data)

Species	Total Number of Fish	Number of bait interactions observed (some individuals interacted multiple times)			Number of bait interactions per species
		Inspected Bait	Touched Bait	Consumed bait	
Orangespine Unicornfish (*Naso literatus*)	13	10	8	0	18
Convict Tang (*Acanthurus triostegus*)	8	0	0	0	0
Whitebar Surgeonfish (*Acanthurus leucopareius*)	85	19	0	0	19
Orangeband Surgeonfish (*Acanthurus olivaceous*)	7	3	5	0	8
Achilles Tang (*Acanthurus achilles*)	2	0	0	0	0
Ringtail Surgeonfish (*Acanthurus blochii*)	1	0	0	0	0
Eyestripe Surgeonfish (*Acanthurus dussumieri*)	1	0	0	0	0
Lagoon Triggerfish (*Rhinecanthus aculeatus*)	1	1	0	0	1
Black Durgon (*Melichthys niger*)	6	21	13	0	34
Pinktail Durgon (*Melichthys vidua*)	5	13	9	0	22
Moorish Idol (*Zanclus cornutus*)	1	0	0	0	0
Ornate Butterflyfish (*Chaetodon ornatissimus*)	1	0	0	0	0
Longnose Butterflyfish (*Forcipiger longirostris*)	1	0	0	0	0
Cornetfish (*Fistularia commersonnii*)	1	0	0	0	0
Gray Reef Shark (*Carcharhinus amblyrynchos*)	1	1	0	0	1
Blackspot Sergeant (*Abudefduf sordidus*)	1	3	0	0	3
Manybar Goatfish (*Parupeneus multifasciatus*)	2	0	0	0	0

Blue Goatfish (*Parupeneus cyclostomus*)	3	0	0	0	0
Yellowstripe Goatfish (*Mulloidichthys flavolineatus*)	1	0	0	0	0
Hawaiian Hogfish (*Bodianus bilunulatus*)	1	1	1	0	2
Parrotfish spp. (Family *Scaridae*)	2	0	0	0	0

Table 2. Observations of terrestrial species showing positive bait interactions as evidenced by pyranine exposure during nocturnal terrestrial inert bait interaction surveys on Lehua Island, September 2015.

Species	**Observation**
American cockroach (*Periplaneta americana*)	Carried bait, consumed[(1)]
Beetle sp. (Order *Coleoptera*)	Consumed
Big-headed ant (*Pheidole megacephala*)	Carried bait, consumed
Centipede sp. (Class *Chilopoda*)	Positive biomarker[(2)]
Compost mite (Order *Acrina*)	Consumed
Cricket sp. (large bodied) (Order *Orthoptera*)	Consumed
Cricket sp. (small bodied) (Order *Orthoptera*)	Consumed
Isopod sp. (Order *Isopoda*)	Consumed
Oriental cockroach (*Blatta orientalis*)	Consumed
Shore bird sp.	Feces positive biomarker
Silverfish (*Lepisma sacharina*)	Consumed
Spider sp. (Order *Araneae*)	Consumed[(2)]
Unidentified guano	Positive biomarker[(3)]

[(1)]Positive biomarker in gut
[(2)]Consuming glowing insect
[(3)]Quarter-sized guano positive biomarker

Table 3. Observations of species interacting with inert pellet bait during marine surveys on Lehua Island, September 2015 (Manuel Mejia pers. comm [The Nature Conservancy Honolulu])

Species	**Observation**
Achilles Tang* (*Acanthurus achilles*)	Contact
Black DurgonTriggerfish (*Melichthys niger*)	Consumed bait
Blackspot Sergeant/Damselfish (*Abudefduf sordidus*)	Consumed bait
Bluestripe Snapper* (*Lutjanus fulvus*)	Consumed bait
Boomerang /Whiteline/Scythe Triggerfish (*Sufflamen bursa*)	Consumed bait
Bright-eye Damselfish (*Plectroglyphidodon imparipennis*)	Consumed bait
Butterfly fish sp. (Family Chaetodontidae)	Contact
Christmas Wrasse (*Thalassoma trilobatum*)	Consumed bait
Four-spotted Butterfly Fish (*Chaetodon quadrimaculatus*)	Consumed bait
Hawaiian Hog Fish* (*Bodianus albotaneniatus*)	Consumed bait
Hawaiian Sergeant (*Abudefduf abdominalis*)	Consumed bait
Hawaiian Wrasse (*Labroides phthirophagus*)	Consumed bait
Hermit Crab sp. (Superfamily Paguroidea)	Contact
Indo-Pacific Sergeant (*Abudefduf vaigiensis*)	Consumed bait
Lowfin Chub (*Kryphosus vaigiensis*)	Consumed bait
Oblong Urchin (*Echinometra oblonga*)	Contact
Orange-band Surgeonfish* (*Acanthurus olivaceous*)	Contact
Ornate Wrasse (*Halichoeres ornatissimus*)	Consumed bait
Pale Rock-boring Urchin (*Echinometra mathaei*)	Contact
Pinktail Triggerfish (*Melichthys vidua*)	Consumed bait
Potter's Angelfish (*Centropyge potteri*)	Consumed bait
Saddle Wrasse (*Thalassoma duperrey*)	Consumed bait
Spotted Boxfish (*Ostracion meleagris*)	Contact
Stocky Hawkfish (*Cirrhitus pinnulatus*)	Consumed bait
Surge Wrasse (*Thalassoma purpureum*)	Consumed bait
Triggerfish sp. (Family Balistidae)	Consumed bait

*Species known to be collected for human consumption

Table 4. Observations of species negative for pyranine exposure and not observed interacting with bait during nocturnal terrestrial inert bait and marine bait interaction surveys on Lehua Island, September 2015 (Manuel Mejia pers. comm [The Nature Conservancy Honolulu])

Species	**Observation**
Common house gecko (*Hemidactylus frenatus*)	Negative biomarker
Moth sp. (Order *Lepidoptera*)	Negative biomarker
Red-footed Booby (*Sula sula*)	Negative biomarker feces
Wedge-tailed Shearwater (*Puffinus pacificus*)	Negative biomarker feces
Convict Tang* (*Acanthurus triostegus*)	No interaction
Hawaiian Monk Seal (*Neomonachus schauinslandi*)	No interaction
Moorish Idol (*Zanclus cornutus*)	No interaction
Pacific Sailfin Tang (*Aebrasoma veliferum*)	No interaction
Surgeon Fish sp. (Family *Acanthuridae*)	No interaction
Unicorn Fish sp.* (*Naso* sp.)	No interaction
Yellowstripe Goatfish* (*Mulloidchthys flavoineatus*)	No interaction

*Species known to be collected for human consumption

Appendix H. Biosecurity Protocols

Table 1. Lehua Island Protocols and Procedures (LIPP)

Lehua Island Protocols and Procedures (Updated July 2008)

Trip Leader Responsibilities

Kaua‘i DOFAW would designate a trip leader for every group who would inform the group about all island rules and procedures and would also be responsible for the following:

- Making sure that all necessary permits have been obtained and all island drop-off and pick-up arrangements have been made, including contingency plans for weather delays
- Ensuring that the group brings sufficient food and water, including extra for weather delays
- Ensuring that communications and emergency evacuation plans are in place
- Ensuring that the camp site is kept in good order and all garbage and used water jugs are removed
- As requested by DOFAW, conducting supply inventories at the camp
- Checking to make sure all alien species prevention measures have been implemented

Alien Species Prevention

- BRING NO RODENTS…. NO INSECTS….AND NO SEEDS!!
- Inspect all Lehua gear and make sure it’s free of any rodents, insects, and seeds: this includes shoes, socks, clothing, other soft materials, camping gear, food and supplies
- Prior to helicopter take-off, inspect any slingload materials, including the nets, for alien species and minimize the amount of time slingloads and pallets are left out prior to transport to Lehua
- Use Int paved area of the heliport for loading, take-off and gear storage
- Seal all packages and gear tightly, especially food containers, and don’t leave them out where pests can get in
- If possible, pack on the day of departure to avoid bringing alien stowaways
- Do not bring fruits or vegetables with seeds (like tomatoes) to Lehua

Human Safety

- Be extremely careful where you walk and carry Int cell phone or walkie-talkie
- Report violations of seabird sanctuary regulations to Kaua‘i DOFAW at (808) 274-3433
- Document and photograph violations if possible, but do not attempt to enforce regulations

Monk Seal Avoidance

- Try to stay 100’ away from monk seals
- If a seal reacts to you, leave the area

Seabird Avoidance

- Whenever possible, stay on established trails
- Avoid walking close to nesting birds and any actions that flush birds, especially when they are sitting on eggs or have young chicks
- Stay alert for bird burrows and avoid crushing them; May through November is the peak nesting season for burrow-nesting species
- If you crush Int burrow, gently dig out the bird

Archaeological Site Avoidance

- Learn to recognize archaeological sites and the tags used to mark sites
- Never disturb any rock platform or rock pile, even small piles
- Avoid disturbing any marked site in any way
- Stay on established trails as much as possible
- If you find any artifacts or human remains, leave them alone and report the location and date of the discovery to Kaua‘i DOFAW at (808) 274-3443

Trash Disposal

- Leave no trace of human presence – bring all trash off the island

Table 2. Protocols Specific to the Lehua Island Ecosystem Restoration Project

Alien Species Introduction Prevention

The access by people to Lehua Island is by permit from DOFAW only. Unpermitted access is a violation of seabird sanctuary.

People, supplies, and equipment brought to Lehua Island pose the main risk for inadvertent Invasive Alien Species (IAS) introductions. People most frequently access Lehua Island by boat. Helicopters are used infrequently to transport cargo and people.

Plant seeds, invertebrates, reptiles, and rodents are the most likely things to be transported due to their size and their tendency to hide in recesses. Prevention (stopping the IAS before it gets to the island) is the most operationally efficient and cost effective way to prevent IAS establishment. The emphasis should be on preventing IAS getting to the island rather than trying to detect and eradicate them once they are present. However, if novel IAS are detected on Lehua, efforts for an appropriate rapid response would be considered.

The following section provides protocols to minimize the risk of introduction of these IAS and others to Lehua Island by human activities.

General Protocols:

Boats and Helicopters

- Be vigilant for biosecurity hazards at the port and aboard the vessel used for access to Lehua. If IAS are detected aboard the vessel, they must be removed prior to accessing Lehua.
- When contracting or chartering boats and helicopters, agreements should include the right to inspect the vessel and/or require necessary preventative measure be in place.
- Members of any party accessing Lehua Island would inspect all cargo immediately before loading onto the vessel. Attention would be placed on high-risk cargo such as food, timber, fabric, and other items that may attract or hide IAS.
- All cargo, including containers, boxes, bags, and gear loaded aboard vessels would be tightly sealed prior to loading to minimize opportunities for IAS access.
- Helicopters would use a paved area of the heliport at the point of origin for loading, take-off and sling operations.
- Prior to sling load operations, cargo and nets would be inspected for IAS. If possible, pack sling loads on the day of departure to minimize risk of stowaways. Store the sling loads away from sources and pathways of IAS.

Food and Waste

- Avoid consumption of fruits with gut resistant seeds (e.g. tomatoes, cucumbers and blackberries) prior to travel. Do not bring these fruits to Lehua Island. De-seeded, tinned, or cooked alternatives are safe to bring to Lehua Island.
- All fresh food brought to Lehua Island would be thoroughly washed, prior to departure.
- All food would remain sealed in pest free containers.
- All food would be inspected for the presence of IAS regularly.
- All food waste and packaging would be kept in sealed containers and removed from the island.
- Avoid defecating in the field: use the composting toilet at camp whenever possible.

People and Gear

- All gear, including shoes, socks, clothing, other soft materials, all Velcro, camping gear, food, and supplies would be inspected and sealed prior to departure to Lehua Island.
- All straps and pockets would be inspected prior to departure to Lehua Island.
- Boots would be scrubbed clear prior to use on Lehua Island.
- Store all gear, supplies and equipment away from sources and pathways of IAS, prior to departure.

Rapid response to IAS detection

- All people permitted to access Lehua should be vigilant and alert to the presence of novel IAS.
- In the case of detection of a novel IAS, permitted personnel must communicate the finding to DLNR immediately.
- DLNR would mobilize efforts as possible to mount a rapid response.
- Following the rat eradication operation, rats would be monitored for 1-2 years to confirm eradication. If rats are detected within that timeframe, a new eradication operation would be mounted as described in the EA.

Appendix I. Birdstrike Analysis Using Data from the Palmyra Atoll Rat Eradication.

Table 1. Species of birds estimated to be killed from collision with the helicopter during aerial operations for each action alternative, with number of individuals per species. Estimates are extrapolated from data from the Palmyra Atoll rat eradication project using flight hours (actual and projected), highest bird count per species per island, and total number of bird strikes per species on Palmyra. Other species of birds are not expected to experience collisions either because of low numbers or behavior that makes them less at risk. Greater numbers associated with diphacinone are due to more aerial applications resulting greater helicopter time.

Species	Highest bird count-Lehua	Highest bird count-Palmyra	Alternative 2 (diphacinone / brodifacoum)	Alternative 3 (brodifacoum)
Black noddy	220	8,000	2(1/1)	1
Brown booby	600	758	7(4/3)	3
Red-footed booby	1,500	7,000	2(1/1)	1
Red-tailed tropicbird	100	261	3(2/1)	1
White-tailed tropicbird	7	8	8(5/3)	3
Great frigatebird	150	400	8(5/3)	3
Golden plover	5	100	2(1/1)	1
Ruddy turnstone	7	39	2(1/1)	1
Cattle egret	10	NA	5(3/2)	1

Appendix J. Comparison of bathymetry and setting of islands where brodifacoum was detected in near shore marine organisms and Lehua Island.

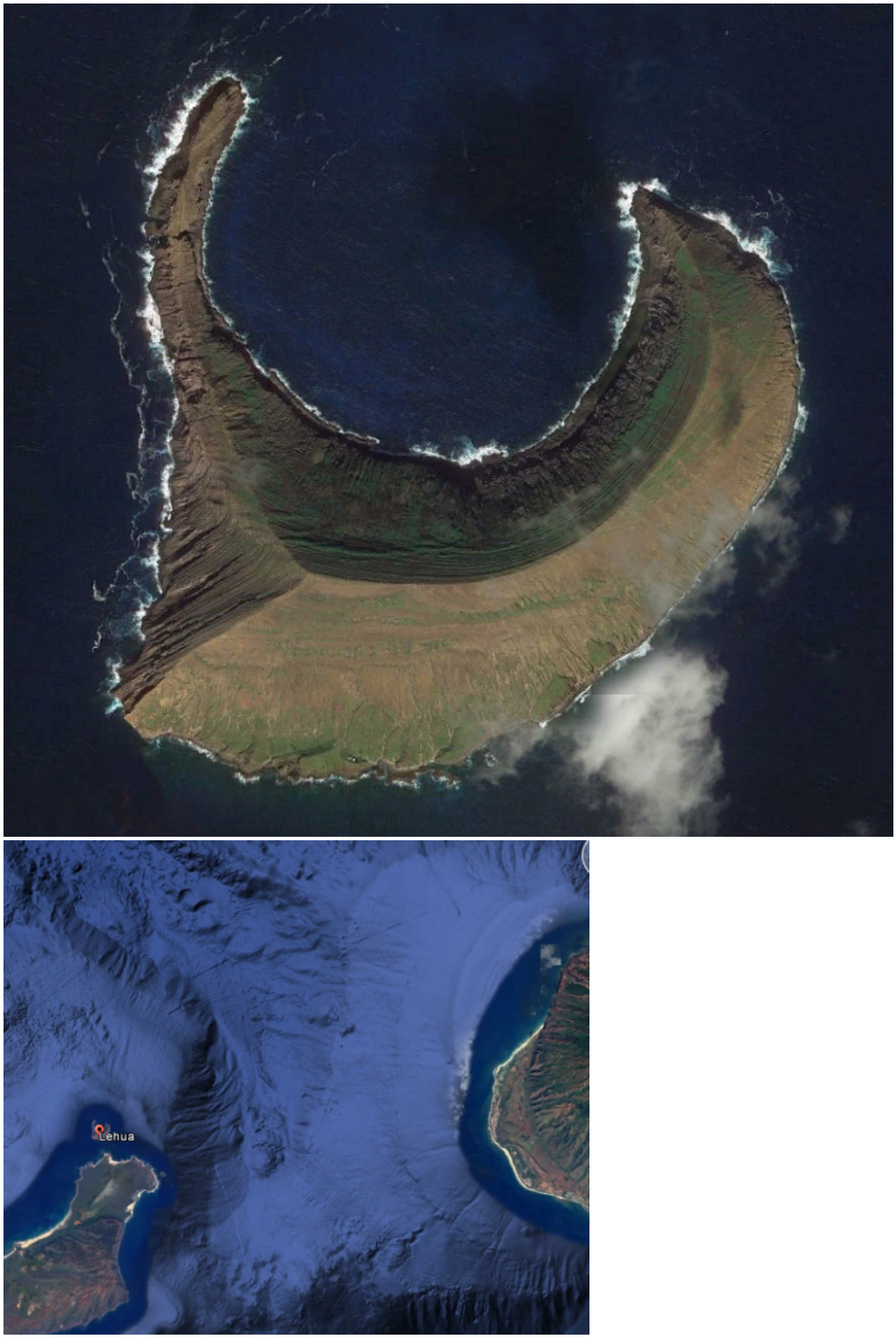


Figure 1. Google Earth image of Lehua Island and its relationship to Kauaʻi and Niʻihau. Lehua is approximately 1 km from Niʻihau and 30 km from Kauaʻi.

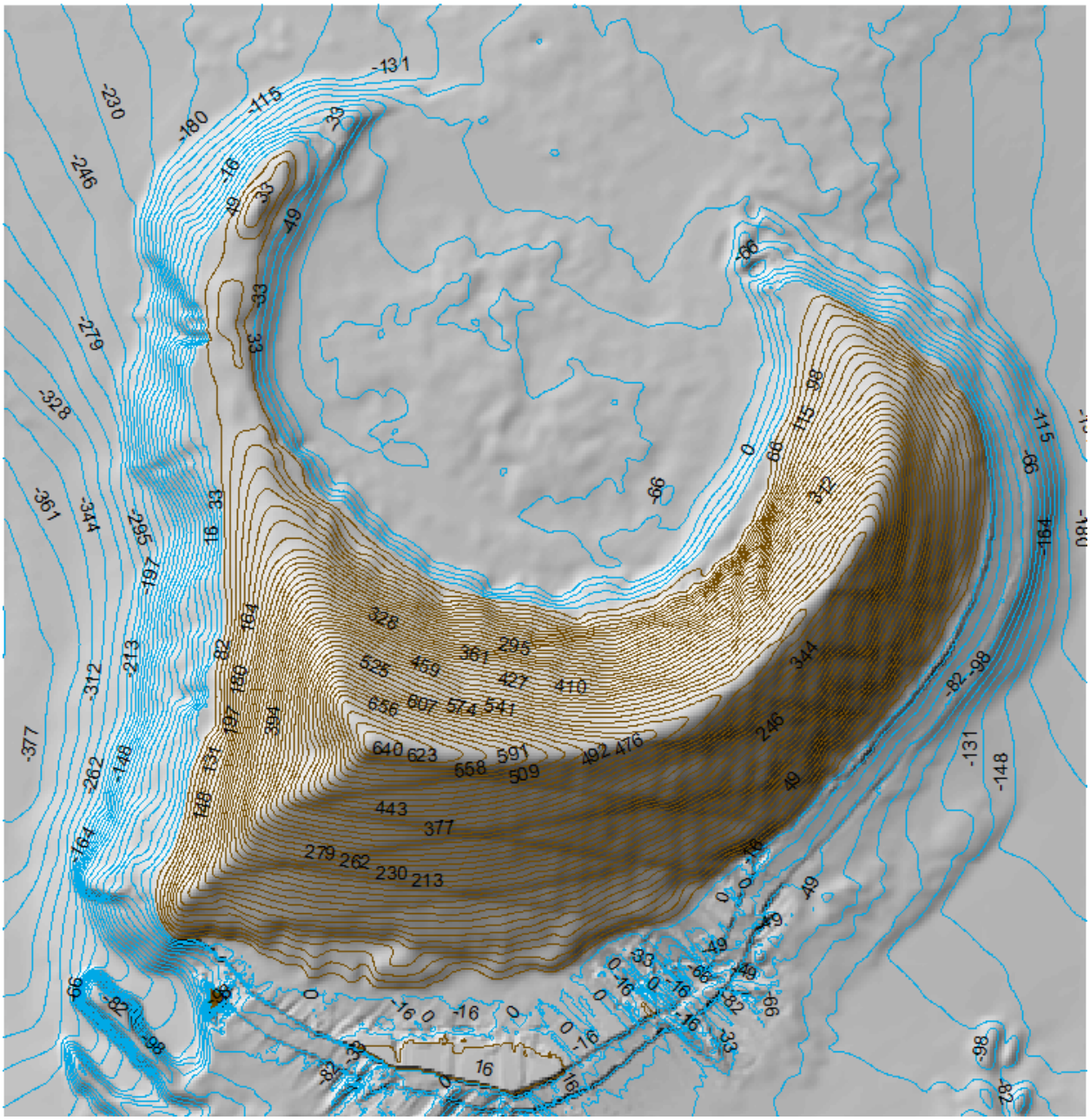


Figure 2. Lehua Island above sea level topography (brown lines) and below bathymetry (blue lines). Contour intervals are 16.4 ft. Maps used to generate the figure lacked bathymetric data for the area on the south shore and should be considered inaccurate.

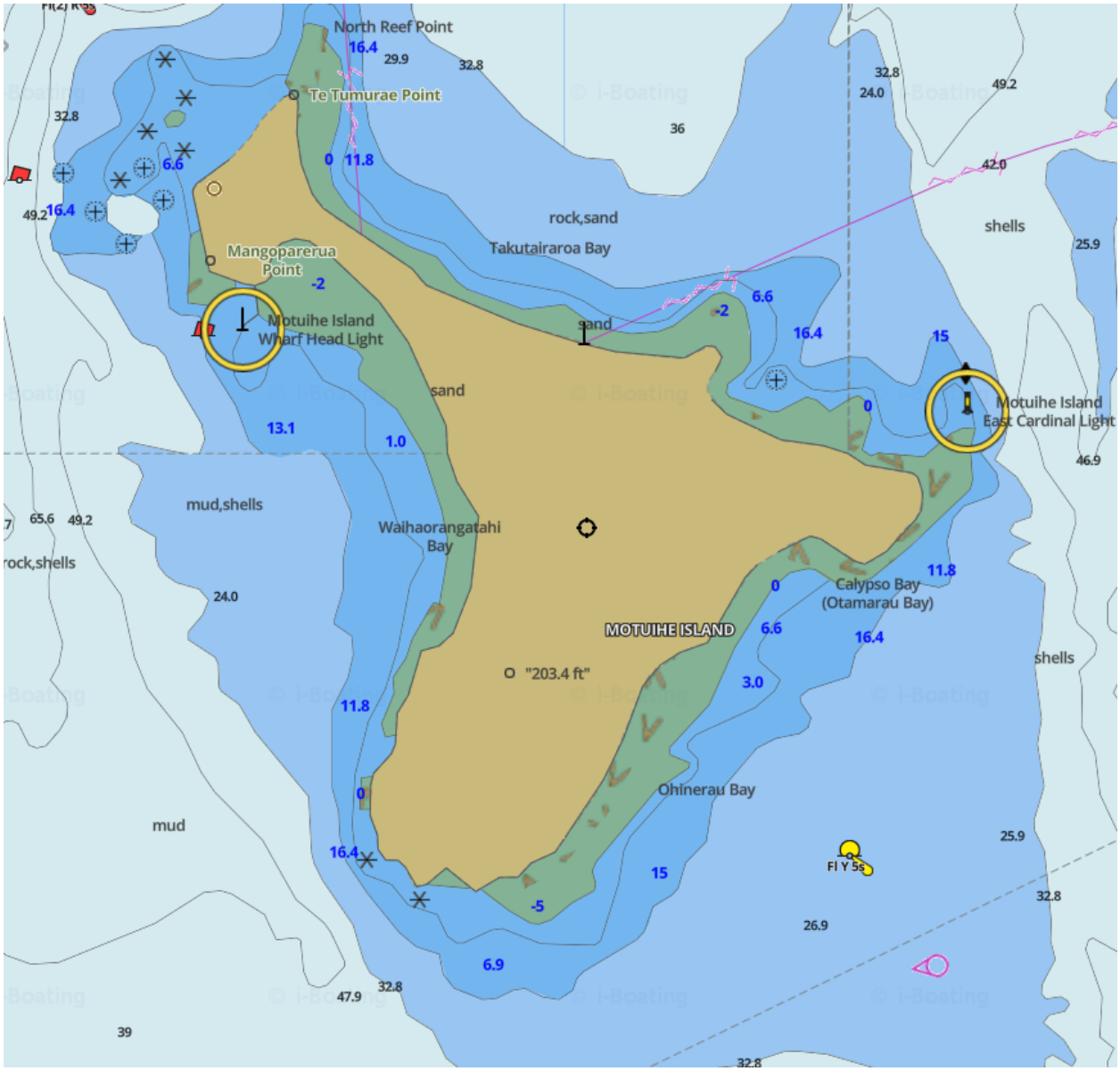


Figure 3. Motuihe Island, New Zealand bathymetry. Measurements are in feet and blue figures are below sea level.

Figure 4. Google Earth image of Motuihe Island, NZ.

Figure 5. Google Earth image of Motuihe Island, NZ in Kauraki Gulf.

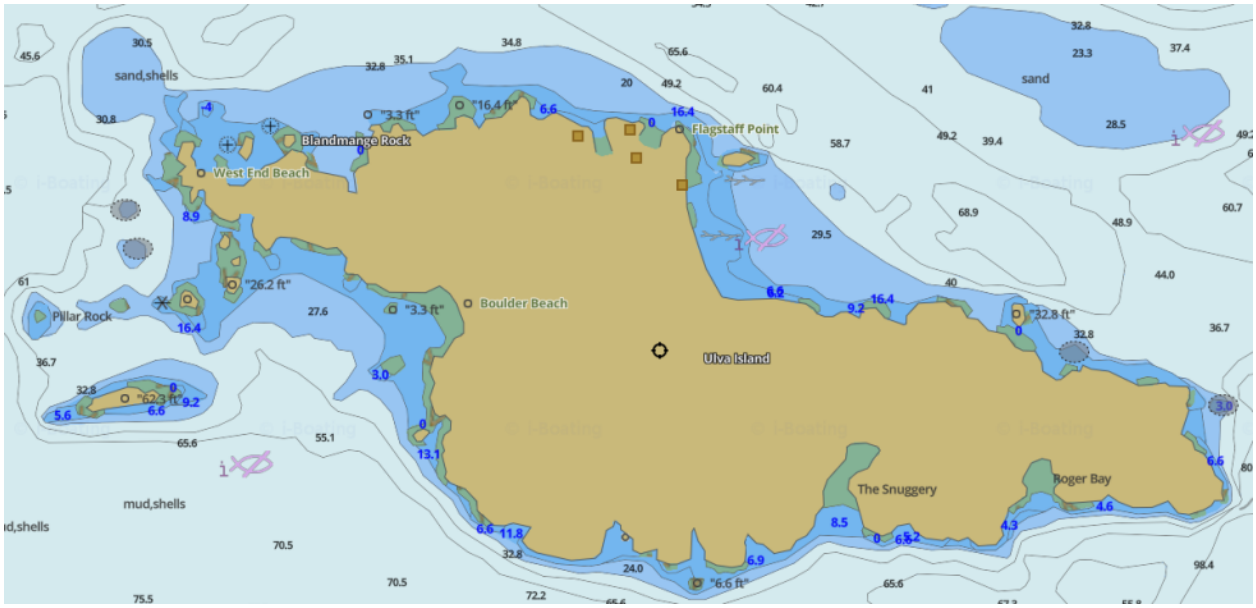


Figure 6. Ulva Island, New Zealand bathymetry. Measurements are in feet and blue figures are below sea level.

Figure 7. Google Earth image of Ulva Island, NZ.

Figure 8. Google Earth image of Ulva Island, NZ in Paterson Inlet.

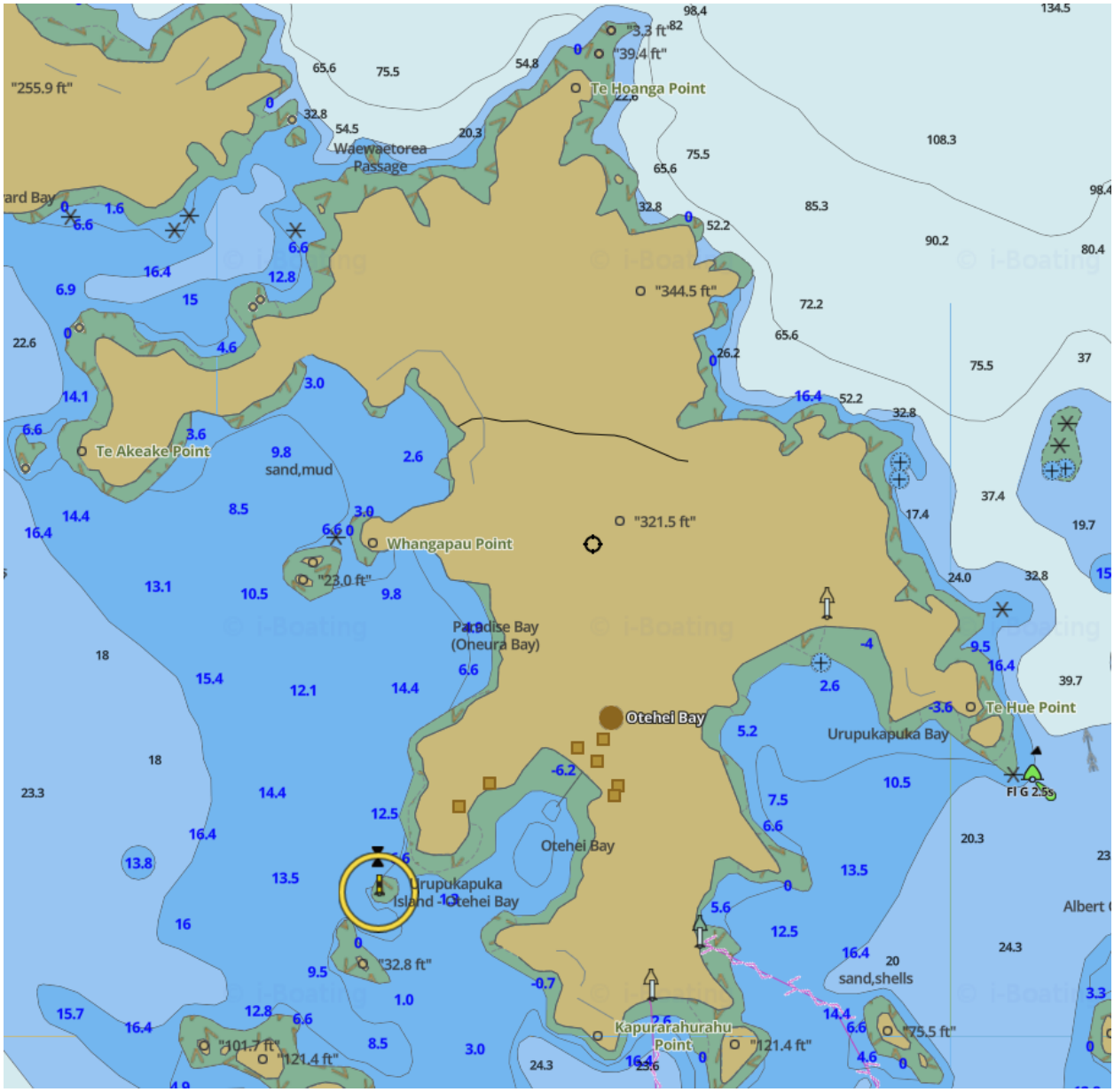


Figure 9. Urupukapuka Island, New Zealand bathymetry. Measurements are in feet and blue figures are below sea level.

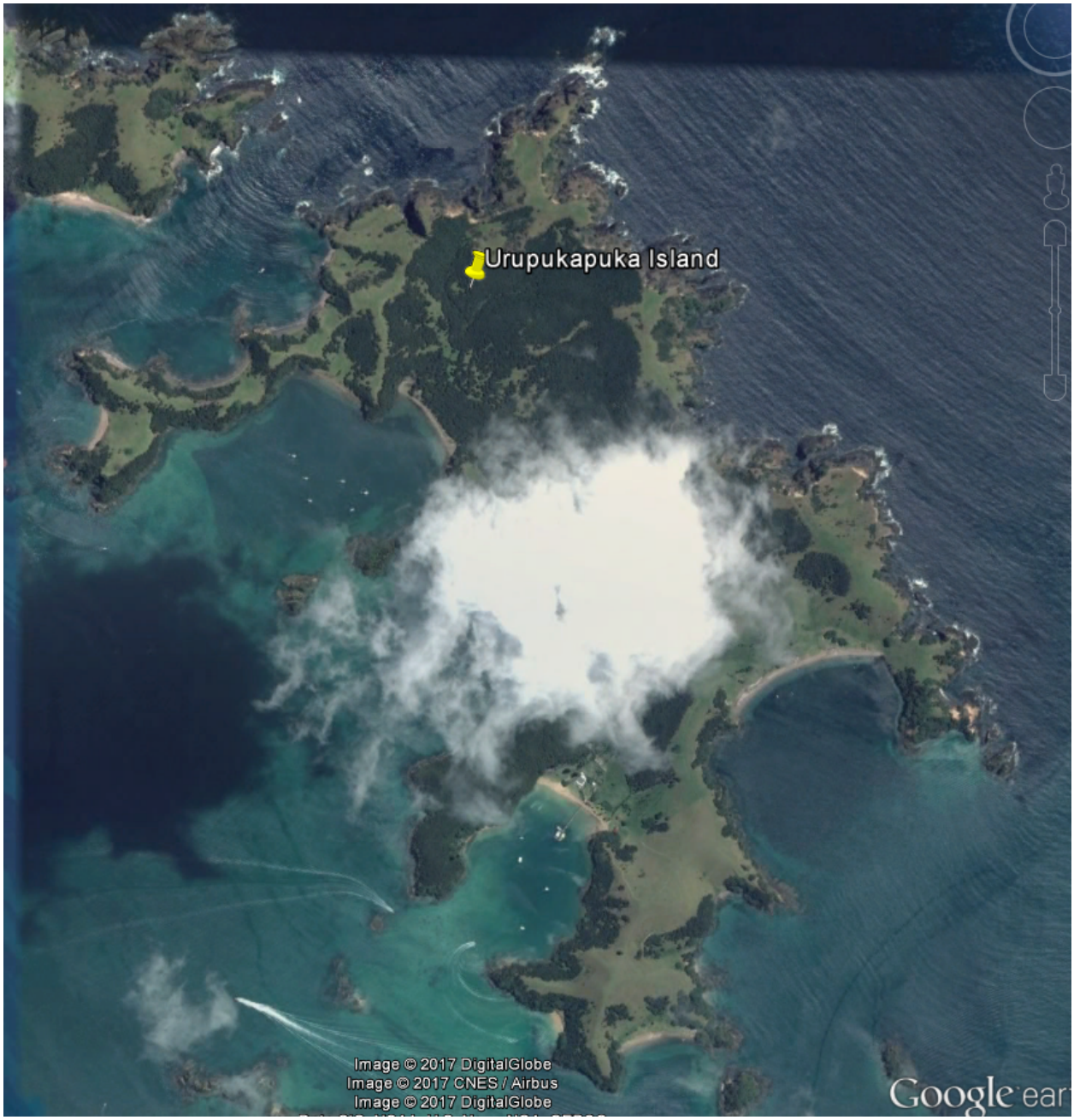


Figure 10. Google Earth image of Urupukapuka Island, NZ.

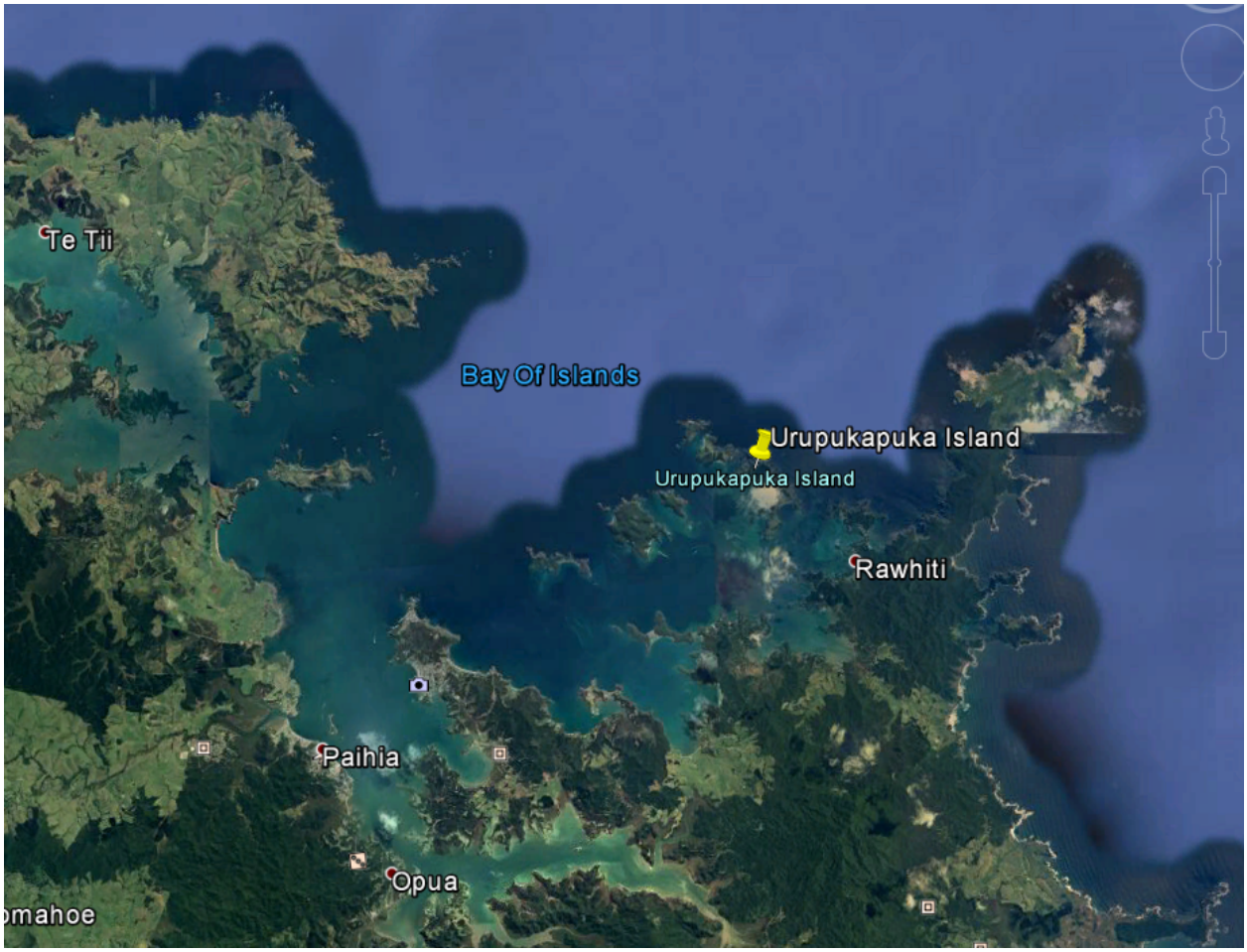
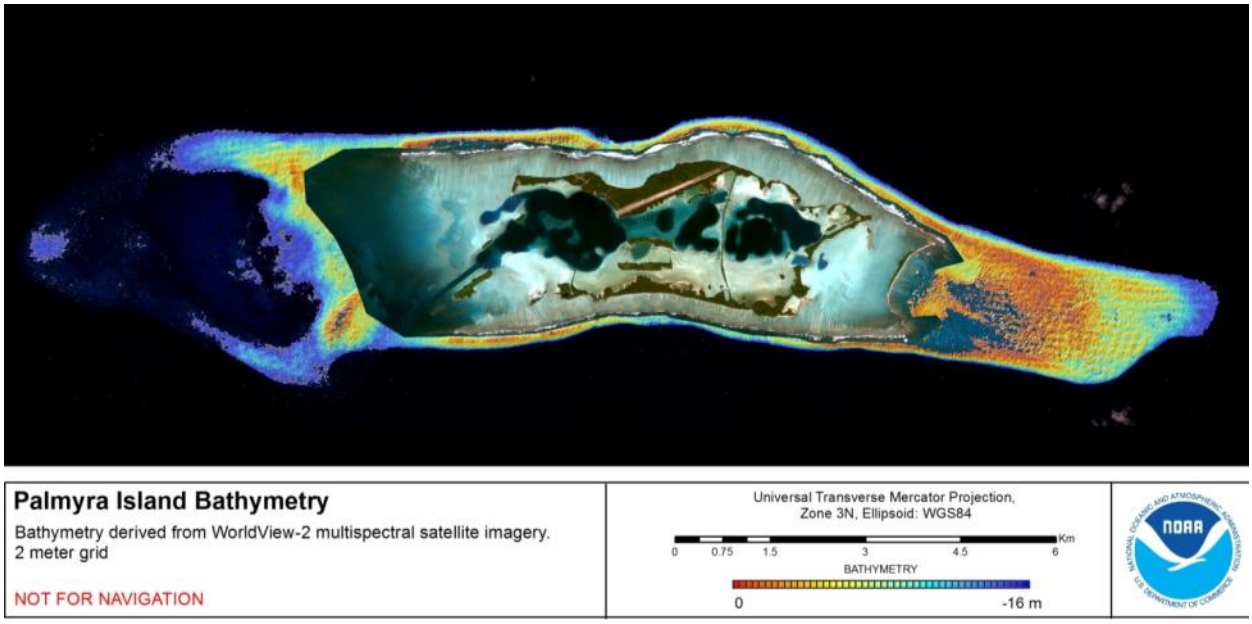


Figure 11. Google Earth image of Urupukapuka Island, NZ in Bay of Islands.



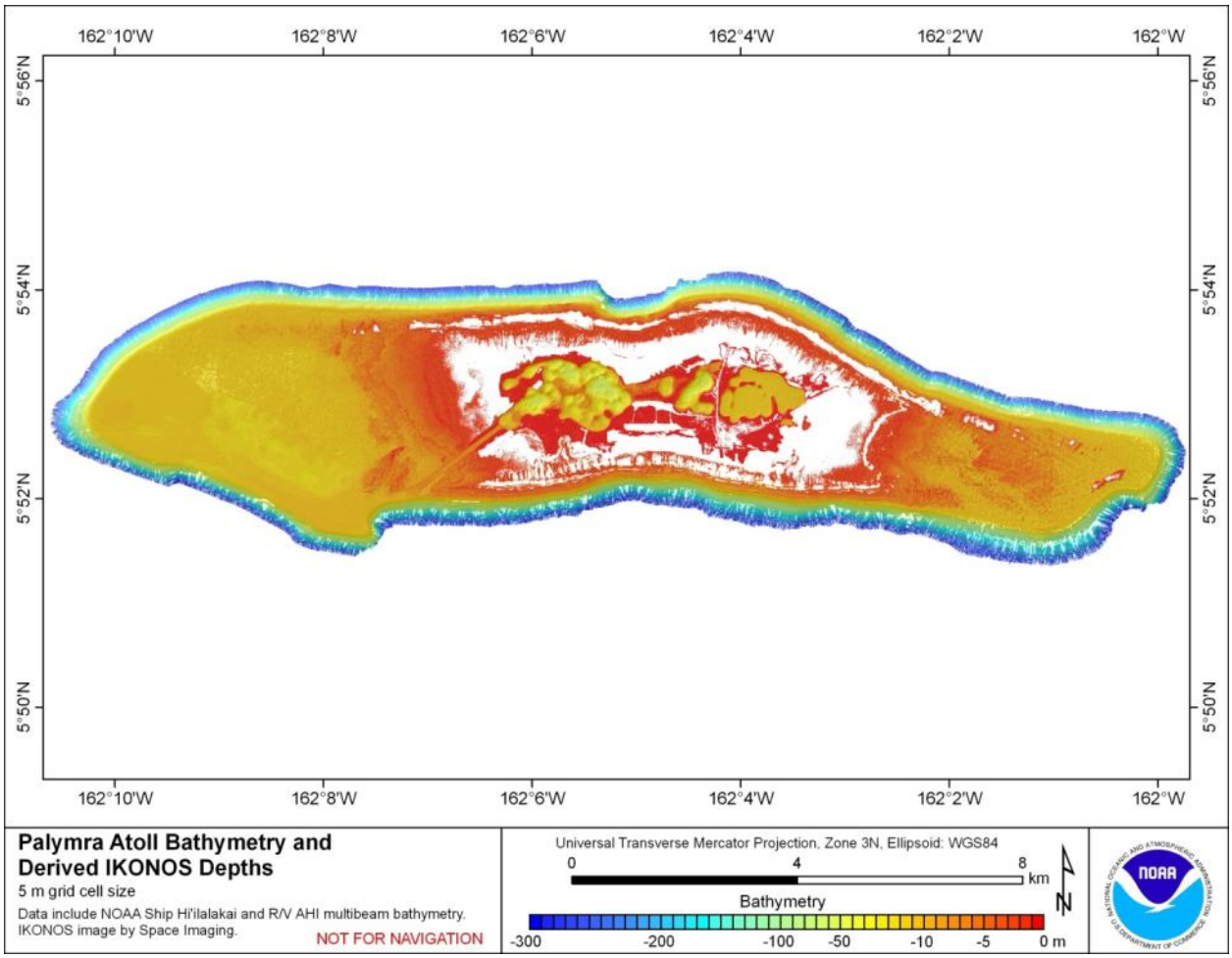


Figure 12. Palmyra Atoll bathymetry using multispectral satellite imagery and IKONOS.

Figure 13. Google Earth image of Palmyra Atoll.