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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 10, 2016

Director
Office of Environmental Quality Control
Department of Health, State of Hawaii
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

Dear Director:

Under the provisions of Act 172 (12), the Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) has determined at the outset that a Programmatic Environmental Impact Statement (PEIS) is required for Invasive Rodent and Mongoose Control and Eradication on U.S. Pacific Islands Within the National Wildlife Refuge System and in Native Ecosystems in Hawaii. A completed Bulletin Publication Form and a summary of the proposed action is enclosed (with a copy of the same sent via electronic mail to oeqc@doh.hawaii.gov).

Pursuant to the requirements of Section 11-200-3, Hawaii Administrative Rules, and Section 11-200-15, Hawaii Administrative Rules, we request that you publish public notice of this statutory determination in the next available periodic bulletin (Environmental Notice) for the public to submit comments to DLNR-DOFAW from publish date through April 7 in order to align with the federal PEIS process.

If there are any questions, please contact Patrick Chee at 808-587-4191.

Sincerely,

James Cogswell
Wildlife Program Manager
Division of Forestry and Wildlife

Copy: Governor
Enclosures: (1) Completed OEQC Publication form
(2) Summary description of action in electronic format

AGENCY PUBLICATION FORM

Project Name:	Programmatic Environmental Impact Statement (PEIS) for Invasive Rodent and Mongoose Control and Eradication on U.S. Pacific Islands Within the National Wildlife Refuge System and in Native Ecosystems in Hawaii
Project Short Name:	Rodent and Mongoose Control and Eradication PEIS
HRS §343-5 Trigger(s):	Projects that will tier from this PEIS will potentially use State funds and the actions will potentially be done on State lands.
Island(s):	Statewide
Judicial District(s):	
TMK(s):	
Permit(s)/Approval(s):	
Proposing/Determining Agency:	Department of Land and Natural Resources, Division of Forestry and Wildlife
Contact Name, Email, Telephone, Address	Patrick Chee, patrick.c.chee@hawaii.gov 808-587-4191 1151 Punchbowl St. Rm. 325 Honolulu, HI 96813
Accepting Authority:	Governonor David Ige, State of Hawaii
Contact Name, Email, Telephone, Address	415 South Beretania St. #5 Honolulu, HI 96813
Consultant:	NA
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.
____ 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.
__X__ 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
Provide a description of the proposed action and purpose and need in 200 words or less.

The Hawai'i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), and the U.S. Fish and Wildlife Service (FWS) intend to prepare a Programmatic EIS (PEIS). The Draft PEIS will analyze the impacts of, and alternatives to, using Integrated Pest Management (IPM) to control or eradicate invasive rodents and mongooses in native ecosystems within the State of Hawai'i and on other U.S. Pacific islands (to be determined) within the Hawaiian and Pacific Islands National Wildlife Refuge Complex, administered by the FWS Refuge System, to protect native wildlife and plants, including federally listed threatened and endangered species and designated critical habitats. The principles of IPM are a way to strategically guide pest management planning and implementation. DOFAW and FWS may use this IPM approach on the lands they administer in Hawai'i and elsewhere in the Pacific, and in habitat restoration projects they fund. Land ownership where this approach could be utilized includes Federal, State, County and private. This PEIS, however, only creates a planning document and no specific sites will be part of this process. In order to run concurrent with the Federal PEIS process, DOFAW will hold its comment period open until April 7.

Environmental Impact Statement Preparation Notice (EISPN)

for Invasive Rodent and Mongoose Control and Eradication on U.S. Pacific Islands within the National Wildlife Refuge System and in Native Ecosystems in Hawai‘i

Photo courtesy of © Jack Jeffrey Photography

Joint Lead Agencies:

State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife

Joint Lead Agency: U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai‘i

[Date]

Summary

Introduction

The State of Hawai‘i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), and the U.S. Fish and Wildlife Service (FWS) intend to prepare a Programmatic EIS (PEIS) in compliance with the National Environmental Policy Act (NEPA), 40 CFR §§ 1500-1508 and the State of Hawai‘i environmental review process, as defined by Chapters 201N and 343 of the Hawai‘i Revised Statutes (HRS) and Title 11 Chapter 200 of the Hawai‘i Administrative Rules (HAR).

This Draft PEIS will analyze the impacts of, and alternatives to, using Integrated Pest Management (IPM) to control or eradicate invasive rodents and mongooses in native ecosystems within the State of Hawai‘i and on other U.S. Pacific islands (to be determined) within the Hawaiian and Pacific Islands National Wildlife Refuge Complex (HPINWRC), administered by the U.S. Fish and Wildlife National Wildlife Refuge System (Refuge System), to protect native wildlife and plants, including federally listed threatened and endangered species and designated critical habitats. The principles of IPM are a way to strategically guide pest management planning and implementation. DOFAW and FWS may use this IPM approach on the lands they administer in Hawai‘i and elsewhere in the Pacific, and in habitat restoration projects they fund. The agencies may also recommend that it be incorporated into habitat conservation plans and other applications for ESA permits, as appropriate. Land ownership where this approach could be utilized includes Federal, State, County and private.

Issues identified through preliminary scoping may meet some of the significance criteria listed under HAR §11-200-12; therefore DOFAW and FWS have determined that an EIS is appropriate for evaluating the proposed approach to rodent and mongoose control and eradication.

Consideration of potential impacts to Native Hawaiian cultural and subsistence activities such as fishing, use of traditional cultural sites and gathering medicinal plants will be included in a Cultural Impact Assessment prepared for the Draft PEIS.

This Environmental Impact Statement Preparation Notice (EISPN) is being prepared in conjunction with the Notice of Intent (NOI) that was published in the *Federal Register* on June 30, 2015, per NEPA. The purpose of both the EISPN and the NOI is to provide an opportunity for comment by reviewing agencies, Native Hawaiian and other governmental and nongovernmental entities and the public, to ensure that the Draft PEIS fully and adequately addresses environmental concerns in its evaluation of impacts and benefits to the the people and resources of Hawai‘i and that all actions within the proposed program are planned effectively with the fewest adverse impacts. The accepting authorities for the Final PEIS are the Governor of Hawai‘i, and the Director of Region 1 for FWS.

The PEIS is for informational and planning purposes to improve and facilitate rodent and mongoose control; it does not initiate any specific action or project. All future projects proposing to tier from

this PEIS will be subject to site-specific NEPA and/or HRS 343 analyses consistent with Federal and State procedures. The ability to tier from the PEIS would provide efficiencies for the site-specific NEPA compliance process. Site-specific projects would also need to comply with all other applicable legal requirements for such projects.

Alternatives

Preliminary scoping has identified the no action alternative, a possible proposed action, and other potential alternatives summarized in the following Table:

Action/Alternative	Description	
	Is it an IPM Approach?	**Methods to be included**
Proposed Action: Ground and Aerial IPM	Yes	Mechanical; all toxicant application methods; use of diphacinone, chlorophacinone, brodifacoum.
No Action	No/some	State of HI - mechanical; bait station (diphacinone only); U.S. Pacific islands within the HPINWRC - current techniques already approved under environmental compliance.
Ground-only IPM Alternative	Yes	Mechanical; bait station, hand broadcast; use of diphacinone, chlorophacinone, brodifacoum.
Current methods within the Main Hawaiian Islands, with additional uses of diphacinone on offshore islands	Yes	Main Hawaiian Islands - mechanical; bait station (diphacinone only); uninhabited offshore islands within the Main Hawaiian Islands and on other U.S. Pacific islands (to be determined) within the HPINWRC - application of diphacinone in bait stations, and by canopy baiting, hand and aerial broadcast.

Preliminary Issues

The following issues have been identified through preliminary scoping for the Proposed Action, No Action Alternative, and other Alternatives. Criteria for determining the significance of impacts for each of these issues will be developed in the Draft PEIS, and each issue will be evaluated for direct, indirect, and cumulative impacts, and for short-term and long-term effects on the human environment. With this notice, DOFAW requests comments, recommendations, and advice on issues, alternatives, and mitigation to be addressed in the Draft PEIS, including but not limited to:

- The potential to increase or decrease populations of native species, especially those that are rare;

- The potential to impact species protected under the Federal and State Endangered Species Acts, the Marine Mammal Protection Act, and the Migratory Bird Treaty Act, and other terrestrial species;
- The potential to impact populations of other non-target invasive species;
- The potential to impact game animals;
- The humaneness of rodent and mongoose control or eradication methods on target and non-target species;
- The potential to impact Native Hawaiian religious cultural rights and practices;
- The potential to impact the ability of Native Hawaiians to exercise their traditional and customary gathering rights for subsistence;
- The potential to impact archaeological and cultural resources; and
- The potential to counteract declines in population levels of native species that are also declining due to the effects of climate change.

In addition, the following issues specific to the use of rodenticides will be addressed:

- The potential for the use of each of the three rodenticides to impact soils, surface waters, and groundwater, including movement of rodenticides through water-based (e.g., riparian or stream) ecological systems;
- The potential for the use of each of the three rodenticides to impact freshwater fish and invertebrates;
- The potential for the use of each of the three rodenticides to impact marine species, including, but not limited to, fish, invertebrates, and corals;
- The potential for the use of each of the three rodenticides to impact essential fish habitat; and
- The potential for the use of each of the three rodenticides to cause human health impacts from consumption of meat from mammals, birds, fish and shellfish, and from drinking water.

Providing Comments

We are seeking comments, information and suggestions from the public, interested government agencies, Native Hawaiian organizations, the scientific community, and other interested parties regarding the objectives, proposed action, and alternatives that we have identified and described above. When submitting comments or suggestions, explaining your reasoning will help us evaluate your comment or suggestion. We are particularly interested in information related to the following questions:

(1) What do you think about protecting native species and ecosystems from introduced rodents and mongooses?

(2) Under what circumstances do you think they should be controlled and eradicated?

(3) Are there additional criteria for evaluating methods for rodent and mongoose control and eradication that we have not considered?

(4) Should the criteria for evaluating methods for rodent and mongoose control and eradication be modified in any way?

(5) How would you balance these criteria when evaluating the methods?

(6) What recommendations or suggestions would you make regarding the methods that are proposed for evaluation?

(7) Are there any other methods for rodent and mongoose control that should be included? If so, please describe them in sufficient detail so that they can be evaluated.

(8) Should any of the identified alternatives be modified?

(9) Are there any other alternatives that should be considered? If so, please describe them in sufficient detail so that they can be evaluated.

(10) Are there issues not included in the list above that should be addressed?

(11) The process of determining the significance of impacts to resources is unique to each resource, and is based upon the context and intensity of the impacts. The context refers to the setting of where the proposed action may occur, the affected areas or locations, the resource affected, and the proposed action's short and long-term effects. The intensity refers to the severity of the impact. The evaluation of significance will rely upon information received during scoping, and may be modified as information is revealed through the analyses. Are there resources for which you can identify criteria that should be used to begin to determine the significance of the impacts to these resources? Please include your thoughts on the context and intensity of the effects.

You may request to be added to the Service and DOFAW contact list for distribution of any related public documents. Information on the Draft PEIS is also available on the web at http://www.removeratsrestorehawaii.org. Special mailings, newspaper articles, and other media announcements will inform interested and affected persons, agencies, and organizations of the opportunities for meaningful involvement and engagement throughout the planning process for the proposed IPM approach, including notices of public scoping meetings and notices of availability of the Draft and Final PEIS. This notice will be provided to Federal, State, and local agencies, and Native Hawaiian and other potentially interested organizations, groups, and individuals for review and comment.

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CHAPTER 1. PURPOSE AND NEED FOR ACTION

INTRODUCTION

The presence of nonnative rodents and mongooses in Hawai‘i has resulted in, or contributed to, the extinction or endangerment of many native species. The loss of native species also threatens Native Hawaiian cultural practices that rely on these species.

The rodent species that have spread out of their natural ranges to successfully colonize new areas possess the following traits: comfortable living with or around people but also able to thrive in wild habitats; flexible diets; and high reproductive rates (Macdonald and Fenn 1994). When rodents are introduced to islands, they are able to survive and reproduce quickly, and their offspring and subsequent generations disperse widely. Their populations typically increase rapidly and reach high densities, decimating native species (Harper and Bunbury 2015).

Mongooses have been deliberately introduced on some oceanic islands with the intent to control invasive rodents; however, rather than controlling or eradicating rodent populations, mongooses have coexisted with rats and mice, and instead caused the decline or extinction of native bird, amphibian, reptile and mammal species (Seaman and Randall 1962, Nellis and Small 1983, Roy *et al*. 2002, Watari *et al*. 2008).

Prior to the arrival of humans, only two species of terrestrial mammals were native to the Hawaiian Islands – the Hawaiian hoary bat (‘ōpe‘ape‘a, *Lasiurus cinereus semotus*) and an undescribed bat known only from prehistoric bone deposits. Currently, four species of rodents (three rat and one mouse *spp.*), the small Indian mongoose (*Herpestes auropunctatus*), feral domestic cats and dogs, feral pigs, goats, cattle, sheep and other ungulates are found widely throughout the Hawaiian Islands (Hess *et al.* 2009, Tomich 1986). The Polynesian rat (*Rattus exulans*) and the black rat (*R. rattus*) are the most abundant rat species found in the wild, in dry to wet habitats (Sugihara 1997, Lindsey *et al.* 1999, Cole *et al.* 2000). The Norway rat (*R. norvegicus*) is typically found in man-made habitats such as urban areas or agricultural fields (Tomich 1986, Tobin and Sugihara 1992), although it is occasionally trapped in Hawaiian forests (Lindsey *et al.* 1999). In addition, a species of, or multiple species of, commensal mouse (*Mus* spp.) occurs throughout the islands (Tomich 1986). Mice are the only invasive rodent still present in the Northwestern Hawaiian Islands (NWHI), on Midway Atoll.

For some native Hawaiian species, rodents are the primary threat, and for others, their effects may be less severe, but may still be a significant factor that impedes recovery. Depredation by rats and mice has been documented on Hawaiian plants (e.g., Cuddihy and Stone 1990), insects (e.g., Cole *et al.* 2000), land snails (e.g., Mosher *et al.* 2010), forest birds (e.g. Snetsinger *et al.* 2005), waterbirds (e.g., Eijzenga 2004), and seabirds

(e.g., Hodges and Nagata 2001). In addition, rats may predate on the Hawaiian hoary bat, and the eggs and hatchlings of green and hawksbill sea turtles (honu, *Chelonia mydas* and honu ʻea, *Eretmochelys imbricate*), since rat predation on other species in these groups has been documented outside of Hawaiʻi (e.g., Fellers 2000, Caut *et al.* 2008, Cuervo 2004). Given the breadth of Hawaiian species affected by rodents, and the sheer numbers of rodents present, the magnitude of their impacts has devastated and continues to negatively alter Hawaiian ecosystems.

Mongooses are widely distributed and well established in Hawaiʻi on the islands of Oʻahu, Maui, Molokaʻi, and Hawaiʻi Island. Their possible introduction to Kauaʻi is still under investigation. Mongooses in Hawaiʻi feed on a wide variety of prey and locally available food, eating terrestrial vertebrates (reptiles, birds, rodents, amphibians), invertebrates (insects, spiders, crabs), and carrion and small fruits in lesser amounts (Baldwin *et al.* 1952). Their impacts on many of Hawaii's endangered birds are well-documented, including evidence of mongooses attacking the adults of Hawaiian goose (nēnē, *Branta sandvicensis*) (Banko 1982, Banko 1992), the Hawaiian crow (ʻalalā, *Corvus tropicus*) (P. Harrity, pers. obs.), the Hawaiian common gallinule (ʻalae ʻula, (*Gallinula chloropus sandvicensis*) at Ukoa Pond, Haleiwa, Oʻahu (A. Henry and D. DesRochers, pers. obs.), and at Ohiapilo, Molokaʻi, (L. Tanino and C. Cowles, pers.obs.), and the Hawaiian petrel (ʻuaʻu, *Pterodroma sandwichensis*) (Bryan 1908, Hodges and Nagata 2001). Mongooses take eggs and young as well, reducing the reproductive success of nēnē (Banko 1982, Hoshide *et al.* 1990, Banko 1992, Baker and Baker 1995), ʻalalā (Giffin 1983), the Hawaiian stilt (aeʻo, *Himantopus mexicanus knudseni*) (Eijzenga 2004; A. Dibben-Young, unpubl data), and the Hawaiian petrel (Bryan 1908, Hodges and Nagata 2001). The mongoose may also affect native plant and invertebrate populations, given their omnivorous diet and wide distribution in native habitats (Bryan 1908, Baldwin *et al.* 1952, Tomich 1986, Hodges and Nagata 2001). Beccari and Rock (1921) noted that for the *Pritchardia* species of palms "mature seeds are very scarce owing to rats and mongooses which eat the fruits as soon as they have fallen."

Federal and State agencies have invested considerable resources into rodent and mongoose management and control because of their devastating impacts on native ecosystems and on federally and state-listed threatened and endangered species in Hawaiʻi. Native species needing protection from rodents and mongooses are found in fragmented small areas, such as wetlands or coastal areas, and in large continuous swaths of native forest. The control projects currently conducted in the Main Hawaiian Islands are limited to an extremely small scale by circumstances such as topography, land ownership boundaries, remoteness and costs. However, rodents and mongooses are widespread and reach high population densities not only in human-altered areas but also in relatively intact native ecosystems. No natural or man-made features within the islands impede their distribution. Thus, small-scale control efforts are overwhelmed by

new individuals replacing those removed, and control must be done either continuously or repeatedly. Hawaii's native species will require protection from rodents and mongooses in perpetuity.

Introduced rats and mice are also present on some uninhabited offshore islands within the Main Hawaiian Islands (MHI) and other U.S. Pacific islands within the Pacific Islands National Wildlife Refuge Complex (HPINWRC) such as the atolls of Midway, Wake and Johnston. Eradication techniques need to be available for uninhabited offshore islands within the MHI and on other U.S. Pacific islands within the HPINWRC to quickly respond to new rodent introductions as well as to eradicate existing rat and mouse populations.

Effective rodent and mongoose control and eradication is essential to halt further declines and extinctions of many species, particularly those listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA) and protected by the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712).

NEED FOR ACTION

DOFAW and FWS need an approach to rodent and mongoose control and eradication that not only results in documentable benefits to native species, but which also is compatible with other resource uses, such as for fresh water, hunting and fishing, and Native Hawaiian cultural practices. Resource management in Hawai‘i is often evaluated within the context of the ahupua‘a, the pre-Western-contact system of land division typically extending from the mountains into the sea, including the nearshore marine environment. Under this ecosystem model, actions taken anywhere within an ahupua‘a are understood to have the potential to affect the entire ahupua‘a and even other ahupua‘a as well.

Because the number of native species affected by rodents and mongooses is so high, and the total area over which native species are distributed on the Main Hawaiian Islands is so large, the effectiveness and the scale over which rodent and mongoose control is conducted must both be increased substantially. The approach should incorporate methods to assess the effectiveness of the control and to detect and quantify indirect and cumulative effects resulting from the control. In New Zealand, these concepts are successfully used to protect native plant and animal species from rodents. The population dynamics of native species are first modelled in relation to different levels (indices) of rodent control, as measured by footprint-tracking tunnels and/or snap-traps placed throughout the treatment area. Levels of reproductive success, survival, and population growth of the native species are then correlated with specific indices of rodent activity (e.g., Armstrong *et al.* 2006). Rodent control efforts are adjusted to meet the target indices of rodent activity that yield the desired effect on the native species' populations.

IPM AND RELEVANT FEDERAL AND STATE LAWS, REGULATIONS, POLICIES, AND PLANS

Principles of Integrated Pest Management

This approach is consistent with Integrated Pest Management (IPM). Federal law (7 U.S.C. § 136r–1) (Integrated Pest Management) directs Federal agencies to use IPM techniques in carrying out pest management activities. The Department of the Interior and FWS policies (517 DM 1, 569 FW 1) require that all pest management activities conducted, approved, or funded by FWS, on or off FWS lands, be conducted using IPM. IPM is described by the U.S. Environmental Protection Agency (EPA), the National Park Service (NPS), and FWS as a process that relies on knowledge of the pest's population dynamics and behavior to design the most effective combination of methods for managing the pest. These can include cultural, mechanical, chemical, and/or biological control tools. IPM incorporates flexibility of the methods in order to match the most effective tools with the goals established for the pest control. A fundamental principle of IPM, as stated in the FWS's Guidance for Preparing and Implementing Integrated Pest Management Plans (2004), is to "select those methods, or combination of methods, that are feasible, efficacious, and yet most protective of non-target resources, including wildlife, personnel, and the public." It is distinguished from other pest management approaches by its emphasis on establishing action thresholds, monitoring, and ongoing evaluation of the effectiveness and the risks of the control methods selected. The target pest activity must be monitored within the treatment area and, following principles of adaptive management, the methods may be adjusted or changed to respond to pest behavior, pest population levels, and non-target impacts. The IPM process directly lends itself to informing adaptive management decisions.

Relevant Legal Consistency Analyses

The analysis of the proposed action and alternatives in the Draft PEIS will include consideration of the need to implement rodent and mongoose control and eradication in compliance with applicable Federal and State laws and regulations such as the Endangered Species Act, the Clean Water Act, Section 106 of the National Historic Preservation Act, the American Indian Religious Freedom Act, the Coastal Zone Management Act, Hawai'i State Wildlife Action Plan, DLNR's watershed protection initiative, the FWS's Pacific Islands Fish and Wildlife Office Strategic Plan (USFWS 2012), and the 2008 Management Plan for the Papahānaumokuākea Marine National Monument. The PEIS will support a phased decision making process that provides compliance for some of the statutory and regulatory requirements listed above at the programmatic level, and will attempt to identify and describe other requirements that must be deferred until a subsequent site-specific proposal is developed. Each

implementing entity would be responsible for ensuring that all applicable statutory and regulatory requirements are met for a specific project.

The use of pesticides is regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. §136 et seq.) and the Hawai‘i Pesticides Law (HRS 149A). No special provisions exist under FIFRA for the use of pesticides for conservation purposes; these uses must comply with the same requirements for effectiveness and safety that apply to agricultural and public health uses. Any use of a rodenticide for conservation purposes considered by this PEIS would need to be covered by pesticide labeling approved by the EPA and the State of Hawai‘i Pesticides Branch.

PURPOSE OF ACTION

The purpose of this proposal is to develop, and make available to conservation entities in Hawai‘i, an effective, comprehensive, and landscape-level IPM approach to rodent and mongoose management based on sound ecological principles, and in compliance with State and Federal pesticide laws and regulations. The specific objectives of this approach will be to:

(1) Protect native species in Hawai‘i and on other U.S. Pacific islands (to be determined) within the HPINWRC from the impacts of rodents and mongooses;

(2) Increase populations of native species important to Native Hawaiian culture;

(3) Identify effective methods for rodent and mongoose control and eradication that are compatible with and safe for all natural resources and the human environment;

(4) Facilitate the effective and cost-effective use of these methods in Hawai‘i and on other U.S. Pacific islands (to be determined) within the HPINWRC; and

(5) Comply with the Endangered Species Act, Migratory Bird Treaty Act, and other Federal and State laws and regulations.

In accordance with this approach, the PEIS process will:

(1) Collect quantitative and qualitative documentation of rodent and mongoose impacts to native species in Hawai‘i;

(2) Using the documentation from step 1, assess the need for rodent and mongoose management;

(3) Evaluate the effectiveness of past and current rodent and mongoose control and eradication projects;

(4) Evaluate the suitability of rodent and mongoose control methods not previously used in Hawai‘i;

(5) Identify impacts on the human environment (interpreted comprehensively under NEPA to include 'the natural and physical environment and the relationship of people with that environment') from the implementation of each rodent and mongoose control method considered, and develop criteria for significance compliant with HRS 343;

(6) Identify consistent standards for rodent and mongoose management project implementation, including standards for monitoring, and for thresholds and triggers requiring remedial action for any significant impacts on the human environment caused by these projects; and

(7) Develop the components required of an adaptive management approach (per the Department of the Interior's Guidance on Coordinating Adaptive Management and NEPA Processes (OEPC ESM 13-11)).

Site-specific projects will be subject to additional HRS 343 and/or NEPA compliance, which may rely on and tier to the analyses presented in the PEIS, including those related to mitigation measures and standards. Mitigation measures may also be developed to reflect site-specific circumstances, as long as they meet the standards set in the PEIS. The PEIS will identify impacts that would not require mitigation and impacts that cannot be mitigated without compromising the effectiveness of the rodent and mongoose control or eradication method. Under the latter circumstances, DOFAW and FWS could decide in the PEIS not to include such methods in our preferred alternative; or we could analyze whether there are different control methods with lesser impacts that could be used. Even if we ultimately include such methods as options in our proposed action, subsequent site-specific HRS 343 and/or NEPA compliance would evaluate the site-specific impacts.

GEOGRAPHIC SCOPE OF DRAFT PEIS

This Draft PEIS will analyze the impacts of, and alternatives to, using IPM to control or eradicate invasive rodents and mongooses in native ecosystems to protect native wildlife and plants, including federally-listed threatened and endangered species and designated critical habitats. DOFAW and FWS may use this IPM approach on the lands they administer in Hawai‘i and elsewhere in the Pacific, and in habitat restoration projects they fund. The agencies may also recommend that it be incorporated into habitat conservation plans and other applications for ESA permits, as appropriate.

The areas included within the scope of the Draft PEIS are:

- Federal, State and county parks, wildlife refuges and other public lands;
- State Natural Area Reserves, State Wildlife Sanctuaries, forest reserves and conservation districts;

- military (Department of Defense) lands outside of developed cantonment and residential areas;
- private lands, including agricultural lands with protected or native species;
- uninhabited areas within Hawaiian Home Lands;
- the Main Hawaiian Islands (MHI);
- the Northwestern Hawaiian Islands (NWHI);
- Kure Atoll, located in Honolulu County, under state jurisdiction and included within the Papahānaumokuākea Marine National Monument; and
- Other U.S. Pacific islands (to be determined) within the Hawaiian and Pacific Island National Wildlife Refuge Complex (HPINWRC).

The geographic scope of the Draft PEIS does not include the following islands because the regulatory authorities and legal jurisdictions addressed in the Draft PEIS are not necessarily consistent with those in place on these islands:

- American Samoa, under the jurisdiction of the United States as an unorganized unincorporated territory;
- Commonwealth of the Northern Marianas Islands, a commonwealth in political union with the United States;
- Guam, an unincorporated territory of the United States and part of the Marianas Islands, under the jurisdiction of the Secretary of Interior.

CHAPTER 2. PROPOSED ACTION AND ALTERNATIVES CONSIDERED

INTRODUCTION

In analyzing the proposed action and alternatives, we will explore the following in the Draft PEIS:

(1) Approaches that use IPM in accordance with the Department of the Interior and FWS IPM policies, and that are in compliance with FIFRA and the Hawai‘i Pesticides Law and regulations; and

(2) Particular methods of rodent and mongoose control or eradication that could be used.

The Draft PEIS will compile research and experience-based data on rodent and mongoose management from Hawai‘i, other Pacific islands, and elsewhere, and information on rodent and mongoose management from the public, other agencies, Native Hawaiian organizations, NGOs, and other interested parties. All of the compiled data and information will be used to evaluate the proposed action and alternatives.

ALTERNATIVE SELECTION CRITERIA

To determine how well the proposed action and alternatives facilitate achieving the objectives, as stated in the Purpose of Action, each alternative will be measured against the following criteria, which are not presented in order of priority:

(1) How effective the proposed methods are at increasing populations of native species;

(2) The ability to measure the effectiveness of the proposed methods through monitoring;

(3) The ability for wildlife managers to effectively implement the proposed methods;

(4) The safety of the proposed methods for non-target species, humans, and the environment;

(5) The cost-effectiveness of the proposed methods;

(6) The level of support from communities, wildlife managers, Native Hawaiian organizations, and regulatory agencies for implementation of the proposed methods;

(7) The compatibility of the proposed methods with Federal and State laws and regulations, including Federal and State pesticide laws and regulations, and Executive Orders; and

(8) The humaneness to the target animals of the proposed methods, in terms of animal welfare.

Preliminary scoping has identified the no action alternative, a possible proposed action, and other potential alternatives summarized in Table 1:

Table 1. Alternatives Considered in Detail in the Draft PEIS.

Action/Alternative	Description	
	Is it an IPM Approach?	**Methods to be included**
Proposed Action: Ground and Aerial IPM	Yes	Mechanical; all toxicant application methods; use of diphacinone, chlorophacinone, brodifacoum.
No Action	No/some	State of HI - mechanical; bait station (diphacinone only); U.S. Pacific islands within the HPINWRC - current techniques already approved under environmental compliance.
Ground-only IPM Alternative	Yes	Mechanical; bait station, hand broadcast; use of diphacinone, chlorophacinone, brodifacoum.
Current methods within the Main Hawaiian Islands, with additional uses of diphacinone on offshore islands	Yes	Main Hawaiian Islands - mechanical; bait station (diphacinone only); uninhabited offshore islands within the Main Hawaiian Islands and on other U.S. Pacific islands (to be determined) within the HPINWRC - application of diphacinone in bait stations, and by canopy baiting, hand and aerial broadcast.

DESCRIPTION OF METHODS

Mechanical

Live Traps: Cage traps of a variety of designs allow an animal to enter through an open door that closes when the animal steps on a plate or pulls at a bait. Food baits, scent lures, or visual lures are used to attract the animal into the trap. The animal may be euthanized or released unharmed. Examples of traps used in Hawai‘i include Hagaruma, Tomahawk, and Havahart.

Kill Traps: A food bait is placed on a triggering mechanism that releases a spring-loaded bar designed to break the animal's neck. Traps may be placed inside bait stations, Coreflut tunnels, or wooden boxes to exclude birds and other nontarget animals. Examples of traps used in Hawai'i include Victors, KaMates, and New Zealand Department of Conservation traps called DOC 250s.

Multi-kill Devices: These devices are defined under FIFRA Sec 2h as an instrument intended for trapping or destroying a pest, and includes a type of device manufactured in New Zealand that is being used for rat and mongoose control in Hawai'i (Goodnature®). The animal sticks its head inside a vertically placed plastic tube, touches a trigger in front of a scent lure inside the top of the tube, and compressed carbon dioxide gas from a canister fires a piston into the side of its head. Unlike traps, the animal drops out of the device onto the ground, and the device can be triggered by new animals for as long as gas remains in the canister, up to 21 to 24 times, according to the manufacturer.

Rodenticide Application Methods

Bait Stations: Bait is placed into a sturdy plastic box with several holes allowing the target animal to enter and feed on the bait. Bait stations are required to exclude nontarget animals from accessing bait, and prevent bait from being removed from the stations by rodents.

Figure 1: Bait station containing rodenticide (Photo by L. Scharf)

Canopy baiting (also referred to as bola baiting): Bait is placed in plastic or cloth bags and then placed into the canopy of trees or shrubs using poles or sling shots.

Hand Broadcast: Bait pellets are flung by hand or by using a hand-operated mechanical spreader by applicators walking along parallel transects. The pellet density (number of pellets on the ground per unit area) must be at the application rate specified on the product label.

Aerial broadcast: Bait pellets are dispersed from an agricultural spreader bucket suspended from a helicopter at an application rate specified on the product label. When the pilot remotely triggers open a gate at the bottom of the conical hopper, the pellets flow out through an aperture onto a motor-powered spinner which flings them over 360 degrees in swaths many meters wide as the helicopter flies in parallel paths over the application area. A GPS (Global Positioning System) in the helicopter records the flight paths, which are downloaded when the helicopter lands into a GIS (Geographic Information System) program to produce maps of where the bait was applied and at what density. The density of pellets as measured on the ground (application rate) and the width of the swath within which pellets are applied are determined by a number of factors, including width of the aperture of the bucket, flight speed, height of the helicopter, wind speed, and terrain. Prior to the treatment, the application rate must be calibrated by the pilot using placebo pellets or the rodenticide pellets, in an area where the pellet density can be measured on the ground. Pellet density should also be measured in subsamples of the treated area, but if the area is too remote or too dangerous to access, then the calibration rate can be used to estimate the application rate.

Figure 2: Helicopter with bait spreader bucket containing rodenticide bait flying over Mōkapu Island (Photo by H. Eijzenga)

Rodenticides

Brodifacoum, chlorophacinone, and diphacinone are anticoagulants. Anticoagulants act by inhibiting the clotting of blood and damaging the small blood vessels. Symptoms include bleeding nose and gums, extensive bruises, anemia, fatigue, and difficulty breathing. Symptoms are delayed until clotting factors circulating in the blood are used up and no new factors are made in the liver to replace them. This can take from several days to more than a week. Whether or not an individual survives depends on the amount of anticoagulant consumed and the duration of time they are exposed. Also, an animal suffering from anticoagulant poisoning may be more vulnerable to predators because of weakness and abnormal behavior, and also to dying from other causes such as starvation, hypothermia, and otherwise minor injuries. Susceptibility to anticoagulants varies among individuals and among species.

There are two categories of anticoagulants. First-generation anticoagulants were developed in the 1950s, and include diphacinone, chlorophacinone, and warfarin (also called Coumadin). Diphacinone and warfarin have been used extensively as human pharmaceuticals to prevent and treat blood clots. Because they are metabolized and/or excreted more rapidly by the body (in days to a maximum of a few weeks), the first-generation anticoagulants must be consumed over a number of days before enough accumulates to cause an effect. This significantly lowers the risk of poisoning to nontarget species, because a single exposure is usually not enough to cause symptoms. First generation anticoagulants persist in animal tissues for days to a maximum of a few weeks. Diphacinone and chlorophacinone are the most commonly used rodenticides to protect crops worldwide, and are also available to the public for use in and around buildings.

The second-generation anticoagulants were developed in the 1970s and 1980s. There are four compounds: brodifacoum, bromadiolone, difenacoum, and difethialone. They bind more tightly in the liver and are metabolized and/or excreted more slowly, so they can persist in tissue for months. They are toxic in lower doses and in shorter exposures (from a single feeding to a day or two of feeding) than are the first-generation anticoagulants. They are not used in agriculture and are restricted to use in bait stations in and around buildings. However, despite being limited to uses around buildings, they are the most commonly found rodenticide in wildlife worldwide and in Hawai‘i because of their persistence and ability to move up the food chain. The EPA in 2008 limited the public’s ability to purchase the second-generation anticoagulants, and in 2014 the state of California banned their sale to and use by the general public because of the widespread exposure of the second-generation anticoagulants to many species of wildlife.

Baits of all of these rodenticides contain extremely low concentrations of the active ingredient due to their high toxicity to rodents: 0.0025% (25 parts per million) for brodifacoum, and 0.005% (50 parts per million) for diphacinone and chlorophacinone.

The other proportion of the baits consists of grain, dye to color the bait, flavorizers, and nontoxic fillers, all of which are contained in formulas proprietary to the manufacturers.

The proposed action and the alternatives presented in the Draft PEIS will include Best Management Practices (BMPs) and standard operating procedures (SOPs) for each method and each target species. The BMPs will summarize the overarching principles by which rodent and mongoose control and eradication will be conducted. The SOPs will describe in detail how each method would be implemented to ensure they achieve natural resource management goals. The proposed BMPs and SOPs will be based on knowledge of the species' biology and behavior, field experience from past use, and research studies. The proposed action and alternatives will incorporate an adaptive management approach so that monitoring data can be used to inform changes to the SOPs within the IPM framework, to improve their effectiveness and safety. Some of the proposed methods have not yet been used in the State of Hawai'i or validated by research and will need to go through a sequence of field trials before SOPs and BMPs can be finalized. These methods will be identified in the Draft PEIS and the requirements for the necessary field trials will be described.

PROPOSED ACTION

Summary of Proposed Action

DOFAW and FWS propose to develop an IPM approach to control or eradicate invasive rodents and mongooses in the State of Hawai'i and on other U.S. Pacific islands (to be determined) within the HPINWRC to protect native wildlife and plants, including federally listed threatened and endangered species.

The proposed action would rely on the principles of IPM (described above in the Need for Action) as adapted for application under the unique circumstances associated with Hawai'i and other U.S. Pacific islands (to be determined) within the HPINWRC. The first step in the protocol for applying IPM principles at a site would be to identify the natural resource management goals and conduct qualitative and quantitative assessments to determine if the targeted pests are negatively affecting native species and interfering with achieving the identified goals. If so, then the merits of available management methods would be evaluated using IPM principles to determine the most appropriate methods to implement, and giving consideration to impacts to the human cultural environment using criteria established in the Draft PEIS. Third, the selected methods would be implemented along with monitoring of the species targeted for control or eradication, and selected non-target species and the native species being protected. This sequence of IPM steps establishes the link between the level of pest activity and the impacts on native species, and provides feedback on the effectiveness of the methods applied at reducing the level of rodent or mongoose damage to native species. The

methods may then be adjusted or changed to respond to rodent and mongoose behavior, their population levels, and impacts to non-target species, following the principles of adaptive management.

The Draft PEIS will analyze the effectiveness of, and environmental impacts from, a number of specific methods that could be applied for rodent and mongoose control or eradication under an IPM approach. These include: (1) mechanical traps and multi-kill devices; and (2) the application of vertebrate toxicants, including the rodenticides diphacinone, chlorophacinone, and brodifacoum. Rodenticide application methods to be discussed will include bait stations, hand-broadcast, aerial-broadcast, and other techniques described on the labels (Appendices 1-4) such as canopy baiting trees. The specific methods, or combinations thereof, that could be applied under site-specific projects would be determined based on the consistency with the IPM protocol discussed in the previous paragraph and the analyses of effectiveness and impacts in the PEIS, and any other site-specific compliance that is necessary, such as a site-specific NEPA analysis.

Control Principles

Agriculture has been at the forefront of developing and improving broadscale rodent control techniques due to the high crop losses rodents cause worldwide. Mass-produced chemical rodenticides, introduced in the 1950's, were the main broadscale tool of modern agriculture, but proved unreliable in their effectiveness. Singleton *et al.* (1999) attribute this to an over-reliance on them and the disregard of basic principles of rodent ecology.

In 1999, Singleton and Brown proposed an ecologically-based rodent management (EBRM) approach to help with mouse populations in Australia and rats in Southeast Asia (Singleton 2014, Abstract). EBRM builds on the foundations of IPM, and 'is refocusing IPM towards understanding the population biology of the pest and the agro-ecosystem in which it lives.' EBRM is currently the main rodent management paradigm in at least 27 countries (Singleton 2014, Abstract).

Fundamental principles of rodent populations and their control are summarized in Davis (1988):

> *"Often the removal of some individuals is compensated by increased proportional survival of the remainder. Also, … the birth rate may increase. The result of these two changes is a sustained yield; the number removed is balanced and therefore continues unabated. A sustained yield is the worst possible result of management. The removal of many rodents gives the appearance of success at a considerable cost. Unfortunately, a high proportion of the programs that kill rodents merely set up a sustained yield situation without reducing damage by rodents."*

The third source of a sustained yield is in-migration of new individuals into the control area. Several studies in Hawai‘i have used radio telemetry to measure the travel distances and home range sizes of rats. At Hakalau Forest National Wildlife Refuge on the island of Hawai‘i, Lindsey *et al.* (1999) reported mean home range sizes of 4.2 ha for male black rats, 1.8 ha female black rats, 2.8 ha for male Polynesian rats, and 3.4 ha for female Polynesian rats. The maximum distance travelled for individual rats was 181 - 406 m for black rats and 206 – 295 m for Polynesian rats. At two locations in Hawai‘i Volcanoes National Park (HAVO), black rats travelled a maximum distance of 117 m in a wet forest, and 407 m in a lowland mesic forest, and Polynesian rats travelled maximum distances of 149 m and 256 m, respectively, in the same forests (Scheffler *et al.* 2012). Similar distances have been reported from New Zealand, with female black rats averaging 100 m per night and males 200 m (Hooker and Innes 1995).

This constant in-migration results in a spillover and edge effect in controlled areas. Edge effects occur when the control area closest to the boundary (the edge) receives a lower level of benefit than areas closer to the center of the control area (the core) (Figure 3). Edge effects may occur if pests from the surrounding uncontrolled area reinvade the edges of the management area and adversely affect the biodiversity there. Conversely, spillover effects may occur when the area directly outside the boundary of the control area receives some level of biodiversity benefit due to the proximity of pest control. Spillover may occur if native plants and animals that benefit from the pest control are also present in the surrounding area. Research in New Zealand that monitored both rodents and an indicator native species (weta (family Anostostomatidae), a large native cricket highly vulnerable to rodent predation) determined that at 200–400 m outside of the control area, pest numbers were lower and weta numbers higher than at 600 m beyond the boundary, suggesting that some level of spillover benefit occurred outside the management area (Nathan 2013). Conversely, from the control boundary to 200 m inside the management area, pest numbers were higher and weta numbers lower than at the core of the area, suggesting that an edge effect also occurred at this site.

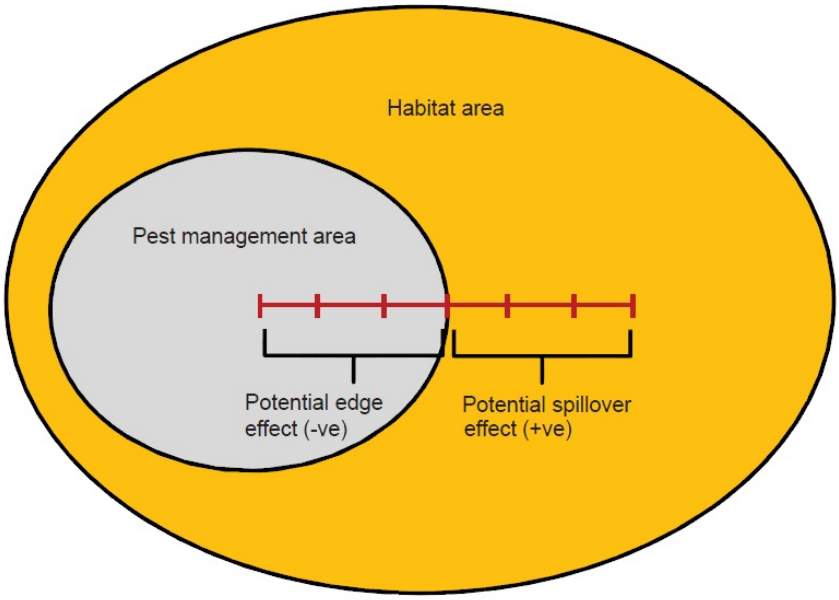

Fig. 1 *Diagram representing transect set-up and demonstrating potential edge and spillover effects.*

Figure 3a: Diagram representing transect set-up and demonstrating potential edge and spillover effects. (Nathan, Kararehe Kino 2013)

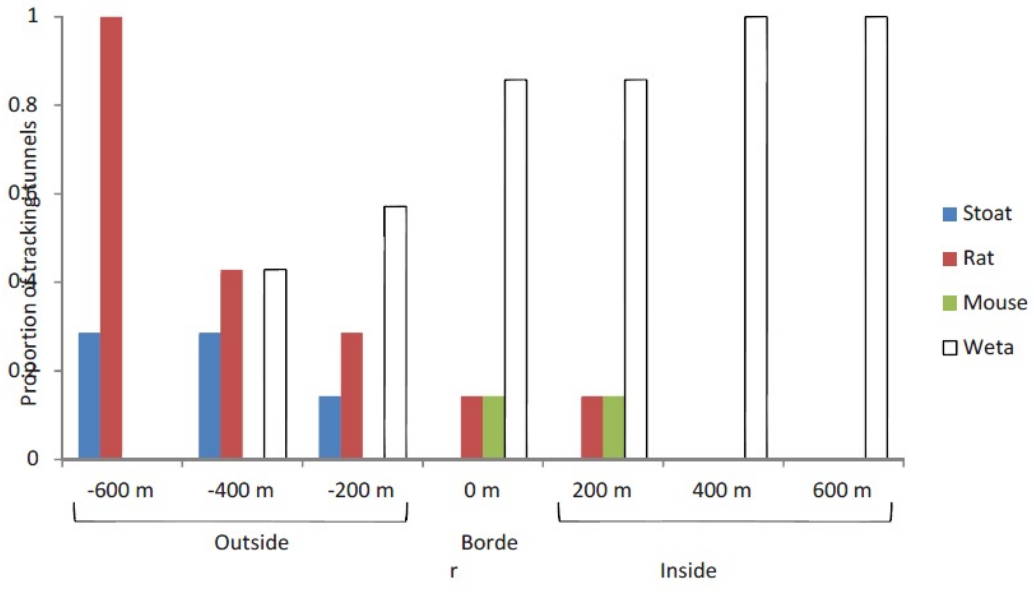

Fig. 2 *Proportion of tracking tunnels visited by pests and weta by distance from the border of pest control.*

Figure 3b: Proportion of tracking tunnels visited by pests and weta by distance from the border of pest control. (Nathan, Kararehe Kino 2013).

Unless rodenticides are applied on a broad scale, they do not impact populations of rodents with high reproductive rates, such as voles (Arjo and Bryson 2007) and deermice (*Peromyscus maniculatus*) (Hooven 1975, Howard *et al.* 1970). Within two weeks deermice reinvaded forested study areas as large as 10 acres in California and Oregon broadcast treated with oat groats containing diphacinone or chlorophacinone. Buckle (1999) notes that farmers baiting a small area create a 'sink' that continuously draws rats in from the surrounding area. Similarly, monitoring of black rats in small fragments (2.4 - 9.9 ha) of New Zealand forests set with grids of snap traps documented near continuous in-migration, leading the authors to conclude "Eradication operations in small fragments... are therefore bound to fail, because they cannot be confined to an isolated landscape unit not connected to extensive source areas. On the contrary, we showed that replacement populations arrived very quickly… Marked individual rats travelled from at least 0.5 km away, reaching all but one of our fragments in a few days" (King *et al.* 2011).

An assessment of the efficacy of diphacinone baits in bait stations against rats on a broad scale has been conducted in New Zealand forests (Gillies *et al.* 2006). Bait stations were placed in grids at five study sites in different forest habitats, ranging from 220 – 1427 ha, which were paired with non-treatment comparison sites. Inked tracking tunnels baited with peanut butter were used to provide indices of rat activity before and during the baiting period in treatment and non-treatment sites. Rat abundances at the largest and smallest treatment sites were reduced to less than the target levels of 5% of tunnels with rat tracks, and were significantly lower than in the non-treatment sites. At the three other treatment sites, no rats were detected in tracking tunnels before or during the trial for one site; rat abundance was not reduced at another site despite high bait take, probably by possums (*Trichosurus vulpecula*); and rat abundance at the third site was reduced by 92%, to less than 5% of tunnels tracked by rats.

A contemporary example of a well-designed rodent control program incorporating a variety of techniques within an IPM framework is provided by Baldwin *et al.* (2013). Voles cause significant damage to artichoke crops in California, but the application of rodenticides is costly, labor intensive, and is restricted in timing due to the risks to nontarget species (McMillin and Finlayson 2010). First, vole activity was measured using the proportion of non-toxic wax blocks with signs of chewing and the proportion of chewing on artichoke stems. These were then compared to live-trapping rates. Chewing on artichoke stems did not correlate well with the levels of vole activity determined by live-trapping, whereas chewing activity on the wax blocks did correlate well. This illustrates the importance of using several independent methods to verify the accuracy of the rodent monitoring method(s) selected, and of periodically utilizing an independent method to ensure that the primary method continues to accurately measure rodent activity. Having established an accurate monitoring method, Baldwin *et al.* (2014)

measured the reduction in vole activity resulting from a variety of methods, including the placement of chlorophacinone pellets under the rows of plants, and the use of a trap-barrier system to slow the rate of in-migration of new individuals back into the fields.

Ultimately, the goal of rodent and mongoose control is to have a demonstrable benefit on native species. Where eradication is not possible, a key component of the proposed approach is to determine the level of rodent and/or mongoose control needed to achieve a particular management goal. As an example, Armstrong *et al.* (2006 a and b) monitored North Island robins (*Petroica longipes*) for five years, during which time rat levels changed dramatically in response to varying efforts of rat control. Ninety-seven bait stations containing brodifacoum were deployed within the 101-ha forest and rat activity was monitored using tracking tunnels. After nine months, baiting was suspended for six months, then reinstated for another 22 months, and then discontinued for the 15 month remainder of the study. When the bait stations were maintained consistently, rat tracking rates ranged from 0 to 9%. Baiting was finally discontinued due to a new policy of the New Zealand Department of Conservation minimizing the use of brodifacoum on the main NZ islands. Over the next 15 months rat tracking rates increased to 100% (all tunnels in the area showed rat tracks). During the five year study, the robins' nest success, reproductive success and survival were also observed. Armstrong *et al.* (2006 a) found that nest success, reproductive success, and survival of juveniles and adult females all declined as rat tracking rates increased. They concluded the rat tracking rate needed to be <20% in order for the robin population to grow, and that it would be "guaranteed to decline if rat tracking were above 40%".

Mongooses in Hawai‘i can travel long distances, making controlling them challenging. Pitt *et al.* (2015) found that mongooses in lowland habitats on the Island of Hawai‘i foraged over large areas, with mean home range sizes of 21.9 and 28.8 ha at two sites. Individual home range sizes varied from 6.0 to 70.2 ha. Home range sizes are dependent upon habitat and resource availability. Hays and Conant (2007) reported home ranges of 8.2–25.7 ha during the breeding season and 1.2–3.3 ha during the nonbreeding season on the island of Oahu, Hawai‘i. Other investigators have reported home ranges of 3.9–19.4 ha for a subtropical rainforest in Puerto Rico (Quinn and Whisson 2005), 10 – 157 ha for a dry forest in Puerto Rico (Berentsen, pers. comm.), 5.7–8.5 ha in Grenada (Nellis and Everard 1983), 22–39 ha in Fiji (Gorman 1979), and <5.0 ha in Amami, Japan (Abe 2008, pers. comm.). Extended home ranges of 25–100 ha were reported by Roy *et al.* (2002) in Mauritius, and Keith *et al.* (1990) found average ranges of 8–191 ha at a lowland lava field on the island of Hawai‘i. Home ranges of individuals in Pitt *et al.* (2015) overlapped extensively, increasing mongoose population density. This study estimated population densities of 0.72 and 1.88/ha for the two sites. Seaman (1952) reported densities of up to 24.7/ha at some anthropogenic food-rich locations in Hawai‘i. Mongoose densities at the two Hawai‘i study sites were lower than the 2.6–6.4/ha found

in Jamaica (Hoagland *et al.* 1989), and higher than those estimated by Quinn and Whisson (2005) for a subtropical rainforest in Puerto Rico (0.19–0.57/ha). Mongoose densities varied by habitat type in Puerto Rico, with 0.44 – 0.72/ha reported by Johnson *et al.* (2015) for the same rainforest, and 0.55-0.75/ha for a dry forest. However, caution must be exercised when interpreting population density estimates due to differing models and programs used. In addition, mongoose populations in Hawai‘i fluctuate greatly from year to year and between seasons (Pearson and Baldwin 1953, Tomich 1986).

In the Pitt *et al.* (2015) study, the maximum daily travel distance recorded for a male was 1208 m and 659 m for a female. Mongooses are highly sensitive to olfactory cues, and can detect scents from considerable distances. During the study six radio-collared mongooses travelled an average of 354 m to a decomposing pig carcass found at one of the sites. Similarly, native species needing protection, such as nesting waterbirds, may attract a number of individual mongooses from long distances, meaning that control methods should extend over large enough areas to intercept in-coming mongooses before they reach the resource. Control conducted over a small area may have the effect of increasing predation on native species by luring mongooses into the area.

Monitoring Methods for Rodents and Mongooses

Monitoring changes in rodent and mongoose populations that result from the control methods is critical to assessing their effectiveness. Under most circumstances it is difficult, if not nearly impossible, to count or estimate the absolute number of individuals within an area, so a variety of methods can be used to detect changes in the population (Engeman and Whisson 2006). This involves overlaying the area with a grid of placements of the monitoring device(s), which are set out for a limited time. Methods include setting kill traps and calculating the proportion of traps that catch an animal; mark-recapture (in which the animal is fitted with an eartag or pit-tag and released, potentially to be captured or detected again); tracking tunnels (in which the animal runs over an inked area and leaves its tracks on a sheet of paper) and the proportion of tunnels with activity is recorded; and, for rodents only, the proportion of non-toxic wax blocks or chew cards that show signs of gnawing. Motion-sensing cameras can also be used to document rodent and mongoose activity at particular locations. Finally, fitting a number of individuals with radio collars can be used to estimate the proportion of the population killed by the control methods. Figure 4 shows an example of the tracking tunnel data collected for rats and mice at Ka‘ena Point Natural Area Reserve on O‘ahu.

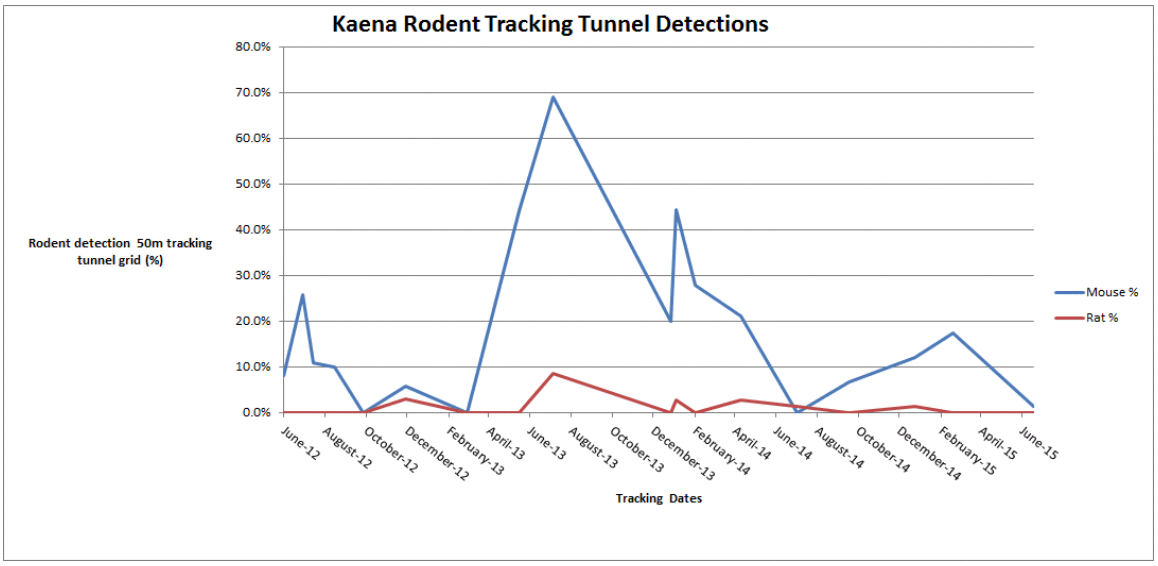

Figure 4: Tracking Tunnel Detections, Kaena Point Natural Area Reserve (C. Miller, NARS, unpubl. data)

Monitoring For Nontarget Species

The effort put into monitoring for nontarget species and environmental effects is equally important to the effort put into monitoring for the target species and the benefits to native species. For any contaminant, including rodenticides, collection of dead or moribund individuals is likely to represent only a subset of the actual exposure or mortality attributable to that contaminant. In order to document mortality, a carcass must be observed, reported, collected, and chemically analyzed while still relatively fresh (Vyas 1999, entire). Individuals that die in the wild may be quickly removed by scavengers. For example, the loss rate of dead birds in this manner may be up to 98%, depending on season, location, and species, with losses generally occurring within 24 - 96 hours after placement of a carcass in experimental studies (Peterson *et al.* 2001, Vyas *et al.* 2003, Prosser *et al.* 2008). Carcass detection studies have found that even when searches are performed on carcasses known to exist (e.g., placed by a researcher for study), a percentage will never be found due to scavenging, location in remote and inaccessible areas, or size or coloration that renders the carcass inconspicuous (Vyas 1999, Elliot *et al.* 2008). The delayed toxicity of Anticoagulant Rodenticides and persistence within food webs can result in contaminated rodents being found within and adjacent to the treated area weeks or months after bait application further temporally or geographically distance the carcass from the application area (Geduhn *et al.* 2014, Tosh *et al.* 2012, Sage *et al.* 2008). Public reporting of wildlife mortalities in general is limited both by detection of carcasses as well as uncertainty as to whether the incident should be reported and to whom it should be reported, procrastination, and apathy (Vyas 1999). Even when a mortality incident is reported to the appropriate authorities, an immediate investigation

may not be possible because of the distance, terrain, weather, private property restrictions, limited resources, and other on-going investigations. Consequently, when a carcass is recovered during a field investigation, the biological and chemical matrices which are used to confirm the cause of death may not be in analyzable condition due to decomposition or scavenging (Vyas 1999). This was the case for an ʻìo found six months after an aerial broadcast of diphacinone in Hawai'i Volcanoes National Park (HAVO) (Spurr *et al.* 2003). In contrast, when 7 out of 10 radio-collared pigs died during a trial at Keauhou Ranch on the island of Hawai'i using diphacinone bait applied by aerial broadcast and in bait stations, carcasses were found quickly enough to confirm that pigs had eaten bait from both application sources and the trial was discontinued, with no further bait applied.

ALTERNATIVES CONSIDERED

At this time, we anticipate that the Draft PEIS will analyze the following alternatives:

No Action Alternative

The "no action" alternative would involve continuing to conduct rodent and mongoose control as currently practiced within the State of Hawai'i, using live and kill traps, multi-kill devices, and diphacinone in bait stations, generally on a very small scale. Diphacinone has been used in bait stations to protect Hawaii's native species since the 1990s (see Conservation Uses of Rodenticides in Hawai'i section for more information). Within the State of Hawai'i, this alternative would not include controlling rodents and mongooses using any bait distribution method other than bait stations or any rodenticide other than diphacinone. The Refuge System would continue to plan and conduct island eradications on both inhabited and uninhabited islands within the HPINWRC using aerial broadcast of brodifacoum under the national labels already approved by EPA (see Eradications on other U.S. islands section for more information). Each site-specific project would be responsible for its own environmental compliance. Monitoring of the effects of the control method(s) on target species, nontarget species, and the benefits to native species would be limited and conducted only at some of the treatment sites.

IPM Ground-Only Alternative

Under this alternative, rodent and mongoose control or eradication would be done by using traps and multi-kill devices, as well as by the application of diphacinone, chlorophacinone, and brodifacoum in bait stations and by hand-broadcast. Rodenticides would not be aerially applied under this alternative. The principles of IPM, including monitoring the targeted rodent or mongoose population and selected non-target species and native species, could be implemented to improve the effectiveness of ground-based

methods over current practices, as described in the Introduction and the No Action Alternative.

Current, Ground-Only Methods Within the Main Hawaiian Islands, With Additional Limited Uses of Diphacinone on Uninhabited Islands

Under this alternative, all currently used ground-based methods of rodent and mongoose control and eradication would be considered as part of the IPM process described above. Application of diphacinone by bait station, canopy baiting, hand and aerial broadcast would be considered for use on islands other than the main, inhabited Hawaiian Islands, including uninhabited offshore islands within the MHI and on other U.S. Pacific islands (to be determined) within the HPINWRC.

ALTERNATIVES NOT CONSIDERED IN THE DRAFT PEIS

Other Rodenticides

The use of rodenticides other than diphacinone, brodifacoum, and chlorophacinone will not be considered in the Draft PEIS. Only compounds currently registered for use on rodents in the United States for agricultural and/or conservation purposes have data sets extensive enough to support analyses of environmental impacts in the Draft PEIS. No acute toxicants, such as zinc phosphide, will be considered because of the high risk of poisoning to non-target species and human applicators from these fast-acting compounds. Other rodenticides may be considered in the future in supplements to the PEIS.

Biological Control

The use of biological control agents for rodents and mongooses will not be considered in the Draft PEIS. No biological control agents (predators, parasites, or disease organisms) have been able to significantly reduce rodent or mongoose populations on a broad scale in Hawai‘i or elsewhere. qOpportunities to mitigate impacts to the Polynesian rat, which is significant in Hawaiian culture, by confining its control to a small proportion of its overall population in Hawai‘i, would also be lost with the release of a biological control agent.

Introducing predators has generally not been effective in reducing invasive rodent populations because rodent population densities are determined by factors independent of predation, including their high reproductive rate, the availability of food resources, and weather conditions. Two examples of using predators for rodent control in Hawai‘i are the introduction of mongooses in the 1880s by the sugar plantations, and barn owls in the late 1950s into the early 1960s. These biological control efforts were ineffective at reducing rodent damage in sugar cane and resulted in adverse impacts that are still ongoing to native species. Under current practices and regulations, these types of introductions would not occur. Previous studies on disease agents for rats and mice have

been conducted with bacteria such as Salmonella enteritidis, as well as a protozoan, viruses, and a nematode, but none have met standards for safety and effectiveness for use in the United States. Rodents and mongooses are well-known vectors of many diseases and parasites that are readily transmitted to humans and domestic animals, such as rabies, leptospirosis, and murine typhus, making this alternative too risky to consider. At present, we are unaware of any programs worldwide that are identifying new biological control agents for rodents, and no research has been conducted for mongooses.

Chemosterilants and Fertility Control Agents

Chemosterilants and fertility control agents will not be considered in the Draft PEIS. To date, the successful use of wildlife chemosterilants has been in laboratories, pens, and limited field situations. In the latter situation, animals are either captured, treated and released, or are injected using darts at close range, which is impractical for small mammals. Although research is underway to develop chemosterilants for rats and mice, it is in the early stages. No research on the use of chemosterilants has been conducted on Polynesian rats or mongooses. If a type of bait is developed to deliver the sterilant compound, measures to prevent ingestion by non-target organisms, including protected native species, would have to be developed. Chemosterilants and fertility control agents are regulated under FIFRA, and any such product proposed for registration and licensing in Hawai‘i would need to complete the same process of data generation and review required for rodenticides. For these reasons, consideration of chemosterilants and fertility control agents would be speculative at this time.

CHAPTER 3. AFFECTED ENVIRONMENT

NATIVE SPECIES IN HAWAI‘I

The Hawaiian Islands are the most isolated archipelago in the world, situated in the middle of the Pacific Ocean more than 2,000 miles from the nearest continent. Relatively few life forms were able to cross the ocean and successfully colonize the Hawaiian Archipelago because of their extreme isolation. Even fewer species were able to successfully establish populations on the archipelago over its history. Rainfall and terrain varies enormously over very short distances. The Hawaiian Archipelago possesses a wide range of habitats, including: alpine shrub lands, wet montane cloud forests, dryland forests, dry coastal grasslands, and wetland areas (Loope 1998). Colonists rapidly adapted to their new environments evolving unique traits in populations that were isolated from one another within and between islands. As a result, the archipelago displays some of the world’s premier examples of evolution (Carlquist 1982). The Hawaiian Archipelago possesses the highest proportion of species unique to that location of anywhere in the world. Rates of endemism (percent of species found nowhere else on earth) are typically 99 to 100 percent for terrestrial insects, spiders and land snails, 90

percent for plants, more than 80 percent for breeding birds and 15 to 20 percent for aquatic fauna.

Although there are many Hawaiian species have yet to be described, the estimated number of endemic species (a species native and confined to a certain region; having comparatively restricted distribution) (USFWS) is thought to include more than 14,000 terrestrial, 100 freshwater and 6,500 marine taxa. Among these are an estimated 10,000 species found nowhere else on the planet. This rapid evolution produced many species with unusual characteristics or life-histories, including two dozen flightless birds (now extinct), mintless mints, thornless blackberry plants, blind big-eyed spiders, carnivorous caterpillars, diadromous fish that scale 1,000-foot waterfalls to return to freshwater spawning areas and nectivorous birds with bills superbly adapted to the corollas of particular native flowering plant species.

Before the arrival of humans to the archipelago, the evolution of new species in the Hawaiian Islands exceeded losses to extinction. Many species began a precipitous decline to extinction beginning with the arrival of the first Polynesians, and accelerating with the explorers and settlers from Western Europe and North America following Captain Cook's European discovery of the islands in the 1780s (Kirch 1982, Loope 1998). Native Hawaiians utilized some of these native species for food and ornaments, greatly reducing native bird populations. Some native species were lost as their unique habitats were degraded and destroyed for agriculture, aquaculture, and development. Thousands of alien plant and animal species have been introduced by human activities.

NON-NATIVE SPECIES IN HAWAI'I

A significant portion of all species in Hawai'i now are nonnative and some of these pose significant threats to Hawaiian ecosystems. Feral ungulates, such as cattle (*Bos primigenius*), pigs (*Sus scrofa*), goats (*Capra aegagrus hircus*), black-tailed deer (O*docoileus hemionus columbianus*), Axis deer (*Cervus axis*), sheep (*Ovis aries*), and mouflon sheep (*O. gmelini musimon*) consume and trample native understory plants, creating conditions favoring non-native plant infestation and establishment, and mosquito breeding sites (Tomich 1986, Hess *et al.* 2009). Invasive invertebrates and diseases weaken and kill native plants, compete with native pollinators, and are one of the primary threats to native forest birds (Mitchell *et al.* 2005).

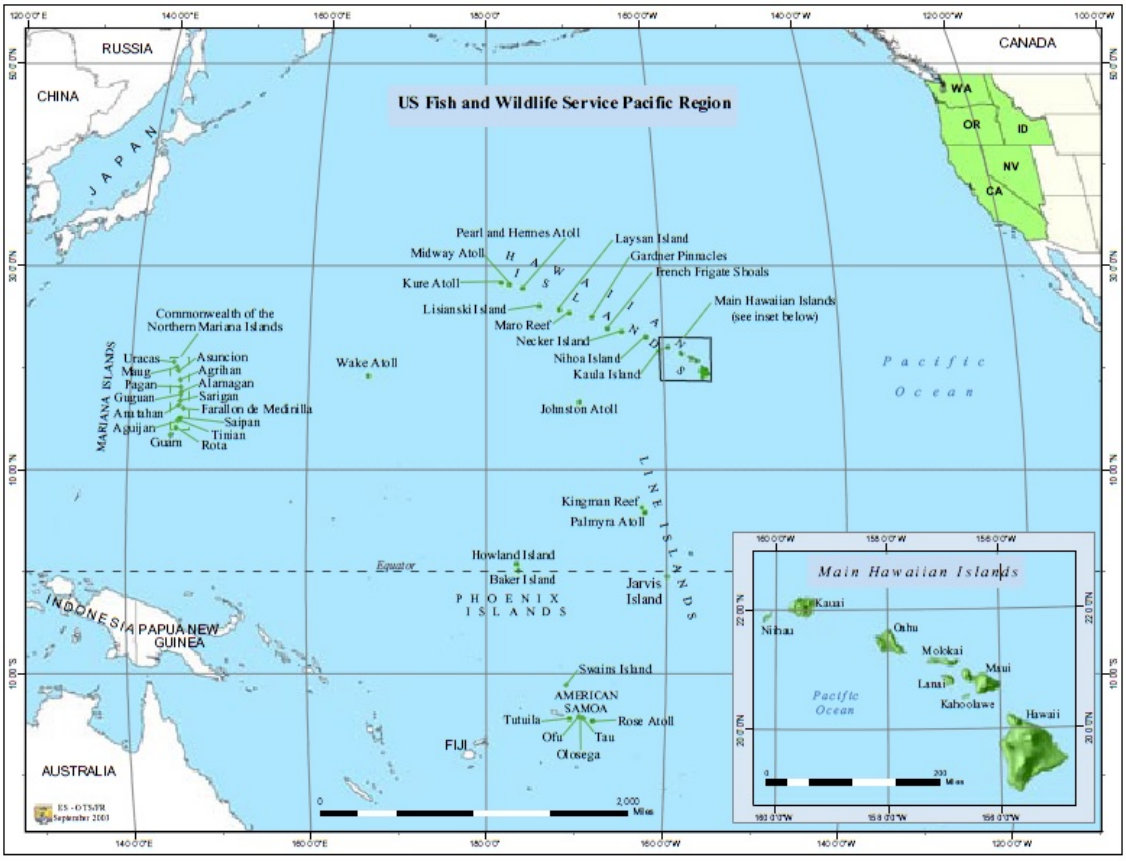

Figure 5: Map of U.S. Fish and Wildlife Service, Pacific Region. (USFWS Seabird Conservation Plan-Pacific Region)

The Polynesians brought the first pigs to Hawai‘i. The Polynesian pig or pua‘a had an important cultural role, as seen in the ahupua‘a, the traditional land division. Early Western observers noted that they were small and highly domesticated (Tomich 1986). The pigs were seen as an important protein source, and it was noted that they were kept in pens. Wild pigs were not mentioned in the journals of some of the early westerners who explored the native forests (Cuddihy and Stone 1990). The Polynesian pigs subsequently interbred with feral domestic swine brought by western colonists to the islands. Over a few short generations, the pigs became more feral, and new development and western agriculture across much of the lowlands pushed them from the lowlands into the upland forests (Cuddihy and Stone 1990).

Of the four rodent species in Hawai‘i, the Polynesian rat (‘iole) arrived first. It dispersed throughout the islands of the Pacific from its native range in continental Asia, travelling on the voyages of the people colonizing the Pacific (Matisoo-Smith and Robins 2009, Rick *et al.* 2013). It arrived in Hawai‘i with the first people, around AD 1000 (Athens *et al.* 2002, Athens 2009). The reasons for the widespread co-occurrence of the Polynesian rat with the early human settlers of Pacific islands are not known. Although it could have been deliberately included among the food animals in the provisions taken along by the

Polynesians, *R. exulans* are also notorious stowaways and agricultural pests. The ease with which they could have been unintentionally transported is illustrated by an anecdote in Stokes (1917), in which a Hawaiian fisherman accidentally introduces Polynesian rats from Kailua beach to Popoia Island. They had hidden in the folds of his fish-net and escape when the net is spread out on the island.

The ʻiole appears in numerous Hawaiian cultural contexts, including the Kumulipo (the Hawaiian creation chant) (Beckwith 1972), legends of Pikoiakaʻalalā, the rat shooter (Westervelt 1915, Fornander 1917), ʻōlelo noʻeau or Hawaiian proverbs that associate the rat with unfavorable human acts and character traits (Pukui 1983), place names (Pukui 1974), names of plants and limu (Valier 1995), and as ʻaumakua (Pukui and Elbert 1986). The Maori of New Zealand traditionally consumed kiore (*R. exulans*) (Trotter and McCulloch 1989), and *R. exulans* was a significant component of the diet of the people of Rapa Nui (Commendador *et al.* 2013). On the other hand, Polynesians would have directly experienced the rat as a competitor for the crops (Nelson 2012) and birds (Kirch 1982) that they relied upon. The Polynesian rat is now believed to be responsible for the decimation of the palm forests of Rapa Nui (Hunt and Lipo 2009) and Oʻahu (Athens 2009), illustrating its ability to rapidly reproduce and outcompete its human transporters.

From their origins in Asia, Norway and black rats spread into Europe, then North America, and finally the Pacific (Atkinson 1973, McNeill 1994); carrying the plague and other pestilence with them (Tomich *et al.* 1984, Ikeda 1985, Stenseth *et al.* 2014, Kosoy *et al.* 2015). Rats and mice were unambiguously stowaways on Western sailing ships, and measures were taken to try to prevent them from accessing ships at port (Atkinson 1977). Captain Cook describes letting rats off his ship in Tahiti using cables and planks: 'the ship being a good deal pestered by rats' (Cook 1785, p. 81, as cited in Atkinson 1973). Herman Melville complained about rats on whaling ships: 'they darted in upon us at meal times and nibbled our food … every chink and cranny swarmed with them' (footnote on p 317 of McNeil 1994, quoted in King 1984 p 68).

Atkinson (1977) provides a comprehensive discussion on when these species may have arrived in the Hawaiian Islands. Mice were first documented by the Russian explorer Kotzebue in 1816 (Atkinson 1977), and by 1835 Hawaiians had noted the presence of a rat larger than the Polynesian rat, which Atkinson (1977) concludes is the Norway rat. Based on a number of factors, including the rapid sequential declines and extinctions of many species of Hawaiian forest birds on each island, Atkinson (1977) places the black rat's arrival in the late 1870s or early 1880s, first on Oʻahu, from which it later spread to the other islands. The first case of bubonic plague in Hawaiʻi was documented in December 1899 (Ikeda 1985). Quarantine measures included preventing ships from docking at the wharf in Honolulu Harbor, greasing all mooring lines, and requiring a rat-guard on each mooring line anchored to the shore. Rat-trapping and poisoning were instituted by the Honolulu Chamber of Commerce. Despite these measures, the plague

spread to Kauaʻi, Maui and the island of Hawaiʻi, where it persisted until the final human case (nonfatal) was recorded in 1949 (Tomich *et al.* 1984). Other rat species originally from Asia, such as the rice-field rat (*R. argentiventer*) and the Asian house rat (*R. tanezumi*), may also have arrived in Hawaiʻi, but surveys have not been conducted that would detect their presence.

Although mice are usually either ignored as a predator affecting native species in Hawaiʻi, or viewed as secondary to rats, their impacts to island species can be quite devastating (Angel *et al.* 2000). Mice are abundant in Hawaiian ecosystems and periodically undergo population explosions (Tomich 1986, Sugihara 1997), which may exacerbate their already significant injury to native species.

The small Indian mongoose was first intentionally introduced to the island of Hawaiʻi in 1883 by sugar plantations to reduce populations of rodents in the sugar cane fields, and subsequently became established on all the Main Hawaiian Islands except Kauaʻi, Lānaʻi and Niʻihau (Tomich 1986). However, there have been frequent sightings of varying credibility since the mid-1970s on Kauaʻi. Two live mongooses were captured in Lihue and Nawiliwili Harbor in 2012 (K. Gundersen, Kauaʻi Invasive Species Committee, 2012) and a lactating mongoose was observed on a road in Kauaʻi in 1976. No further captures or direct evidence of mongoose has been documented since then. Public outreach has resulted in numerous reports of sightings throughout the island, but response to credible sightings and clusters of sightings has been hampered by limited resources and technical expertise. Systematic surveys using experienced trappers are needed to detect an incipient mongoose population on Kauaʻi.

SUMMARY OF NATIVE FAUNA OF HAWAIʻI

Native Terrestrial Mammals and Impacts of Rodents

The ʻōpeʻapeʻa (Hawaiian hoary bat) is the only land mammal native to the Hawaiian archipelago and is an endemic subspecies of the hoary bat found throughout North and South America. Historically, it is known from all of the MHI but Niʻihau. It is federally-listed as endangered due to apparent population declines and a lack of information on its distribution, abundance and habitat needs. Habitat loss and roost disturbance are thought to negatively affect the bat. It is unknown whether predation by introduced mammalian predators is also a factor (USFWS 1998).

Not much is known about ʻōpeʻapeʻa in Hawaiian culture.

Rodents probably have both direct and indirect impacts on the Hawaiian hoary bat, through predation and competition for insects, which are consumed in large numbers by mice and rats (Sugihara 1997, Cole *et al.* 2000, St. Clair 2010). A solitary, tree-roosting bat (Tomich 1986), it may be especially vulnerable to rat predation during the summer pupping season when females are less mobile and their young are nonvolant. Although

rat predation on the Hawaiian hoary bat has not been observed, rats have severely impacted both continental and island species of bats. The introduction of black rats is believed to have caused the extinction of endemic species of island bats in Australia (McKean 1975 as cited in Daniel and Williams 1984) and New Zealand (Daniel and Williams 1984). The black rat, which is also not native to North and South America, was determined to be the primary factor in reproductive failure for a maternal colony of Townsend's big-eared bat (*Corynorhinus townsendii*) in California (Fellers 2000). The dietary overlap between the Hawaiian hoary bat and rodents appears to place them in direct competition (Jacobs 1999), so it could be possible for rodents to deplete the food resources of the bat.

Native Bird Communities

Hawai'i is home to a remarkable diversity of endemic forest birds and provides habitat for globally significant nesting populations of seabirds. Year-round residents include forest birds, the endemic waterbirds and some seabirds, but many species of seabirds and migratory shorebirds and waterbirds only visit the state for breeding or wintering grounds.

Forest Birds

The 'io or Hawaiian hawk (*Buteo solitarius*) and the pueo or Hawaiian short-eared owl (*Assio flammeus sandwichensis*) are the only remaining native raptors in Hawai'i. The 'io is listed as endangered by both the FWS and the State of Hawai'i and is restricted to the island of Hawai'i. Primary threats include predation by introduced rodents, mongooses and cats, particularly for the ground-nesting pueo, and habitat loss (Loope 1998).

The Hawaiian honeycreepers (family Fringillidae) are often cited as a dramatic example of the process of rapid evolution through adaptive radiation, with at least 40 species having evolved from a single common ancestor. This group of birds diversified to fill niches often occupied by separate families on continental environments. There are only about 23 existing species of native Hawaiian forest birds, less than half the number known from historic and fossil records (Olson and James 1982), and one third of those remaining are extremely rare or possibly extinct. More than half are endangered. A number of factors have contributed to this decline including land conversion from native forests for agricultural uses, forest degradation by ungulates and invasive plants, the introduction of avian diseases, and small mammalian predators. Native forest birds were virtually eliminated from lowland areas by mosquitoes following their introduction in 1826, as native birds had no natural resistance to mosquito-spread avian malaria and avian poxvirus (FWS Recovery plan).

In addition, invasive birds and arthropod species may compete with native forest birds for food or nest resources, and some species likely persist now only in marginal habitats.

The various ways in which native forest birds are important to Native Hawaiian culture include:

Food: Unidentified flightless birds were easily hunted for food by the early Hawaiians (Stone 1985). Some water and forest birds also used for food included the nēnē, ʻio, pueo, ʻalalā, ʻōʻō (*Moho* spp.), ʻelepaio (*Chasiempis sandwichensis* spp.), ʻiʻiwi (*Vestiaria coccinea*), mamo (*Drepanis* spp.) and the ʻapapane (*Himatione sanguinea*) (Amante-Helweg and Conant 2009).

Featherwork: Kia manu (bird catcher) were tasked by the aliʻi to go into the forest to catch birds and use their feathers for an array of feather works. Some of the items that were made were ʻahuʻula (cloaks and capes), mahiole (helmets), kāhili (feather standards), and lei hulu (feathered lei). Several species confirmed for Hawaiian feather work included the nēnē, ʻio, ʻōʻō, ʻalalā, ʻiʻiwi, mamo, ʻapapane, ʻamakihi (*Hemignathus* spp.), and the ʻōʻū (*Psittirostra psittacea*) (Amante-Helweg and Conant 2009). Because of the association with akua and ʻaumākua, the feathers of the birds were of high value and contained mana, and were reserved for the aliʻi to denote high status (Amante-Helweg and Conant 2009).

Religion: Because of the strong connection to place, Hawaiians saw their deities in the form of birds as well. Lea, a goddess to canoe builders, showed herself in the form of the ʻelepaio. The kia manu prayed to their god, Kūhuluhulumanu, and offered their first catch to him.

Kū, along with taking the form of the ʻōhiʻa tree, also takes the form of the ʻio (Amante-Helweg and Conant 2009 and Krauss 1993).

Birds are very important to aliʻi and makaʻāinana, and their families, acting as ʻaumākua, or guardians. The guardian could be a deity or it could be a departed family member. Birds known to be ʻaumākua were the ʻio, pueo, ʻōʻō, ʻalalā, ʻelepaio, ʻiʻiwi, mamo, ʻapapane (Amante-Helweg and Conant 2009).

Rituals: The art of canoe making incorporates the goddess Lea who, after prayers made by the people, arrives in the form of the ʻelepaio. *"Ua ʻelepaio ia ka waʻa"* (the ʻelepaio has marked the canoe log), this ʻolelo noeau, Hawaiian proverb, speaks of how canoe makers of old would have the ʻelepaio pick out their koa trees for canoes (Pukui 1983). If she [Lea] had walked the length of the tree without stopping, it meant that the tree could be used. However, if she stopped and pecked at areas, it meant the tree was full of insects and shouldn't be used (Amante-Helweg and Conant 2009, Krauss 1993, Pukui 1983).

ʻAlalā translates from the Hawaiian language as: "to bawl, bleat, squeal, cry...; the Hawaiian Crow; a talkative person; and a style of chanting" (Pukui and Elbert 1986). The herald of a battle formation was also known as the ʻalalā (L. Naone-Salvador, pers. comm. 2002). Munro (1944) suggested the bird's name might also reflect its habit of

rising (ala) with the sun (lā). As the largest forest bird, after the Hawaiian Hawk and among the most charismatic, the ʻalalā is highly regarded by the Hawaiian people. Before the arrival of Europeans, it was kept as a ceremonial pet, regarded as a family guardian spirit or ʻaumakua, and its feathers were used to decorate statues and kahili (Cook 1784, Malo 1951, Handy *et al.* 1972, Medway 1981).

Forest Birds and Impacts of Rodents

Atkinson (1977) argues that the introduction of the black rat to Hawaiʻi in the late 1800s was the primary cause of the sudden extinction of 30 species or subspecies of endemic Hawaiian forest birds in the twenty years between 1890 and 1910. Since then, the black rat has continued to have negative effects on Hawaii's native land birds such as the Maui creeper (ʻalauahio, *Paroreomyza montana*), which frequently loses eggs and nestlings to rats (Baker and Baker 2000). Rats have been particularly devastating for those species that are now listed as Federally and State endangered. Predation by rats was the greatest cause of nest failure for the puaiohi, or small Kauaʻi thrush (*Myadestes palmeri*), occurring at 38% of active nests with known fates, whose population is declining precipitously (Tweed *et al*. 2006). Rats were documented to take the entire nest contents, including the adult female incubating the eggs, of the crested honeycreeper (ʻākohekohe, *Palmeria dolei*) (Simon *et al.* 2001), and the nestlings and adult female puaiohi (Tweed *et al*. 2003). Nest depredation and female mortality by black rats has been implicated as the primary cause of the substantial decline of the endangered Oʻahu ʻelepaio (*Chasiempis sandwichensis ibidis*) (Mosher *et al.* 2010, VanderWerf and Smith 2002). Pletschet and Kelly (1990) documented depredation by black rats and feral cats as the primary cause of mortality for palila (*Loxioides bailleui*) nestlings on Mauna Kea. The degree to which rats have directly impacted the Hawaiian crow is unknown, although at least one incident of egg depredation has been observed (P. Banko, pers. comm.). As direct competitors for many of the native fruits in the ʻalalā's diet, rats may have reduced the quality of native forest habitats to the point where they could no longer support the ʻalalā.

Ground-Nesting Birds and Impacts of Rodents

Six species of existing endemic birds utilize wetlands in Hawaiʻi: the Laysan duck (*Anas laysanensis*), nēnē (Hawaiian goose), koloa maoli (*A. wyvilliana*, Hawaiian duck), ʻalae ʻula (Hawaiian common gallinule), ʻalae keʻokeʻo (*Fulica alai,* Hawaiian coot) and aeʻo (Hawaiian stilt). All of these species are listed as endangered by the FWS and by the State. The primary threats to these species include loss and degradation of wetland habitats, predation by non-native predators, hybridization between non-native mallards (*A. platyrhynchos*) and the koloa maoli, human-caused disturbance and mortality, and disease (USFWS 2004, USFWS 2009, USFWS 2011). An additional indigenous species that utilizes wetlands, the ʻaukuʻu (*Nycticorax nycticorax*, black-crowned night-heron), is common throughout the MHI.

Polynesian legends speak of how Maui goes in search of the secret of fire. He finds that ʻAlae (the gallinule) held the secret and tries to force it out of her. ʻAlae deceives Maui, telling him to rub various items together. Growing impatient, Maui twists her throat until she screamed the secret. After finally finding out the secret, Maui rubs her forehead with the fire stick, leaving the notable red mark of the ʻalae ula (Westervelt 1910).

Rats affect the reproductive success of Hawaii's ground-nesting birds. They take nēnē eggs (Baker and Baker 1995) and young (K. Misajon, NPS, pers. comm. 2011). Their impacts are well-documented for some species of Hawaiian waterbirds. Rats consumed approximately six Hawaiian stilt and coot eggs at Pearl Harbor during the 2004/5 nesting season (A. Nadig and M. Silbernagle, pers. obs.). Eijzenga (2004) noted rat tracks and crushed eggshells in Hawaiian stilt nests at the James Campbell National Wildlife Refuge on Oʻahu. Coot and stilt eggs at several sites on Molokaʻi showed clear signs of rat depredation (Figure 6, A. Dibben-Young, pers. obs.), and 10% of Hawaiian stilt eggs at Ohiapilo Pond, Molokaʻi, were eaten by rats during the 2010-2013 nesting seasons (A. Dibben-Young, pers. comm.). A rat was observed in camera images of a coot nest at Hamakua Marsh on Oʻahu from which all of the eggs disappeared (K. Doyle, pers. comm.). Stilt feathers found in rat scats (A. Dibben-Young, pers. comm.) indicate that rats may predate live birds, or that they scavenge carcasses that died from other causes.

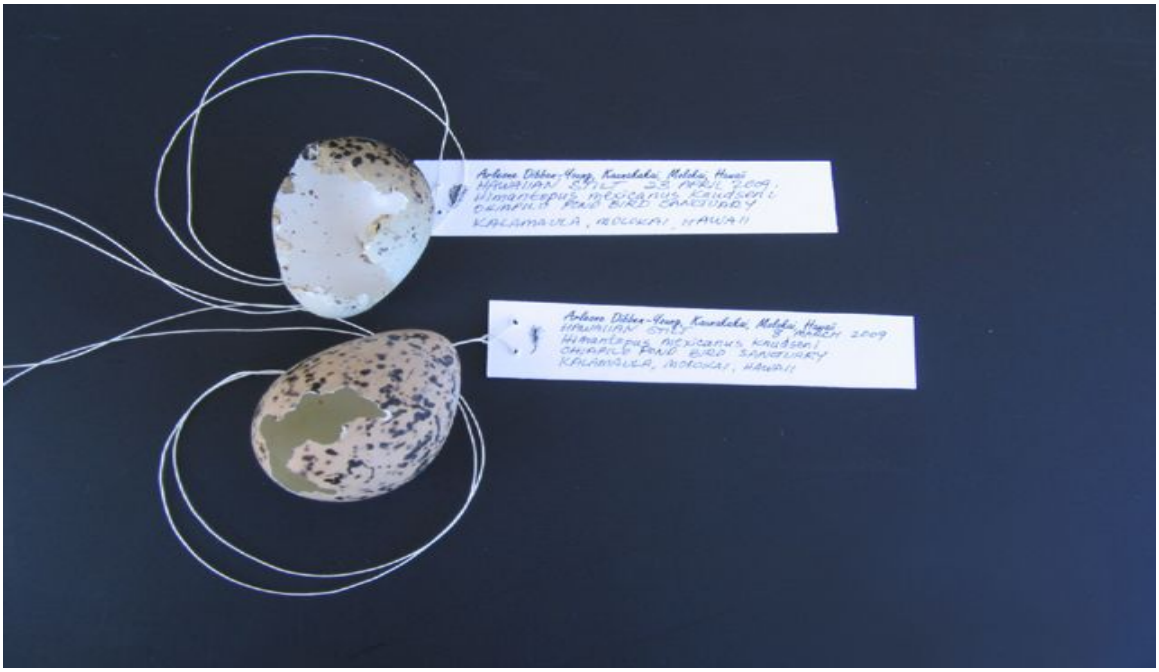

Figure 6: Rat depredated Hawaiian stilt eggs, Ohiapilo Pond, Molokaʻi (Photo by A. Dibben-Young).

Seabirds and Impacts of Rodents

Hawaiian seabirds have undergone a series of historical events that have had varying degrees of impact on their populations. Ancient Hawaiians ate Bulwer's petrel (ʻou,

Bulweria bulwerii) and Newell's shearwater (ʻaʻo, *Puffinus auricularis newelli*) chicks, and the bones of these and numerous other seabird species have been found in archeological sites throughout Hawaiʻi (Olson and James 1982). Tattoo needles were fashioned out of Laysan Albatross (*Phoebastria immutabilis*) bones. They are called mōlī, which is fitting, as it is also the Hawaiian name for these seabirds. It is likely that many seabirds that now nest only on offshore islands once nested throughout the main islands before being extirpated by early Polynesians and their introduced non-native mammals such as rats, dogs and Polynesian pigs. Current populations are likely significantly reduced from historical numbers. The arrival of Europeans to the islands brought numerous additional threats. Traders exploring the NWHI killed albatross chicks for down and the adults for feathers. They mined guano from Laysan, Lisianki and other islands, and collected seabird eggs to sell as food. This exploitation caused the populations of numerous Hawaiian seabird species to plummet to dangerously low levels by the turn of the 20th century. Europeans also brought cats and two additional species of rats, all of which negatively affect seabirds (Tomich 1986).

Historically, high densities of seabirds nested on all Hawaiian Islands, but now most are restricted to the NWHI or to predator-free offshore islands within the MHI. A few birds, such as the ʻuaʻu (Hawaiian petrel) and ʻaʻo (Newell's shearwater), nest in high elevations or in inaccessible locations such as sheer cliffs on the MHIs.

Primary threats to seabirds while on land in Hawaiʻi include predation by feral cats, rodents and mongooses, loss or degradation of habitat due to habitat-modifying invasive plants or animals and human disturbance including coastal lighting.

Seabirds are important to Polynesian wayfinders. Polynesians would navigate the open ocean through constant observation of the stars, the sun, the ocean swells, and other signs of nature for clues to direction and location of a vessel at sea. Seabirds, like the Manu o Kū (*Gygis alba*, White Tern) and the noio (*Anous stolidus*, Brown Tern (Noddy)) are used as land indicators. Manu o Kū fly as far as 130 miles out to sea to feed and return to land to nest and thus provide the bearings for land that may not be in sight (Thompson, Polynesian Voyaging Society).

Rats severely impact seabirds in the Hawaiian Islands. The black rat caused dramatic population declines of the Bonin Petrel (*P. hypoleuca*) on Midway Atoll by depredating eggs (Seto and Conant 1996). On Kure Atoll, Kepler (1967) observed and photographed Polynesian rats eating nesting Laysan albatrosses alive, and Fleet (1972) reported that rats were killing most of the red-tailed tropicbird (*Phaethon rubricauda*) nestlings in his study area, as well as causing more than half of the total egg loss. Two species of seabird endemic to the Main Hawaiian Islands, 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 the decline is low reproductive success due to rats. Hodges and Nagata (2001) identified rats as the predator causing the most mortality of Hawaiian

petrel eggs and chicks in the years 1964-1996 at Haleakalā National Park. In more recent years, the use of still and video cameras to monitor petrel and shearwater nesting burrows at multiple locations across the main islands has documented the frequency with which black and Polynesian rats, as well as mice, enter burrows (Raine and McFarland 2013a,b). Graphic images of black rats dragging chicks out of their burrows have been recorded at Lanaihale (C. Costales, pers. comm.) and Hono o Nā Pali on Kauaʻi (Raine and McFarland 2013a). The State of Hawai'i in the Hawai'i Comprehensive Wildlife Conservation Plan identifies predation by invasive rats to be a threat to the native species of seabirds (Mitchell *et al.* 2005).

Migratory Shorebirds

Several species of migratory shorebirds winter in Hawai'i. Of these, the Pacific golden plover (kōlea, *Pluvialis fulva*), the ruddy turnstone ('akekeke, *Arenaria interpres*), the wandering tattler ('ūlili, *Heteroscelus incanus*) and the bristle-thighed curlew (kioea, *Numenius tahitiensis*) are regular migrants that have been identified as important in the U.S. Shorebird Conservation Plan (Brown *et al.* 2001) because the populations in Hawai'i are hemispherically significant or relatively large. No documentation of rodent or mongoose predation on migratory shorebirds is known from Hawai'i.

Endemic Birds of the NWHI

Four species of birds are only found in the NWHI: the Laysan finch (*Telespiza cantans*), Nihoa finch (*T. ultima*), Nihoa millerbird (*Acrocephalus familiaris*), and the Laysan duck. These species are among the rarest birds in the world. Historically single island endemics, secondary populations of the Laysan finch, Nihoa Millerbird, and Laysan duck have been established on other islands as insurance against catastrophic events that could cause the extinction of a single island's population (e.g., Reynolds *et al.* 2008). Major threats include the introduction of habitat-modifying invasive plants, the introduction of habitat-modifying or predatory invasive animals and environmental factors, including natural disaster, drought and long-term climate change resulting in the rise of sea levels. Without rapid and effective intervention, introduction of rats to these islands would result in immediate extirpations/extinctions, based on the rapid extinction of the Laysan rail (*Porzana palmeri*) and the extirpation of an introduced population of Laysan finches caused by the introduction of black rats to Midway Atoll during WWII (Fisher and Baldwin 1946).

Terrestrial Invertebrates

Similar to native forest birds, Hawaii's native terrestrial invertebrates are characterized by high levels of endemism – over 90 percent of terrestrial invertebrates are found nowhere else on earth. Within the family drosophilidae (e.g., vinegar flies), there are nearly 1000 Hawaiian species (Leblanc *et al.* 2013, Magnacca *et al.* 2008), which

evolved from a small number of colonists (Kaneshiro 1997). Many other adaptive radiations are found among terrestrial arthropod groups: more than 350 species of *Hyposmocoma* moths (Rubinoff 2008), 180 species of *Sierola* spp. wasps (Bethylidae) (Gordh 1998), and 177 species of *Proterhinus* beetles (Nishida 1994).

A number of invertebrates have been listed as federally endangered or threatened by FWS. As of August 2013, a total of 65 invertebrates were listed as endangered and 2 as threatened. These include 45 species of snails (44 endangered and one threatened), the majority of which are O‘ahu tree snails of the genus *Achatinella*. Hawaiian folklore speaks of the singing snails calling to the kolea (Pacific Golden Plover) for water from the ‘akolea fern (*Athyrium microphyllum*) (*Kahuli Aku*, Keola Beamer). 767 land snail species are included in the Hawai‘i Comprehensive Wildlife Conservation Strategy, and all are described as Species of Greatest Conservation Need (Mitchell *et al.* 2005). All 41 species of the genus *Achatinella*, endemic to O‘ahu, are federally listed under the federal Endangered Species Act, and listed as “Endangered” by the State of Hawai‘i. Those species left are isolated to small patches of their former ranges, mostly on high mountain ridges (Hadfield *et al.* 1993). The list also includes one spider, the Kaua‘i cave wolf spider (*Adelocosa anops* spp.), and an amphipod, the Kaua‘i cave amphipod (*Spelaeorchestia koloana*). A total of 20 insect species are federally listed (19 - endangered and 1 - threatened). In addition to the Blackburn’s sphinx moth (*Manduca blackburni*), the insects include 14 species of picture-wing flies and five species of damselflies from the genus *Megalagrion*.

The main threats facing terrestrial invertebrates are loss and degradation of native habitats, predation and competition from invasive species and the loss of native host plants.

Not much is known about other invertebrates in Hawaiian culture.

Impacts of Rodents on Land Snails in Hawai‘i

Hawaiian land snails once made up a significant portion of the terrestrial biodiversity in the islands and were ubiquitous in dry, mesic, and wet forest habitats across the archipelago. What was once a diverse group of almost 1500 recognized endemic taxonomic units in 10 different families (excluding countless unidentified species), has been reduced by as much as 60 - 90% because of habitat degradation and the presence of introduced predators, such as the cannibal snail (*Euglandina rosea*), Jackson’s chameleon (*Chamaeleo jacksonii*), and rats.

When rats depredate snails, particularly larger species (greater than 10 mm), they leave discarded shells with characteristic damage to the apex and whorls (Figure 7). Because of this, rat predation on land snail species in the genera *Achatinella* and *Partulina* has been well documented (Hadfield 1986, Hadfield *et al.* 1993, Hadfield and Saufler 2009). Hadfield and Saufler (2009) attributed *Partulina redfieldi* population declines of up to

87% over 20 years on Moloka‘i to predation by rats. Conversely, due to their extreme rarity, rat predation on large species in the family Amastridae has been less documented in the literature, but regularly observed in the field by Hawai‘i Snail Extinction Prevention Program (SEPP) staff. (David R. Sischo, SEPP Coordinator, pers. comm.). Rat predation on minute snail species (less than 10 mm), in all 10 families, likely occurs but is difficult to detect because rats damage shells beyond recognition, or ingest the entire shell while feeding. Predation by mice and mongoose has not been observed, but snails likely are part of these species' omnivorous diets.

Figure 7: Rat damage to *Achatinella concavospira* shells. *A. concavospira* is endemic to the Wai‘anae Mountains of O‘ahu and the species has experienced severe range restrictions and extirpations due to predation by rats (Photo by D. Sischo).

Impacts of Rodents on Other Invertebrates in Hawai‘i

Invertebrates are frequently found in the stomachs of rodents in Hawai‘i and elsewhere (Russell 1980, Stone *et al.* 1984, Sugihara 1997, Cole *et al.* 2000, St. Clair 2010). Extirpations and extinctions of endemic species of invertebrates due to rodent introductions have been documented outside of Hawai‘i (St. Clair 2010). Arthropods are one of the most common components in the diets of all three rodent species in Hawaiian ecosystems, and Lepidoptera larvae comprise a significant portion of this category (Russell 1980, Sugihara 1997, Cole *et al.* 2000). Some insects may be so preferred as a food item that rodents can have population-level effects. The rarity of certain species of

Hawaiian moths with particularly large larvae, such as the Fabulous Green Sphinx (*Tinostoma smaragditis*), may be due at least in part to rat predation. Howarth and Stone (2007) found the remains of previously undescribed endemic species of crickets, beetles and lacewings in rat stomachs from Kīpahulu Valley in Haleakalā National Park. Rats have been documented to occur deep within the cave habitat of Kauai's listed cave arthropods (G. Smith, USFWS, pers. comm., 2005), and rat predation could be a significant factor impeding their recovery.

Marine Species

Marine ecosystems in Hawai'i support over 1,200 species of fishes, with around 500 species adapted to live on coral reefs, and the rest adapted to the open ocean waters, deep habitats, estuaries or areas characterized by sandy sea floor. These fishes occupy a range of niches from herbivores to carnivores that specialize on microscopic plankton, seashells, crabs, shrimp or other fishes. Many of these species are important in commercial or recreational fisheries, and are taken in sufficient quantities to warrant management under a Fishery Ecosystem Plan developed by the Western Pacific Regional Fishery Management Council and NOAA under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §1801 et seq.). In addition to being managed under the Hawaiian Fishery Ecosystem Plan, some species of stony corals, black corals, seahorses and sharks are protected by the Convention on International Trade in Endangered Species (CITES) Appendix II.

Marine species that occur in Hawaiian waters that are currently protected under the Endangered Species Act of 1973 (ESA; 16 U.S.C. § 1531 et seq.) include sea turtles and marine mammals. The turtle species include: green, hawksbill, leatherback (*Dermochelys coriacea*), North Pacific distinct population segment of loggerheads (*Caretta caretta*), and olive Ridley (*Lepidochelys kempii*) sea turtles. The green and olive Ridley turtles are listed as threatened, while the North Pacific DPS of the loggerhead, leatherback, and the hawksbill are all listed as endangered. Although all five species of sea turtles may be found in Hawaiian waters, only two species, the green and hawksbill, are common residents. Although they are not yet final, three species of corals, (*Montipora dilatata* (Hawaiian Reef Coral)*, M. flabellata* (Blue Rice Coral)*, and M. patula* (Sandpaper Rice Coral) that occur in the Hawaiian Archipelago have been proposed for listing as threatened under the ESA as well (Sakashita and Wolf 2009).

A Hawaiian legend tells of a hero named 'Ai'ai who created honu from drawings on a rock (McDonald and Weissich 2003). Other stories portray honu as aumākua; a messenger, a monster set to attack enemies, a living canoe to transport lost lovers, and foundation for some of the islands (McDonald and Weissich 2003). In some areas the green turtle was reserved for feasts attended exclusively by men. In the Hawaiian Islands, in ancient times, women were entirely prohibited from eating turtles (Balazs 1980,

Kalakaua 1888). Certain parts of the green turtle, such as the fat, were also used for medicinal purposes to treat burns and other skin disorders. In addition, dried carapaces of the green turtle were used as containers, and the disarticulated bones were used for kitchen utensils, sewing needles, fish hooks, and agricultural tools. While green turtle scutes are also known to have been fashioned into ornaments and utensils, the thicker and more attractive plates of the hawksbill were preferred for this purpose whenever available. Live hatchlings were (and in some places still are) commonly raised as pets where they eventually died or were released or eaten when they grew to a certain size (Green Turtle Recovery Plan 1998).

Over 50 species of marine mammals are residents or occasional visitors to the Hawaiian Archipelago. Marine mammals protected under the ESA include: humpback whale (*Megaptera novaeangliae*), blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*), fin whale (*Balaenotera physalus*), sei whale (*Balaenoptera borealis*), the Main Hawaiian Islands insular false killer whale, and the Hawaiian monk seal (*Monachus schauinslandi*). All of these marine mammal species are listed as endangered under the ESA. The Hawaiian monk seal is endemic to Hawai‘i, and is one of the most endangered species in the world, with a current population of approximately 1,100, and a population trend that is declining.

All marine mammals are protected by the Marine Mammal Protection Act (16 U.S.C.§ 1361 et seq.). Year-round Hawai‘i resident cetacean species include: the spinner (*Stenella longirostris*) and bottlenose dolphins (*Tursiops truncatus*), while others like the migratory humpback whales (*Megaptera novaeangliae*) spend just a few winter months each year in Hawaiian waters to give birth and breed. Many of the resident cetacean species feed on fishes and squids that occur in the moderately deep waters off Hawaii’s coasts.

Unlike the mammals that arrived in Hawai‘i with the early Polynesian voyages, the dog (‘īlio), pig (pua‘a), and rat (‘iole), all of which were identified by a single Hawaiian name, seals were found to be referred to in ‘ōlelo Hawai‘i (the Hawaiian language) by several different terms. Among these were *he ‘īlio o ke kai* (the dog of the sea, also *‘īlio o ke kai*), *‘īlio-holo-kai* (the dog that runs in the sea), *‘īlio-holo-i-kauaua* (dog running in the toughness), *hulu* (fur; possibly a historic usage to refer to arctic fur seals), and *kila* or *sila* (an adaptation of the English word seal). With their furred bodies and bark-like calls, it is easy to see how seals were identified as the dogs of the sea. The range of different names used to refer to these animals, however, some of which were derived from the English term seal, might suggest that seals were not frequently encountered by the Hawaiians of the late pre-Contact period (NOAA PEIS Recovery Plan, 2014).

The whale is the largest ocean form and a majestic manifestation of the god, Kanaloa. The ivory of whale is made into palaoa (carved whale-tooth pendant) and is worn by high ranking ali‘i. It is said that Kanaloa brought mana to the carver, to the pendant itself, as

well as the wearer. Possessing this kinolau (body form) of Kanaloa gave the ali‘i characteristics, intelligence, and knowledge of the God (Kanahele 1993).

Impacts of Rodents on Sea Turtles in Hawai‘i

Impacts from rodents to sea turtles have not been well-documented in Hawai‘i. However, directly observed predation by black rats on hatchlings of the green sea turtle is reported by Caut *et al.* (2008) on Surprise Island, New Caledonia. On Buck Island in the US Virgin Islands, black rats harassed hawksbill females as they laid eggs, including sitting on their backs, and took eggs and hatchlings (Witmer *et al.* 2007).

SUMMARY OF NATIVE FLORA OF HAWAI‘I

Native Plants and their Uses in Hawaiian Culture

Over 1,000 distinct flowering plant species evolved from approximately 270-280 successful flowering plant colonist species (Wagner *et al.* 1999). In addition, Hawai‘i supports over 188 recognized taxa of native ferns and fern allies, of which about 77 percent are endemic (Palmer 2003). Present total species richness is concentrated on older high islands, primarily, and plant species that have suffered the greatest percentages of habitat loss are concentrated in lowland habitats.

Plants provided a number of essential uses for Hawaiians, including food, clothing, and shelter. Hawaiians also relied on plants for many of their artifacts because the islands lack natural metal and clay materials (Krauss 1993).

The following are examples of plant uses in Native Hawaiian culture (Krauss 1993):

Food: Ancient Polynesians brought food plants with them because they did not know whether food would be available at their new destinations. These plants would later be known as the “canoe-plants”. Kalo (taro, *Colocasia esculenta*), ‘uala (sweet potato, *Ipomoea batatas*), and ‘ulu (breadfruit, *Artocarpus altilis*) were some of the staples used for daily consumption by Hawaiians. While these canoe plants, especially kalo, were the mainstay of the Hawaiian diet, native plants were consumed, especially for medicinal purposes (see Medicine section below) or during times of famine. The starchy pith of the hāpu‘u (*Cibotium* spp.) was cooked and eaten. The fruits of the ‘ōhelo (*Vaccinium* spp.), pōpolo (*Solanum americanum* Mill), naupaka kahakai (*Scaevola sericea*), ‘ūlei (*Osteomeles anthyllidifolia*), lama (*Diospyros* spp.) and ‘ākala (*Rubus* spp.), normally used for refreshments on journeys, were eaten during times of famine as well. Limu (marine or freshwater algae) was gathered from the ocean or rivers and prepared and eaten with fish and poi.

Tools: The ‘ō‘ō (digging stick), lou (fruit-picking stick), and ‘auamo (carrying pole) are some farming tools made from alahe‘e (*Psydrax odorata*), ‘ūlei, kauila (*Colubrina oppositifolia*), and uhiuhi (*Caesalpinia kavaiensis*) trees. Kauila, uhiuhi, or similar hard

woods were used to make fish spears (kao or ʻō). Nets (ʻupena) and fish lines were most frequently made from the olonā (*Touchardia latifolia*) fibers. Fish traps (hīnaʻi) of many shapes and sizes were used for trapping small freshwater fish and prawns in the streams as well as fish in the sea. Traps were made from the roots of ʻieʻie (*Freycinetia arborea*) and from ʻāwikiwiki (*Canavalia* spp.) vines. Composite shark hooks (makau manō) were made from uhiuhi, alaheʻe, koaiʻa (*Acacia koaia*), and ʻāheahea (*Chenopodium oahuense*) wood and were fitted with bone points (Krauss 1993).

Household and other daily items: Cordage, from the fibers of plants, was used to fasten items together. Bast fibers from hau (*Hibiscus tiliaceus*) and olonā were excellent for making cords (Krauss 1993).

Leaves (lau hala) and the male inflorescences of the hala (*Pandanus odoratissimus*), as well as parts from the ʻakaʻakai (*Scirpus validus*), makaloa (*Cyperus laevigatus*), and loulu (*Pritchardia* spp.) were used for plaiting items such as mats, pillows, baskets, and fans (Krauss 1993).

Houses: Posts, rafters, and purlins were made from hard woods such as uhiuhi, naio (*Myoporum sandwicense*), ʻaʻaliʻi (*Dodonaea viscosa*), māmane (*Sophora chrysophylla*), and olopua (*Nestegis sandwicensis*). Three-ply braids of ʻukiʻuki (*Dianella sandwicensis*) cordage was used for lashing the posts together and pili (*Heteropogon contortus*) was the preferred material for thatching (Krauss 1993).

Canoes: The koa (*Acacia koa*) tree was the primary tree for fashioning canoes (waʻa). Koa trees were not simply cut down; a lengthy ritual for cutting down the tree was required. Koa was also used for canoe paddles (hoe) as well. Spreaders for the masts were created from the roots of the ʻōhiʻa (*Metrosideros* spp.) tree because of its strength and natural, almost U-shaped curve. Booms and floats made up the outrigger of a single canoe (waʻa kuakahi) and this was made using hau and wiliwili (*Erythrina sandwicensis*). The sails were made of plaited lau hala patterns (Krauss 1993).

Religion: Hawaiians believed that all things came from closely related deities. These deities could be manifested into many of nature's forms (kino lau) (Anderson-Fung and Maly 2002). Because of this, Hawaiians worshipped and revered all things in nature as it was a direct link to their gods.

Kū, the god of war, sometimes took the form of the ʻōhiʻa. In the ancient form of hula (kahiko), dancers pick plants that are the kino lau of the god being worshipped and adorn themselves with these plants, or place them on the altar (kuahu) of the hālau hula (dancers' house) in the god's honor. Some examples of hula kino lau include lama for Laka a female deity, lehua for Kūkaʻōhiʻalaka, a male Laka deity, halapēpē (*Pleomele* spp.) for Kapo and Laka, palapalai (*Schenomeris chinesis*) for Hiʻiaka, ʻieʻie for Laukaʻieʻie, and maile (*Alyxia oliviformis*) for the four Maile sisters (Anderson-Fung and Maly 2002). Native plants were traditionally used to make musical instruments. Kauila

was the wood exclusively used to make kā lā‘au (beating sticks). Other native plants that made up, at least in part, musical instruments include ‘iliahi (*Santalum* spp.), ‘ūlei, ‘ōhi‘a lehua, ‘ie‘ie, and olonā (Krauss 1993).

Medicine: Different parts of native plants (roots, stems, leaves, flowers, bark, fruits, and seeds) were used for medicinal purposes. Depending on the diagnosis of diseases, determined by the kāhuna lā‘au lapa‘aua (practitioner), different quantities or measurements of leaves, bark, berries, flowers, and flower buds were pounded, stripped, and/or strained in order to be extracted for their sap. The formulations included salt and ‘alaea (red clay). Krauss (2001) provides ancient uses of some native plants. Kauna‘oa (*Cuscuta sandwichiana* Choisy), mixed into several combination of spring water and other plants, was used to help relieve chest codes with thick phlegm and help discharge the placenta and remove accumulated blood after a pregnancy. Ashes of the koa leaves, flowers and buds of the koali ‘awa (*Ipomaea indica*), leaves of the laukahi (*Plantago* spp.), fruits and leaves of the māmaki (*Pipturus* spp.) (starting during the pregnancy) were used as preventative medicine for ‘ea or thrush. Fresh or dried leaves of the māmaki, ko‘oko‘olau, and many other plants were used to prepare teas as tonics and general “cleansing agents.” These are only a few of many examples of native plants used in medicine (Krauss 1993).

Mo‘olelo: Stories of old are created to help explain natural phenomena. Beamer (1984) provides her take on the story of naupaka (*Scaevola* spp.). Naupaka, a beautiful Hawaiian princess was in love with Kaui, a man born without royal status. However, because of their status, they were forbidden to be together. They prayed to the Hawaiian gods for something to be done, but “the sky began to darken and a wind rose through the trees…suddenly, there was a torrent of rain, a loud clap of thunder and a flash of lightening (Beamer 1984); the answer was obvious that they were not to marry. Naupaka took the flower from her hair, tore it in half, gave it to Kaui, and told him to go to the shore and she’d remain in the mountains, never to meet again. This story gives insight to the naupaka’s half-shaped flowers as well as the beach (naupaka kahakai) and mountain (naupaka kuahiwi) varieties.

Impacts of Rodents on Plants in Hawai‘i

The impacts of rodents on native species in Hawai‘i has been the most extensively documented for plants. Plant material is universally found in Hawaiian rodent stomach content studies (Russell 1980, Stone *et al.* 1984, Sugihara 1997, Cole *et al.* 2000). Rats and mice eat virtually every part of plants and at every stage: fleshy fruits, seeds, flowers, stems, leaves, shoots, seedlings, and roots (Russell 1980, Cuddihy and Stone 1990). The effects on plants range from reduced vigor and decreased reproduction, to mortality of individuals and complete lack of recruitment. Rats strip the bark of koa saplings, girdling and killing the young trees (Scowcroft and Sakai 1984). Constant

depredation of *Hibiscadelphus giffardianus* fruit and seeds results in virtually no seedling recruitment, and periodic bark stripping weakens adult trees (L. Pratt, U.S. Geological Survey, email dated 12/03/07; Baker and Allen 1978) and *Pittosporum* spp. (Stone 1985). Plants with large, fleshy fruits are particularly susceptible to rodent depredation: *Freycinetia arborea* Gaudich (Conant 1972; O‘ahu Army Natural Resources Program pers. obs., Figure 8), *Pritchardia* spp. (Beccari and Rock 1921, Male and Loeffler 1997, Mosher *et al.* 2010), *Scaevola* spp. (D. Clark, pers.obs., Figure 9), and plants in the bellflower (e.g., *Cyanea* spp.) and African violet (e.g., *Cyrtandra* spp.) families (Conant 1972, Mosher *et al.* 2010, Cuddihy and Stone 1990). Seed depredation appears to be an important factor contributing to the lack of seedling recruitment of Hawaiian dry forest tree species such as Hawaiian olive (olopua, *Nestegis sandwicensis*), *Alectryon micrococcus*, Hawaiian nesoluma (keahi, *Nesoluma polynesicum*) and *Pouteria sandwicensis* (Chimera 2004). Rodents also affect ecological processes such as seed dispersal (Chimera and Drake 2011, Shiels and Drake 2011).

Figure 8: ‘Ie‘ie (*Freycinetia arborea* Gaudich) without (left) and with (right) rat damage (Photo by O‘ahu Army Natural Resources Program)

IMPACTS OF MONGOOSES ON NATIVE SPECIES IN HAWAI‘I

Mongooses in Hawai‘i feed on a wide variety of prey and locally available food, eating live terrestrial vertebrates (reptiles, birds, rodents, amphibians), invertebrates (insects, spiders, crabs), and carrion and small fruits in lesser amounts (Baldwin *et al.* 1952). Their impacts on many of Hawaii’s endangered birds are well-documented, including evidence of mongooses attacking the adults of nēnē (Banko 1982, Banko 1992), ‘alalā (P. Harrity, pers. obs.), the Hawaiian common gallinule at Ukoa Pond, Haleiwa, O‘ahu (A. Henry and D. DesRochers, pers. obs.), and at Ohiapilo, Moloka‘i (L. Tanino and C. Cowles, pers.obs.), and the Hawaiian petrel (Bryan 1908, Hodges and Nagata 2001).

Mongooses take eggs and young as well, reducing the reproductive success of nēnē (Banko 1982, Hoshide *et al.* 1990, Banko 1992, Baker and Baker 1995), ʻalalā (Giffin 1983), the Hawaiian stilt (Eijzenga 2004; A. Dibben-Young, unpubl data), and the Hawaiian petrel (Bryan 1908, Hodges and Nagata 2001). The mongoose may affect native plant and invertebrate populations, given their omnivorous diet and wide distribution in native habitats (Bryan 1908, Baldwin *et al.* 1952, Tomich 1986, Hodges and Nagata 2001). Beccari and Rock (1921) noted that for the *Pritchardia* species of palms "mature seeds are very scarce owing to rats and mongooses which eat the fruits as soon as they have fallen."

GEOGRAPHY, ECOLOGY, AND DEMOGRAPHICS OF HAWAIʻI

Geography

The archipelago is composed of eight main islands (MHI), Hawaiʻi, Maui, Lānaʻi, Molokaʻi, Oʻahu, Kauaʻi, Kahoʻolawe and Niʻihau, and approximately 124 smaller islands, reefs and shoals spanning over 1,500 miles between 16° and 23° north latitude. The eight MHI support more than 99.9 percent of the archipelago's human population (State of Hawaiʻi Data Book 2002, Mitchell *et al.* 2005). The NWHI include (east to west) Nihoa, Necker (Mokumanamana), French Frigate Shoals (Mokupāpapa), Gardner Pinnacles (Pūhāhonu), Maro Reef (Nalukākala), Laysan (Kauō), Lisianski (Papaʻāpoho), Pearl and Hermes Atoll (Holoikauaua), Midway (Pihemanu) and Kure (Kānemilohaʻi). The NWH I are small islands and atolls in the Hawaiian archipelago extending for 1,200 miles to the northwest of Niʻihau. Once high islands of volcanic origin, their current geomorphic states are the result of millions of years of erosion, subsidence, and reef building (Clague and Dalrymple 1989).

Political Jurisdictions

Hawaiʻi has four local governments: the City and County of Honolulu (Island of Oʻahu and the NWHI), the County of Kauaʻi (islands of Kauaʻi and Niʻihau), the County of Maui (islands of Maui, Molokaʻi, Lānaʻi and Kahoʻolawe) and the County of Hawaiʻi (Island of Hawaiʻi). Hawaiʻi also has a fifth county, Kalawao County, which does not have a separate government unit. Kalawao County covers the former Hansen's disease settlement at Kalaupapa (Molokaʻi) and is managed by the National Park Service (NPS) under a cooperative agreement with the State Department of Health (Mitchell *et al.* 2005).

The NWHI are encompassed within the Papahānaumokuākea Marine National Monument (Monument), established in 2006 by Presidential Proclamation 8031 (Proclamation). Three parties acting as Co-Trustees have the responsibility of managing the Monument: the State of Hawaiʻi, Department of Land and Natural Resources; the U.S. Department of the Interior, Fish and Wildlife Service; and the U.S. Department of

Commerce, National Oceanic and Atmospheric Administration. Native Hawaiian interests are represented by the Office of Hawaiian Affairs through the Monument Management Board. With the establishment of the Monument, a number of existing Federal and State conservation areas remained in place and are subject to their applicable laws and regulations in addition to the provisions of the Proclamation (MMP 2008). They are within the jurisdiction of the State of Hawai‘i, City and County of Honolulu, except for Midway Atoll, which is administered by the Refuge System as Midway Atoll National Wildlife Refuge and Battle of Midway National Memorial. Midway Atoll is an unincorporated territory of the U.S. under U.S. jurisdiction. The Refuge is currently closed to public visitation, but a small resident population of around 40 people maintains the FAA-mandated emergency landing runway, provides support to base facilities and operations, and performs Refuge management activities. Midway is the only location in the NWHI where people live year-round. DLNR rotates staff through a field camp on Kure Atoll, and FWS and NOAA place temporary camps on islands within the Monument for management and research.

Population and Land Use

The U.S. Census Bureau (2015) estimated Hawaii's population at 1.42 million people in 2014, majority of which were from the City and County of Honolulu. Tourism is the primary economic activity in the State, with approximately 8.17 million visitors in 2013 (Hawai‘i Tourism Authority 2014), up from 7.29 million visitors in 2011 (Hawai‘i Tourism Authority 2012). Agriculture, primarily pineapple cultivation and diversified agriculture, and military expenditures are important secondary economic drivers (Mitchell *et al.* 2005).

Unlike many other states, Hawai‘i adopted statewide land use classifications, with all land being zoned in one of four categories: Conservation, Agriculture, Urban, or Rural. About 48 percent of the State (798,702 hectares (ha) or 1,973,636 acres (ac)) is in the State Conservation District, a designation where development and commercial activity is generally limited with varying levels of restrictions based on the applicable subzone. While DLNR manages land in the Conservation District, the counties have primary responsibility for land in the other three districts. Those Districts are subject to county land-use and development controls, including county community plans, zoning and building code regulations which affect farm, residential, commercial and industrial development and use. For each county, Special Management Areas located along the shoreline have an additional layer of regulation that provides special control of development, even for land already subject to Conservation District restrictions (Mitchell *et al.* 2005).

Nearly half of Hawaii's 1.66 million ha (4.1 million ac) are managed by the State or Federal government. The largest landowner, the State of Hawai‘i, manages over 467,000

ha (1,155,900 ac) for watershed protection, preservation of natural resources, agricultural use, recreation, transportation and public safety. The State Department of Hawaiian Home Lands (DHHL) manages an additional 82,000 ha (202,658 ac) in trust for the present and future use by Native Hawaiians. The Federal government (NPS, the FWS, and Department of Defense, with USDA Forest Service considering establishing a National Forest in Hawai‘i) owns or manages, through leases or cooperative agreements, more than 270,000 ha (671,579 ac) for a variety of purposes, including conservation of natural and cultural resources, protection of wildlife habitat, military support and training and public safety (Mitchell *et al.* 2005).

The remaining land is privately owned. Major landowners are Kamehameha Schools, Parker Ranch, Castle & Cooke, Inc., Alexander and Baldwin, Inc., James Campbell Estate, C. Brewer and Company, Ltd., Inc., The Robinson Family, Grove Farm, and Moloka‘i Ranch. The majority (98%) of the island of Lāna‘i is owned by Larry Ellison (doing business as Pulama Lāna‘i), with 2 percent at the summit of the island (Lāna‘i Hale) owned by the State of Hawai‘i. Some of these lands are managed in cooperation with adjacent landowners for conservation purposes as part of a watershed partnership. Modeled after the first watershed partnership that began in East Maui in 1991, there are now eleven watershed partnerships on six islands, involving more than 50 public and private partners and covering over 344,000 ha (850,000 ac) of forested watershed. These voluntary partnerships are the primary vehicle for conservation on private lands in Hawai‘i, as opposed to conservation easements, acquisition or other methods (Mitchell *et al.* 2005).

Protected Lands and Waters

A significant portion of the State (31%) has been designated for long-term resource protection and receives varying degrees of management: 260,267 ha (643,134 ac) are in State Forest Reserves (DLNR), 147,710 ha (365,000 ac) are within National Parks (NPS), 44,177 ha (109,164 ac) are in State Natural Area Reserves (DLNR), 38,400 ha (94,900 ac) are in State Wildlife Sanctuaries (DLNR) and 265,897 ha (657,048 ac) of emergent and submerged land are in Refuge Systems. The Hawaiian Islands Humpback Whale National Marine Sanctuary (NOAA and DLNR) protects an additional 364,200 ha (900,000 ac) of marine waters (Mitchell *et al.* 2005). The Papahānaumokuākea Marine National Monument protects an area approximately 139,793 square miles (362,061 square kilometers) that includes terrestrial and marine regions (MMP 2008).

Over the last decade, land use has transitioned from agriculture (e.g., sugar cane, pineapple cultivation) to resort-residential development and large-lot residential subdivisions on former agricultural lots. Example areas include Mānele Bay (Lāna‘i), west Maui, central O‘ahu and the Hāmākua Coast (Island of Hawai‘i). The dissolutions of the Campbell Estate and the Damon Estate private trusts are expected to result in

additional land use changes. Increased military activity associated with the location of a U.S. Army Stryker Brigade and the possible stationing of an aircraft carrier group is anticipated to result in additional land use changes in the Urban District for housing and infrastructure and in the Conservation District for construction related to training (Mitchell *et al.* 2005).

CLIMATE CHANGE-RELATED LOSS AND DEGRADATION OF HABITAT

The exact nature of the impacts of global climate change and increasing temperatures on native Hawaiian ecosystems have been estimated, and will likely result in the loss of native species (Fortini *et al.* 2013, Benning *et al.* 2002; Pounds *et al.* 1999; Still *et al.* 1999). The temperature in the Hawaiian Islands has been rising over the last 100 years with the greatest increase after 1975 (Giambelluca *et al.* 2008). Also since 1975, the Hawaiian Islands have experienced significantly warmer summer and winter temperatures, mainly due to increased temperatures at night and at higher elevations (above 800 meters [2,625 feet]). The average ambient air temperature (at sea level) is projected to increase by about 2.3 degrees Celsius (4.1 degrees Fahrenheit) with a range of 1.5 to 3.7 degrees Celsius (2.7 to 6.7 degrees Fahrenheit) by 2100 (IPCC 2007). These changes would increase the monthly average temperature from the current value of 23.3 degrees Celsius (74 degrees Fahrenheit) to between 25.0 and 30.0 degrees Celsius (77 and 86 degrees Fahrenheit). How these changes will be distributed across the topographic features of the Hawaiian Islands has been modelled (Zhang 2012, Fortini *et al.* 2013), but may change based upon more updated data.

Currently, in the oceans around the Hawaiian Islands, the average annual rainfall at sea level is about 635 millimeters (25 inches). The orographic (mountain) features of the islands increase this annual average to about 1,778 millimeters (70 inches) but can exceed 6,096 millimeters (240 inches) in the wettest mountain areas. Rainfall is distributed unevenly across each high island, and rainfall gradients are extreme (approximately 635 millimeters [25 inches] per mile), creating very dry and wet areas. Data on precipitation in Hawai‘i, which includes sea level precipitation and the added orographic effects, shows a steady and significant decline of about 15 percent over the last 15 to 20 years (Diaz *et al.* 2005; Chu and Chen 2005). These data are also supported by a gradual but steady decline in stream flow beginning in the early 1940s (Oki 2004).

Global climate modeling predicts that net precipitation at sea level near the Hawaiian Islands will decrease in winter by about 4 to 6 percent, with no significant change during summer (IPCC 2007). An alternate model indicates that wet-season (winter) precipitation will decrease by 5 to 10 percent, while dry-season (summer) precipitation will increase by about 5 percent (Timm and Diaz 2009).

Oki (2004) noted long-term evidence of decreased precipitation and stream flow in the Hawaiian Islands, based upon evidence collected by stream gauging stations. This long-term drying trend, coupled with existing ditch diversions and periodic El Nino-caused drying events, has created a pattern of severe and persistent stream dewatering events (Polhemus 2008). Future changes in precipitation and the forecast of those changes are highly uncertain because they depend, in part, on how the El Nino-La Nina weather cycle (a disruption of the ocean atmospheric system in the tropical Pacific having important global consequences for weather and climate) might change (Hawaii Climate Change Action Plan 1998).

In addition to direct physiological stress to native species, impacts would be expected to include habitat loss and alteration or changes in disturbance regimes. In the case of Hawaiian endemic species, many of which are characterized by limited climactic ranges and restricted habitat requirements, small population size, and low number of individuals, the probability of species going extinct as a result of these factors increases when ranges are restricted, habitat decreases, and population numbers decline (IPCC 2007).

Vegetation distribution will be altered significantly, with certain native plant species experiencing decreases in distribution and some being confined to microhabitat niches (Fortini *et al.* 2013). Altered climate conditions may facilitate the invasion of native ecosystems by invasive plant species (Vorsino *et al.* 2014).

According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs. Experimental evidence and field studies have shown that the malaria parasite does not develop below 13 degrees Celsius (55 degrees Fahrenheit) and maximum malaria transmission occurs where mean ambient summer temperature is 17 degrees Celsius (63 degrees Fahrenheit) (Benning *et al.* 2002). The threat of climate change for the Hawaiian forest birds would be further exacerbated by the extensive loss of suitable habitat due to the change in vegetation composition.

Sea Level Rise

Islands have a limited carrying capacity, and most of them face significant loss of land area and increased erosion resulting from sea level rise and increased storm intensity associated with global climate change. Offshore islands and low-lying atolls in the Northwestern Hawaiian Islands will be affected the most severely, with some overwashed completely during storms, or disappearing permanently (MMP 2008).

Climate Change Effects on Rodent and Mongoose Populations

The predicted warmer and wetter climate trends may also affect rodent populations. Increased rainfall, warmer temperatures, and climatic extremes may “expand the range

and increase the reproductive potential of rodent populations" (Cook and Karesh 2008, Chartered Institute of Environmental Health 2012). In New Zealand, Tompkins *et al.* (2013) modeled that increased beech (*Nothofagus* spp.) seed masting events, as a result of climate change, allowed for rat and stoat populations to become less irruptive and maintain a higher average abundance in this forest type.

Not much is known about how climate change will impact mongoose populations. McCain (2014) suggests that small mammals may shelter from temperature and humidity by using different micro-climates in vegetation and soil.

Predicting the impacts of climate change and invasive species is difficult, because the relationships are complex, incompletely understood, and sometimes unstable (Dukes *et al.* 2009). These uncertainties may require new and adaptive approaches for pest management (Tompkins *et al.* 2013, Chartered Institute of Environmental Health 2012).

HISTORY OF RODENT CONTROL AND ERADICATION IN HAWAI'I AND THE U.S. PACIFIC

Wildlife managers have been adapting agricultural and commensal rodent control methods to native ecosystem conservation needs in Hawai'i and on other Pacific islands under U.S. jurisdiction within the Refuge System since at least the 1980s. Rodenticide application techniques specifically for the protection of native plants and animals from introduced rodents and mongooses have been developed and regulatory approval for their use obtained in Hawai'i and nationally. Rodenticides have been applied in bait stations to control rodent and mongoose populations in native ecosystems on the MHI and to eradicate rats from offshore islands and remote atolls under U.S. jurisdiction (Hess *et al.* 2009). Hand and aerial broadcast of diphacinone and brodifacoum have been used on a number of offshore islands and atolls under U.S. jurisdiction.

Rodenticide Use in Hawaii

Rodents heavily damage sugarcane (Tobin *et al.* 1990), macadamia nuts (Tobin 1992) and other crops. Hawaii's sugarcane growers have used rodenticides extensively since the early 1900s, including strychnine alkaloid, compound 1080 (sodium monofluoroacetate), thallium sulfate, warfarin, fumarin, and pival (Tobin *et al.* 1990, Sugihara 2002). Zinc phosphide- (an acute, non-anticoagulant toxicant) treated oats became the first rodenticide for in-field aerial broadcast in sugarcane approved by the EPA under section 24 (c) of FIFRA in October of 1970, vastly improving application efficiency (Hilton *et al.* 1972). Baits were formulated either as pellets or as treated oats and broadcast by fixed-wing aircraft at the rate of 5.6 kg/ha, with a maximum of 4 applications (22.4 kg/ha) per crop cycle. Damage to sugarcane was reduced by 50–60%, but the effectiveness of this method declined with repeated and prolonged use (Sugihara *et al.* 1995), and the sugarcane industry experimented with aerially broadcasting

diphacinone-treated oats (0.025% a.i.) (Teshima 1976). Two labels for zinc phosphide products that allow for aerial broadcast in crops are currently licensed for use in Hawai‘i (EPA Reg. No. 61282-14, HI Lic. No. 9084.11; EPA Reg. No. 61282-49, HI Lic. No. 9084.15).

Three rodenticide products are currently registered in Hawai‘i as Special Local Needs under section 24(c) of FIFRA for use in bait stations to control rodents in crops: Ramik® Mini Bars (EPA SLN No. HI-080001, EPA Reg. No 7173-243; 0.005% diphacinone) for macadamia nut orchards, Rozol® Mini Blocks (EPA SLN No. HI-080001, EPA Reg. No 7173-243) and Rozol® Pellets (EPA SLN No. HI-080002, EPA Reg. No. 7173-151) (both 0.0005% chlorophacinone) for use in and around tropical nut and fruit orchards, and around fields of corn and soybeans grown for seed, and around sugarcane fields.

The State of Hawai‘i, Department of Health, Sanitation Branch maintains a section 24(c) registration (EPA SLN No. HI-010001, EPA Reg. No. 61282-14) for a 2% zinc phosphide bait to control rodents for public health purposes, usually to prevent mouse irruptions from causing murine typhus outbreaks. The registration allows for application in bait stations and by hand and aerial broadcast in noncrop areas surrounding residential and resort areas and in rangeland.

Numerous rodenticide products containing the following active ingredients are licensed for commensal use in Hawai‘i and are available for retail sale to the public for use in and around buildings, including homes and schools: the first generation anticoagulants chlorophacinone and diphacinone; the second generation anticoagulants brodifacoum, bromadiolone, difenacoum, and difethialone; and the acute, non-anticoagulant toxicant bromethalin.

Conservation Uses of Rodenticides in Hawai‘i

In the 1980s and 1990s, a wide range of toxicants and delivery methods were tried in the Main Hawaiian Islands to develop a method for rodent control in native ecosystems that would be safe, effective, and economical. Both acute and chronic toxicants, including fumarin, zinc phosphide, and brodifacoum in bait stations, as well as zinc phosphide broadcasting, were tested in Hawai‘i Volcanoes National Park (HAVO) and other areas on the island of Hawai‘i. These trials included separate trials of fumarin and zinc phosphide in bait stations and hand-broadcasts of zinc phosphide treated pellets on 0.8 ha areas for 2-week periods in HAVO (Stone and Loope 1987). Maximum rat reductions were only 32% with fumarin. Brodifacoum in bait stations was tested in 1997-1998 in the ‘Ōla‘a Forest, HAVO. Of 81 bait stations with WeatherBlok® (0.005% brodifacoum), only two were visited by rats; reluctance to enter the bait stations rather than lack of acceptance of the baits may have resulted in the low effectiveness of this method (G. Lindsey and T. Smucker, unpubl. data).

In the early 1990s, a group of state and federal agencies, NGOs, and private landowners formed the Toxicant Registration Working Group (TWG) to pursue the registration and licensing of rodenticides with the EPA and State of Hawai‘i for conservation purposes. Group members included many federal, state, and private researchers, managers, and conservationists: DOFAW, FWS, Hawai‘i Department of Agriculture (HDOA), Kamehameha Schools (KS), U.S. Department of Agriculture (USDA)-Animal and Plant Health Inspection Service (APHIS) -Wildlife Services (WS), USDA-APHIS-WS-National Wildlife Research Center (NWRC), the Biological Resources Division of the U.S. Geological Survey (USGS-BRD), the National Park Service, the U.S. Army, the University of Hawai‘i, The Nature Conservancy, and Maui Land and Pineapple Company, among others.

Diphacinone was ultimately selected by the TWG as the preferred rodenticide for use in conservation areas in Hawai‘i because of its effectiveness at controlling rats in agricultural settings in Hawai‘i (Tobin 1992), relatively low risk to non-target species (Kaukeinen 1982), and its limited persistence in the environment (Lund 1988). Another advantage of anticoagulants such as diphacinone is that symptoms are delayed, and therefore the individual does not associate them with the bait. Learned bait aversion can develop with repeated applications of acute toxicants (Lund 1988, Prakash 1988). Using the safety and efficacy data from existing agricultural and commensal registrations, as well as a Hawai‘i-based laboratory efficacy bioassay (Tobin 1992), DOFAW applied for and received approval of a sec 24(c) registration for Eaton’s Bait Blocks® rodenticide with molasses/peanut butter flavorizer (0.005% diphacinone, J.T. Eaton and Co., Twinsburg, Ohio) in 1994 (Conry 1994). The registration, for bait station use in forests, offshore islands, and other non-crop outdoor areas to protect Hawaiian native and endangered plants and animals, was the first rodenticide registration ever issued in the U.S. for controlling rodents for conservation purposes.

Two additional products were registered for conservation uses in Hawai‘i under section 24(c), which included the addition of the small Indian mongoose to the list of target species: Eaton’s Bait Blocks® with fish flavorizer in 1997, and Ramik® Mini Bars (0.005% diphacinone, Hacco, Inc., Madison, Wisconsin) in 1998. In 2005 J.T. Eaton and Company discontinued all field uses of their products, including Hawaii’s conservation uses, citing the high cost of additional record-keeping resulting from the EPA-required nation-wide change of classification to restricted use for all field uses of rodenticides. Ramik® Mini Bars are still registered for conservation use in Hawai‘i (EPA SLN No. HI-980005, EPA Reg. No. 61282-26).

Hawaii’s three conservation bait station registrations for diphacinone have been used throughout the state, including at Hakalau Forest National Wildlife Refuge (Nelson *et al.* 2002) and Hanawī Natural Area Reserve (Groombridge *et al.* 2009) to protect native forest birds; to protect captive released and translocated palila in the Mauna Kea Forest

Reserve (P. Banko, USGS, pers. comm.), to protect wild and captive released puaiohi (*Myadestes palmeri*) on the Alakaʻi Plateau, on Kauaʻi (Woodworth *et al.* 2009); and to protect nesting Oʻahu ʻelepaio, tree snails, and native plants (Mosher *et al.* 2010).

Bait stations have been used to eradicate rats from small offshore islands in Hawaiʻi. Eaton's Bait Blocks® rodenticide with molasses / peanut butter flavorizer (0.005% diphacinone) was used to eradicate black rats from 1.6 ha Mokoliʻi (Chinaman's Hat) off Oʻahu, in a community project coordinated by DLNR (Smith *et al.* 2006).

Rats were eliminated from a 20-ha area of the Kaʻena Point Natural Area Reserve on Oʻahu that is separated from the rest of the island by a predator-proof fence using Ramik® Mini Bars in bait stations placed in a 25-m grid (Young *et al.* 2013).

However, using diphacinone in bait stations over large areas in the main islands, where new rats constantly reinvade the treatment area, requires frequent checking and re-stocking of the stations and is thus labor-intensive and expensive. This makes it impractical for use in large, rugged, and remote areas. The TWG believed that the aerial application of rodenticides was required to effectively protect native species on a broad scale, and in remote and rugged areas. In particular, the TWG felt that the registration of an aerial broadcast use pattern was urgently needed to save Hawaii's most critically endangered species, such as the poʻouli on Maui. The data requirements for this new use pattern, aerial broadcast over non-agricultural land such as native forests, as well as concerns about the risk to non-target species, necessitated that numerous studies be conducted in support of the registration application. Because of FWS's mandate to save the most critically endangered species in the Main Hawaiian Islands, FWS-PIFWO funded USDA's National Wildlife Research Center to assist with completing the efficacy, nontarget risk, and environmental fate studies required to support a Hawaiʻi section 24(c) registration for a diphacinone product label that included aerial broadcast. Hacco's Ramik® Green (0.005% a.i.) pellets were selected because of the large amount of available data on diphacinone and on the Ramik® Green product itself, which already existed as a result of its agricultural and commensal registrations.

One of the primary objectives of these studies was to determine the application rate that reduced rodent populations to low levels, while minimizing the amount of poison bait dispersed into the environment. First, a series of laboratory bioassays, conducted under Good Laboratory Practices (GLP), determined that the minimum exposure time and amount for Ramik® Green to meet the standard EPA efficacy requirement of 80% mortality was 7 days and 37.5 g of bait for a Hawaiian black rat, while 6 days and 30.0 g achieved 90% mortality for Polynesian rats (Swift 1998). Both species also consumed lethal doses of the bait in a laboratory test when presented with an alternate non-toxic food (Swift 1998). Next, a field efficacy trial using hand broadcast of non-toxic Ramik® Green pellets coated with a biological tracer compared three potential application rates. The trial determined that the optimal broadcast rate needed to maximize exposure to rats

while minimizing the amount of bait applied in the environment was 22.5 kg/ha (Dunlevy *et al.* 2000). Ramik® Green was particularly durable under extreme conditions of heat and moisture.

Hand and aerial broadcast trials were conducted with Ramik® Green (fish-flavored 6 gram pellets) in Hawai‘i Volcanoes National Park by USGS-BRD under Good Laboratory Practices standards to confirm the application rate proposed by Dunlevy *et al.* (2000). Prior to the start of the studies, an environmental assessment under NEPA was conducted by the National Park Service for the proposed hand and aerial broadcasts (NPS 1999). The hand broadcast trials were conducted in two treatment plots of 4 ha each, in a wet and a mesic forest in HAVO, each paired with a same-sized non-treatment plot, and were replicated numerous times over two years (Oct. 1999 – Jan. 2002) to account for seasonal variations in rodent populations (Spurr *et al.* 2013). Two hand broadcast applications of 11.2 kg/ha each, done four to six days apart, were conducted twelve times at two- to four-month intervals in the wet forest treatment plot, and three such treatments were made at three- to five-month intervals in the mesic forest treatment plot. There was 100% mortality of all the black rats that had been tracked using radio collars within one week after the initial bait application series in both forest types. Live-trapping and non-toxic census bait blocks measured a 98–100% reduction in rat abundance 2–4 weeks after bait application. Rat abundance usually recovered to pre-treatment levels within 2–5 months of bait application due to reinvasion of rats from surrounding areas.

The aerial broadcast study was undertaken in paired 45.56-ha (113 ac) treatment and non-treatment plots in mesic forests in HAVO in October of 2001. The first application was 11.8 kg/ha and the second five days later was 10.6 kg/ha, for a total application rate of 22.4 kg/ha. All 21 radio-collared rats (all black rats) in the treatment plot died within nine days of bait application, whereas none of the 18 radio-collared rats in the non-treatment plot died. There was a 99% drop in both the rat capture rate and percentage of non-toxic census bait blocks gnawed by rats in the treatment plot relative to the non-treatment plot three weeks after bait application (Spurr *et al.* 2003b). The one rat caught in the treatment plot at three weeks post-application was not ear-tagged and likely a new individual that had moved into the plot. By contrast, 50 black rats and two Polynesian rats were caught in the non-treatment plot at the same time. The rat capture rate in the treatment plot was still reduced by 36% relative to the non-treatment plot six months after bait application.

Efficacy against mice was also high in the aerial broadcast trial, despite the large size of the pellets relative to a mouse (6 g pellet, approximately 12 g for mice captured at the same location in a previous study (Scheffler *et al.* 2012)). The number of mice caught in snap-traps was reduced by 78.9% in the treatment plot relative to the non-treatment plot three weeks after bait application, and the number of mice caught in live traps was reduced by 75.6% in the treatment plot relative to the non-treatment plot three weeks

after bait application (Spurr *et al.* 2003b). Mouse captures recovered to nearly their pre-poison level at three months after bait application, and were almost three times pre-poison levels six months after bait application, demonstrating the ability of rodent populations to rebound when control is inadequate or unsustained.

The draft of a Hawai‘i 24(c) label for the aerial broadcast 6g pellets of Ramik® Green using the data from these studies would be finalized and submitted for registration only if supported by the effectiveness and impact analyses in the PEIS.

The need for rodenticide labels that could be used to eradicate rodents from islands throughout the U.S.’s jurisdiction led to FWS-PIFWO again funding USDA- NWRC in 2007 and 2008 to assist with three Section 3 registrations for conservation uses of brodifacoum and diphacinone. These labels are for application in bait stations, in burrows or tree canopies, and by hand and aerial broadcast on islands throughout the U.S. and its territories and possessions to eradicate or control existing introduced rodent populations and combat new introductions. Their use is restricted to three federal agencies – USDA, FWS, and NPS. No other entity can use them, and the agencies and their individual representatives who apply the bait are legally liable for any misuse or violations of the labels under the provisions of FIFRA.

The application to EPA for the FIFRA Section 3 national registrations for two brodifacoum products consisted of a study with black rats from Anacapa in the California Channel Islands (Howald *et al.* 2001), and small-scale field trials conducted on Palmyra, prior to the eradication of black rats from the atoll (Buckelew *et al.* 2005). The studies were not conducted under Good Laboratory Practices. Although they were approved by EPA, these labels have not been submitted to HDOA for licensing for use in the State of Hawai‘i. They would be submitted for licensing in Hawai’i only if supported by the effectiveness and impact analyses in the PEIS. HDOA could place restrictions specific to Hawai‘i on the labels.

The efficacy data set generated in Hawai‘i for Ramik® Green was used to obtain the section 3 registration for Diphacinone-50, which is Ramik® Green labelled for conservation purposes. With its large data set of GLP studies conducted in Hawai‘i, this label was submitted to HDOA and is licensed for use in Hawai‘i, with USDA-APHIS as the registrant (EPA Reg. No. 56228-35, HI Lic. No. 8600.1).

With the licensing of Diphacinone-50 in Hawai‘i in January 2008, FWS, DLNR and WS initiated a program to conduct small-scale aerial applications on offshore islands before attempting larger applications on the main islands. The goals of this program were 1) to train personnel from within the agencies in Hawai‘i in the specialized techniques required to safely and effectively conduct aerial broadcasts; 2) to document the benefits to native species from using aerial broadcast of diphacinone to remove rats from native

ecosystems; and 3) to monitor nontarget species and the environment to ensure that diphacinone wouldn't cause impacts (Dunlevy and Swift 2010).

The agencies eradicated Polynesian rats from Mokapu Island, a 16-acre island that is a State Seabird Sanctuary approximately one half mile (1 km) off the north shore of Moloka'i with Diphacinone-50 aerially broadcast by helicopter in February 2008. This was the first island in the world where the aerial broadcast of diphacinone was used to eradicate rats. The following year, the agencies conducted an aerial application of Diphacinone-50 on Lehua Island (312 ac) which failed to eradicate Polynesian rats. A fish mortality event on Ni'ihau around the time of the application to Lehua was investigated to determine whether a connection existed between the two events. No diphacinone was found in fish tissue samples, suggesting that the fish mortality was caused by other factors (DAR 2009). No aerial applications of rodenticides have been conducted in Hawai'i since then.

Rodent Eradications on other U.S. Islands

Beginning in 1990, WS eradicated rats from three remote Pacific atolls where rats were impacting seabird colonies. With the FWS and the Samoan Department of Wildlife and Marine Resources, WS removed Polynesian rats from uninhabited Rose Atoll (17 acres, 6.3 ha), American Samoa (Murphy and Ohashi 1991). Brodifacoum (0.005% content active ingredient) was used in bait stations spaced 50 m apart over the entire island along with live and snap traps (Morrell *et al.* 1991, Ohashi and Oldenburg 1992). However, the initial application, while substantially reducing rat numbers, did not result in eradication. A subsequent treatment with bromethalin (0.01% content active ingredient, an acute neurotoxin) was successful (Murphy and Ohashi 1991). WS and DLNR eradicated Polynesian rats in 1993 from 348-acre Green Island, Kure Atoll, also using brodifacoum and bromethalin in bait stations, and snap and live traps (J. Murphy 1994). The following year, the U.S. Navy contracted WS to eradicate black rats from Eastern Island (362 acres) and Spit Island (3 acres) at Midway Atoll, using bait stations for Eastern Island and live trapping on Spit Island (Murphy 1997a).

The successful eradication of rats from the two smaller islands in Midway Atoll, combined with evidence of the devastating impacts rats were having on a key seabird species, the Bonin Petrel (*Pterodroma hypoleuca*) (Seto and Conant 1996), persuaded the U.S. Navy to fund WS to eradicate rats from the final rat-infested island in the atoll, Sand Island. In July of 1996, the entire 1,300-acre (486 ha) island was overlaid with two 50 m grids, one for bait stations (with brodifacoum, and a final application of bromethalin) and one for live traps (Murphy 1997b). The last rat sighting was reported in October 1997. Since this time, the NWHI have been free of invasive small mammals except for the mouse population that survived the rat eradication on Sand Island, Midway.

The next attempted eradication of a Pacific atoll by WS, of black rats from Palmyra, in the equatorial Line Islands in 2001, also using brodifacoum in bait stations, was not successful. This was by far the most complex eradication attempted by Hawai‘i-based wildlife managers, involving approximately 275 ha and 52 islets, some of which were densely vegetated with coconut palms (*Cocos nucifera*), *Scaevola taccada* bushes, and *Pisonia grandis* trees (Ohashi 2001). Numerous factors contributed to the failure, among them a 3-dimensional habitat which resulted in smaller foraging ranges on the ground than the 50 m bait station spacing, and high bait take by the ubiquitous land crabs *Cardisonma carnifex*, *Coenobita brevimanus*, and *C. perlatus*.

In 2010, WS eradicated Polynesian rats from Cocos Island, Guam, using hand broadcast of Diphacinone-50 in the forested areas, and brodifacoum in bait stations around the buildings of the day-use resort (Lujan *et al.* 2010). This was followed by the introduction and subsequent establishment of a population of the critically endangered flightless Guam rail (*Gallirallus owstoni*) (Pitt *et al.* 2012).

FWS Refuges, in partnership with the Non-Governmental Organization (NGO) Island Conservation, has conducted four aerial broadcast eradication projects using the two section 3 brodifacoum labels, with a special supplemental label for Palmyra Atoll allowing a higher application rate (not to exceed a total of 180 kg/ha, or 47,000 kg / 103,500 lbs for the entire atoll). They were conducted on 2,777 ha Rat Island in the Aleutian Islands in 2008 against Norway rats, 232 ha Palmyra Atoll in 2011 against black rats, 122 ha Desecheo in the Caribbean in 2012 against black rats, and 696 ha Wake Atoll in 2012 against Polynesian rats and the Asian house rat (*Rattus tanezumi*). Of these, Rat Island and Palmyra were successful, Wake was partially successful (the Asian house rat was eradicated, but the Polynesian rat was not) and Desecheo failed.

Mouse Control and Eradication in Hawai‘i and on Other Islands

Of all the introduced mammals, mice have been the most difficult to remove from islands (Elliott *et al.* 2015, Bowie *et al.* 2011, MacKay 2011, MacKay *et al.* 2007) and from within predator-‘proof’ fences on mainland New Zealand (Innes *et al.* 2012, Speedy *et al.* 2007). The global failure rate of mouse eradication attempts is 38% (MacKay *et al.* 2007), compared to only 5% and 8% for Norway rats and black rats, respectively (Howald *et al.* 2007). However, the success rate improves to approximately 66% of attempts when mice are specifically targeted for eradication (Elliott *et al.* 2015). In a comprehensive analysis of possible factors responsible for the high failure rate, MacKay (2011) could not identify any particular operational causes.

Almost all mouse eradication attempts have used anticoagulant rodenticides, applied either in bait stations or via hand or aerial broadcast (MacKay *et al.* 2007). The first reported eradication attempt was on Flatey Island, Iceland, in 1971. Warfarin in bait boxes is thought to have been used (MacKay *et al.* 2007, Moors *et al.* 1992). The largest

island from which mice have been eradicated using bait stations stocked with brodifacoum bait is Flat Island (253 ha) in Mauritius (Bell 2002). Eighty percent of the mouse eradication attempts have used brodifacoum as the main or secondary toxicant, but of these only 49% were successful (MacKay *et al.* 2007). The largest island to date from which mice have been eradicated is Macquarie Island (13,182 ha), in the Australian subantarctic, using aerial application of brodifacoum in 2011 (Alderman 2013).

Eradications targeting rats, particularly with bait stations, have been unsuccessful at simultaneously eradicating mice (Bowie *et al.* 2011, Witmer *et al.* 2007). After diphacinone in bait stations was used to eradicate black rats from 80 ha Buck Island, the mouse population exploded from the extremely low numbers that existed prior to the rat eradication (Witmer *et al.* 2007). Similarly, mice survived several years of trapping and bait station application of brodifacoum and bromethalin on Sand Island, Midway Atoll, which eradicated black rats (Murphy 1997b, K. Swift, FWS, pers. obs.). The foraging habits of mice may prevent them from consuming lethal doses of bait, either because the bait is dispersed too broadly or because it is not attractive to them. Rats are aggressive competitors with and predators of mice, and may prevent mice from coming in contact with the bait (MacKay 2011, Ruscoe *et al.* 2011, Goldwater *et al.* 2012).

"Pest-proof" fences in main island areas outside of Hawai‘i have not been successful at achieving mouse-free status, with mice either surviving multiple eradication attempts and/or reinvading (Smuts-Kennedy and Parker 2013, Innes *et al.* 2012, Maitland 2011, Speedy *et al.* 2007). This has led to a resignation to their presence, with monitoring and periodic treatment with anticoagulants when their numbers reach unacceptable levels (Smuts-Kennedy and Parker 2013).

In Hawai‘i, at Ka‘ena Point Natural Area Reserve on O‘ahu (DLNR), a combination of Ramik® Mini Bars (0.005% diphacinone) in bait stations (25 meter grid), and traps (12.5 meter grid) were used to eradicate rats and mice from within a New Zealand-designed and built "predator-proof" fence (Young *et al.* 2013). Mice periodically invade the reserve, but are eventually controlled with the bait stations (Chris Miller, NARS, pers comm.).

Results from the aerial broadcast trials with Ramik® Green (0.005% diphacinone) in paired 45.56-ha (113 ac) treatment and non-treatment plots in mesic forests in HAVO in 2001 demonstrated that broadcast applications of this bait significantly reduced the abundance of mice (Spurr *et al.* 2003b). This study was not designed to target mice, with a pellet size too large relative to a mouse (6 g pellet, approximately 12 g for mice captured at the same location in a previous study (Scheffler *et al.* 2012)), and the total application rate and exposure time of 22.4 kg/ha spaced 5 – 7 days apart based on earlier field trials with rats (Spurr *et al.* 2013, Dunlevy *et al.* 2000). Despite these factors, the number of mice caught in snap-traps was reduced by 78.9% in the treatment plot relative to the non-treatment plot three weeks after bait application, and the number of mice

caught in live traps was reduced by 75.6% in the treatment plot relative to the non-treatment plot three weeks after bait application (Spurr *et al.* 2003b).

In 2012, PIFWO funded USDA-NWRC to design and conduct the studies needed to support conservation use labels for diphacinone and chlorophacinone products for mice that could be applied by hand and aerial broadcast. In the studies, NWRC hand-broadcast non-toxic formulations of Ramik® bait pellets (approximately 1.5 g pellets) and Rozol® bait pellets (chlorophacinone, 0.25-0.28gm/pellet) treated with a biomarker at several application rates and differing intervals between applications in a coastal area of Hawai‘i Volcanoes National Park. A very high proportion (94-97%) of mice trapped in the treatment areas for both baits showed the biomarker at all application rates and intervals (Pitt *et al.* 2013). Field trials using toxic bait are being conducted to confirm that the high acceptance of bait results in high mortality. These data are needed before labels can be drafted and submitted to EPA and the Hawai‘i Pesticides Branch.

Figure 9: Mouse eating naupaka (*Scaevola sericea* Vahl) seed on Midway Atoll (Photo by D. Clark, USFWS)

Mongoose Control and Eradication in Hawai‘i and on Other Islands

Globally, there have been only eight known attempts to eradicate mongooses from islands. Of these, only six were successful. All of them have been relatively small (0.5 – 157 ha) (Barun *et al.* 2011). Methods utilized were box traps baited with meat, and primary and secondary poisoning using the rodenticides brodifacoum, bromadiolone, and thallium sulfate. Two large-scale ongoing mongoose eradication attempts are being conducted in Japan (Abe 2014). The eradication efforts on 71,200 ha Amami-Oshima Island began in 1993, starting with support from local villages and then taken over by the

Japanese Ministry of the Environment in 2000. The mongoose eradication effort in Northern Okinawa also began in 2000 and encompasses 227,130 ha. Because these areas have native mammals, control methods are limited to live- and kill-traps. Where mongoose populations have been reduced to low levels, native species are rebounding. They now need to develop methods for detecting and controlling mongooses at low densities.

Control of mongooses has been conducted much more frequently than attempts at eradication, with live box traps the most common method employed (Barun *et al.* 2011). Kill-trapping and acute toxicants such as thallium sulfate, strychnine and sodium fluoroacetate (1080) were used historically in the Caribbean due to the role of mongooses in the transmission of rabies (Everard and Everard 1992, Baruns *et al.* 2011).

In the years following its introduction to Hawai‘i by sugar plantations in 1883, the mongoose's severe impacts on birds were noted (*The Honolulu Republican*, July 31, 1900), and its eradication proposed (*The Hawaiian Gazette*, June 28, 1904). The Legislature passed a law in 1892 prohibiting the introduction, keeping or breeding of mongoose by the general public. This law, now HRS §142-92, provides for a permit to be issued by the state Department of Agriculture for research or education purposes, but which cannot be issued for Kaua‘i and Lāna‘i. By 1915, the Territorial Legislature had appropriated funds for a bounty on mongoose (Public Health Reports (1896-1970)), and the Territorial Fish and Game Commission and counties eventually led extermination campaigns that offered cash prizes for the greatest number of mongoose scalps (*The Maui News*, September 9, 1921). Suggested methods were to shoot, trap, or poison.

Subsequently, the history of mongoose control in Hawai‘i included the use of thalium sulfate (Kridler 1963), and 1080 injected into chunks of meat that were deposited in crevices near nēnē nests and throughout sanctuaries (DLNR 1974). Numerous sightings of mongooses on Kaua‘i in the 1970s, including a documented road kill of a lactating female in 1976 (Telfer 1977), prompted FWS to contract USDA APHIS WS (Animal Damage Control at the time) to systematically develop a method for mongoose control.

For a wide-ranging carnivore like the mongoose, the efficacy of a control method depends upon the target species being able to detect a bait or lure from a distance, follow it to its source, and be attracted enough to it to enter a trap or bait station. The bait or lure must also be evaluated for its stability and longevity (how long it remains both detectable and attractive). For a toxic bait, the toxicity to the target species must be quantitatively evaluated to ensure that the toxicant is lethal to the majority of individuals in consumable doses. The palatability of the matrix of a toxic bait is critical to ensure that the target species will eat enough of the bait to consume a lethal dose of the toxicant. Therefore, each toxic bait product must have its own series of laboratory and field trials to establish its efficacy for a target species, since the active ingredient is not the sole determinant of efficacy (Palmateer and McCann 1976, Keith *et al.* 1985, Keith *et al.* 1986, Pitt and

Sugihara 2008, Pitt *et al.* 2015). Field efficacy trials for any method targeting mongooses must be designed on a scale large enough to have a statistically significant sample of mongooses, be replicated in several locations, use multiple independent methods to assess the effects on mongoose abundance within the treatment areas, and be compared with a site where no control methods are used.

In the USDA Wildlife Services study (Keith *et al.* 1990), both acute and chronic toxicants, including thallium sulfate, zinc phosphide, warfarin, and diphacinone, were effective against mongooses in laboratory bioassays. Diphacinone was highly effective in low doses (0.18 mg per kg), which would minimize hazards to non-target species. Subsequent field trials at Hawai‘i Volcanoes National Park and at James Campbell National Wildlife Refuge on O‘ahu using diphacinone mixed in raw hamburger at a concentration of 0.00025% diphacinone, placed in bait stations 125-250 m apart, killed high percentages of radio-collared mongooses. In 1991, a Special Local Need registration was approved for 0.1% diphacinone concentrate to be mixed into raw hamburger to make a 0.00025% diphacinone bait to be applied in specially designed bait stations. The design specified a 4-inch diameter PVC pipe in the shape of a T, with entrances in the arms of the T, and bait placed in the supporting arm. This technique proved to be effective but expensive due to the cost of bait, the labor involved in mixing the bait, bait station construction, and installation and maintenance in remote areas; therefore, it was impractical to apply to large conservation areas (Stone *et al.* 1995), and the registration was allowed to expire.

Although no laboratory or field efficacy data existed at the time, the mongoose was listed as a target species on the conservation SLN labels for Eaton’s Bait Blocks® (0.005% diphacinone) with fish flavorizer, and Ramik® Mini Bars, when these two labels were approved in 1997 and 1998, respectively. A later field study conducted at two sites on O‘ahu (Ka‘ena Point Natural Area Reserve and Hamakua Marsh Wildlife Sanctuary) by Smith *et al.* (2000), using 2-foot lengths of 4-inch diameter ABS pipe as bait stations with Eaton’s Bait Blocks® (0.005% diphacinone) with fish flavorizer, killed high percentages of radio-collared mongooses. In 2005 J.T. Eaton and Company discontinued all field uses of their rodenticide products, including Hawaii’s conservation uses, citing the high cost of additional record-keeping resulting from the EPA-required change of classification to restricted use for all field uses of rodenticides. Although, anecdotally, mongooses are known to eat Ramik® Mini Bars and die (A. Dibben-Young, Nēnē O Moloka‘i, pers. comm.; A. Nadig, FWS, pers. comm.), the proportion of mongooses within an area that will be attracted to this product and consume lethal doses is unknown. Laboratory trials on mongooses for Ramik® Mini Bars and other vertebrate toxicants are currently being conducted by USDA APHIS WS.

Recent research on mongoose control has focused on identifying non-toxic baits and lures with a large call distance (distance of effective attraction) to stand out in prey-rich

environments (Pitt and Sugihara 2008, Pitt *et al.* 2015). The instructions for mongoose on the current Ramik® Mini Bars SLN describing the spacing and area over which bait stations should be distributed are based upon the results of Pitt *et al.* (2015), which determined home range sizes and measured the distances mongooses traveled to investigate novel food baits. No field trials have been conducted to determine the effectiveness of the current bait station instructions at reducing mongoose abundances.

Mongooses were eliminated from within an area of the Ka‘ena Point Natural Area Reserve on O‘ahu that is separated from the rest of the island by a predator-proof fence. Ramik® Mini Bars in bait stations were placed in a 25-m grid during construction of the fence, and mongooses disappeared from the area prior to final completion of the fence (Young *et al.* 2013). Since animals were not radio-collared and no carcasses were recovered, the exact methods responsible for the eradication are unknown. Of two mongooses that subsequently entered the fenced area, one was caught in a leg-hold trap, and mongoose scat was detected on top of a bait station from which bait take was noted (Young *et al.* 2013).

A variety of live and kill traps are used for mongoose control in Hawai‘i. The effectiveness of these methods for controlling mongooses is primarily dependent upon the type of bait used, the spacing between traps, and the area over which they are placed (Keith *et al.* 1986, Pitt *et al.* 2015). The skill and experience of the individual trapper in trap placement and setting also affects the success of the method. Thus, trap success can vary significantly between individuals conducting trapping. However, while mortality numbers have been recorded in field trials (e.g., Peters *et al.* 2011) and during operational use of these methods, no independent monitoring methods are used by projects in Hawai‘i to determine whether overall mongoose abundance is reduced under current mongoose trapping practices.

A type of multi-kill device (“self-resetting trap”, brand name Goodnature®) developed in New Zealand for use on stoats (*Mustela ermine*, a species of weasel) and rats, primarily black rats (Gillies *et al.* 2012), is in widespread use in Hawai‘i for controlling mongooses in natural areas. However, no trials using standardized quantitative methods have been conducted in Hawai‘i to evaluate their humaneness on mongooses and their effectiveness at reducing mongoose populations within an area to levels low enough to protect native species. What proportion of mongooses within an area will be attracted to and enter the devices is unknown. The lures sold by the manufacturer that are used with the devices come in a variety of food-based scents, including peanut butter, but scent lures have been shown to be ineffective for mongooses in Hawai‘i field trials (Pitt and Sugihara 2008).

Figure 10: Indian mongoose (*Herpestes edwardsii*) in trap (Photo by USDA, National Wildlife Research Center, Hawai'i Field Station)

ENVIRONMENTAL FATE AND NONTARGET EFFECTS OF BRODIFACOUM, CHLOROPHACINONE, AND DIPHACINONE

Preplanned monitoring of the environmental fate and nontarget effects has been conducted and the results published for some of the aerial applications of rodenticides done on U.S. islands: Anacapa Island (Howald *et al.* 2009); an aerial broadcast trial conducted in Hawai'i Volcanoes National Park (Spurr *et al.* 2003b); Mokapu and Lehua Islands (Dunlevy and Swift 2010); Cocos Island (Lujan *et al.* 2010, Pitt *et al.* 2015); and Palmyra Atoll (Engeman *et al.* 2012, Pitt *et al.* 2015). Additional reports and studies investigated possible nontarget mortalities: feral pigs and a barn owl after an aerial broadcast trial conducted with diphacinone at Keauhou on Hawai'i Island (Pitt *et al.* 2005); numerous birds following the application of brodifacoum to Rat Island in the Aleutian Islands (Ebbert and Burek-Huntington 2010); and a fish die-off of unknown cause at Ni'ihau occurring around the time of application of diphacinone to Lehua (DLNR 2009). The two other aerial application projects on U.S. islands, of brodifacoum to Desecheo Island in Puerto Rico and to Wake Atoll, did not release monitoring reports.

Of the incidents where nontarget exposure of native bird species to the bait was documented, exposure to diphacinone did not result in mortalities (of Micronesian starlings on Cocos Island, Lujan *et al.* 2010), whereas exposures to brodifacoum resulted in numerous avian mortalities (Howald *et al.* 2009, Ebbert and Burek-Huntington 2010, and Pitt *et al.* 2015). No reports have been published to follow up on the long-term effects to populations of any of the bird species involved in the brodifacoum mortalities.

Because diphacinone and chlorophacinone are used extensively in agriculture in the mainland U.S., their potential to cause nontarget mortalities to birds is also documented (McMillin and Finlayson 2010, USFWS 2012a, USFWS 2012b, Vyas *et al.* 2012).

Rodenticides are used throughout the world in agriculture and for commensal rodent control (in and near human habitations), and all of the rodenticide compounds from these sources have been documented to cause not only primary poisonings, but also to bioaccumulate in wildlife (Erickson and Urban 2002, EPA 2011, California Department of Pesticide Regulation 2013). Studies have tested wildlife for anticoagulant rodenticide exposure in Canada (Albert *et al.* 2009), Denmark (Christensen 2012), California (Lima and Salmon 2010, Kelly *et al.* 2014), and in Hawai‘i (USFWS and USDA-APHIS-NWRC unpubl. data). The second-generation rodenticides, especially brodifacoum, were found to be the most prevalent in wildlife, resulting in both the EPA and the State of California placing restrictions on their sale to the general public.

CONSISTENCY WITH EXECUTIVE ORDERS, POLICIES AND PLANS

Executive Orders

The proposed program is consistent with Executive Order 13112 of February 3, 1999, *Invasive Species*, which requires that Federal agencies whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,

(1) identify such actions;

(2) subject to the availability of appropriated funds and within Administrative budgetary limits, use relevant programs and authorities to:

- Prevent the introduction of invasive species;
- Detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
- Monitor invasive species populations accurately and reliably;
- Provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
- Conduct research on invasive species and develop technologies to prevent introduction of and provide for environmentally sound control of invasive species; and
- Promote public education on invasive species and the means to address them.

(3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction of invasive species in the United States or elsewhere unless, pursuant to

guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

Under Executive Order 13186 of January 11, 2001, *Responsibilities of Federal Agencies to Protect Migratory Birds*, the FWS is given authority to recognize and promote the great ecological and economic value of migratory birds to the United States and other countries by promoting the conservation of migratory bird populations. The Executive Order states that each Federal agency shall, to the extent permitted by law and subject to the availability of appropriated funds and within Administration budgetary limits, and in harmony with agency missions:

- Support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions;
- Restore and enhance the habitat of migratory birds, as practicable;
- Prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable;
- Design migratory bird habitat and population conservation principles, measures and practices, into agency plans and planning processes (natural resources, land management and environmental quality planning);
- Ensure that environmental analyses of Federal actions required by NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern;
- Identify where unintentional take of migratory birds reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect on migratory bird populations, focusing on species of concern, priority habitats and key risk factors.

The PEIS will contribute to continuing pursuit of these goals, consistent with Executive Orders 13112 and 13186 and Federal and state policy, by planning the program for control and eradication of invasive rodents throughout Hawai‘i using the IPM approach, where invasive rodents and/or mongooses are adversely impacting native species and ecosystems.

FWS and Hawai‘i Invasive Species Policies

Restoring biological diversity of Hawaiian native ecosystems by removing invasive species and preventing further introductions is a major priority of the FWS policy for

managing refuges for biological diversity, integrity and environmental health (601 FW 3, 2001). In this policy, the FWS defines the following terms:

- **Biological diversity** encompasses the variety of life and its processes, the genetic differences among them, and the communities and ecosystems in which they occur.
- **Biological integrity** is the biotic composition, structure and functioning at the genetic, organism and community levels comparable to historic conditions.
- **Environmental health** is the composition, structure and functioning of abiotic features comparable with historic conditions. Historic conditions include the composition, structure and functioning of ecosystems resulting from natural processes that are believed, based on sound professional judgment, to have been present prior to substantial human-related changes to the landscape.

The FWS policy, as stated in 601 FW 3 (2001), is to first, maintain existing levels of biological integrity, diversity and environmental health at the refuge scale; and secondly, to restore lost or severely degraded elements of integrity, diversity and environmental health at the refuge scale and other appropriate landscape scales where it is feasible and supports achievement of refuge purposes and mission. The policy recognizes that applications of chemicals may be necessary to maintain biological integrity and fulfill refuge purposes. It also focuses on preventing the introduction of invasive species, detecting and controlling populations of invasive species and providing for restoration of native species and habitat conditions in invaded ecosystems.

State of Hawai‘i Invasive Species Policies

The State of Hawai‘i passed Act 85 Session Laws of Hawai‘i (SLH) in 2003 (later amended in 2006, permanent law HRS Chapter 194), regarding prevention, control, research and public outreach for invasive species in Hawai‘i. Section 1 states that:

> *“The legislature finds that the silent invasion of Hawai‘i by alien insects, disease-bearing organisms, snakes, weeds and other pests is the single greatest threat to Hawaii’s economy and natural environment and to the health and lifestyle of Hawaii’s people. Invasive species already cause millions of dollars in crop losses, the extinction of native species, the destruction of native forests and the spread of disease…Unwanted invasive species are entering Hawai‘i at an alarming rate – about two million times more rapidly than the natural rate. In 1993, the Federal Office of Technology Assessment declared Hawaii’s alien pest species as the worst in the nation. Hawaii’s evolutionary isolation from the continents and its modern role as the commercial hub of the Pacific makes these islands particularly vulnerable to destruction by invasive species. Gaps in invasive species prevention and a lack of public awareness further add to this*

serious problem. The present problem is severe. The future, though, may be even more dire. Slow, piecemeal action will not be sufficient. Drastic improvements must be made now to stem the tide of invasive species."

The purposes of this Act are to:

- Provide statutory authority to the Hawai'i Invasive Species Council (HISC) to continue its special purpose to foster and organize coordinated approaches among various executive departments, Federal agencies and international and local initiatives for the prevention and control of invasive species; and
- Affirm the objective of the State to rid Hawai'i of invasive species.

HRS 194-2 created the HISC "for the special purpose of providing policy direction, coordination and planning among state departments, federal agencies and international and local initiatives for the control and eradication of harmful invasive species infestations throughout the State and for preventing the introduction of other invasive species that may be potentially harmful." The council shall designate the department of agriculture, health, or land and natural resources as the lead agency for invasive species control in Hawai'i, and is authorized to "coordinate all efforts between other departments and federal and private agencies to control or eradicate the designated invasive species" (Section 194-3).

HRS 194-2 also authorizes the HISC to "coordinate and promote the State's position with respect to federal issues, including…Coordinating efforts with federal agencies to maximize resources and reduce or eliminate system gaps and leaks…" Representatives of Federal agencies and members of the private sector shall be asked to participate with or consulted for advice and assistance to the Council. The vision statement for the Hawai'i Invasive Species Council Strategic Plan 2015-2020 states: "Hawaii's unique economy, natural environment, and the health and lifestyle of Hawaii's people and visitors are protected from the impacts of invasive species."

HISC has directed funding for the prevention, control, and/or research for rodents and mongooses, but is still in the process of creating administrative rules and officially designating species as invasive (http://dlnr.hawaii.gov/hisc/info/species/).

This PEIS strongly supports the stated goals and efforts of the State of Hawai'i as evidenced in statute, the HISC and its Response and Control of Established Pests Working Group by providing a means for coordinating efforts for control and eradication of invasive rodents and mongooses statewide, including responding to new releases.

Hawaii's State Wildlife Action Plan

Hawaii's State Wildlife Action Plan (2015) identified seven objectives that are necessary for the long-term conservation of Hawaii's native wildlife. The first two are related to protection of native species and habitats and management of invasive species:

- Maintain, protect, manage and restore native species and habitats in sufficient quantity and quality to allow native species to thrive;
- Combat invasive species through a three-tiered approach combining prevention and interdiction, early detection and rapid response and ongoing control or eradication.

Under the first objective, removal of introduced mammals, including rats and mongooses, from important habitats to establish ungulate and predator-free areas on each island, including landscape-level predator management, was identified as a high priority.

Under the second objective, high priority actions include continuing coordination of invasive species prevention, management and control programs for county, state, Federal and private sector entities through existing entities and mechanisms, as well as to continue research on effective management methods and tools for introduced vertebrates and other taxa, including rats and mongooses. This PEIS strongly supports these state efforts.

The State of Hawaii further provides regulation of "predators," which by definition include rats and mongoose, per HRS 183D-1. Under HRS 183D-65, DLNR is authorized to destroy predators when deemed a threat to wildlife.

State of Hawaii's Healthy Forests, Healthy People Initiative

Healthy Forests, Healthy People campaign is a state-wide initiative, spearheaded by DLNR's Division of Forestry and Wildlife, based upon three pillars, Connect, Protect and Respect Hawaii's natural resources. The initiative specifically identifies invasive species control as a priority management goal to ensure the protection of Hawaii's forests.

The Aloha+ Challenge: A Culture of Sustainability He Nohona ʻAeʻoia

The Aloha+ Challenge is a declaration of commitment to build a more secure, sustainable and resilient future for Hawaiʻi signed by elected chief executives of Hawaii July 7, 2014. It includes a pledge to achieve the six targets by 2030, the third of which is "Natural Resource Management: Reverse the trend of natural resource loss mauka to Makai by increasing freshwater security, watershed protection, community based marine management, invasive species control and native species restoration." The declaration begins by noting "our unique island ecosystems and lifestyle are particularly susceptible to invasive species"

Papahānaumokuākea Marine National Monument Management Plan

Management of the Papahānaumokuākea Marine National Monument (Monument) is the responsibility of three Co-trustees: the State of Hawaiʻi, through DLNR; the U.S. Department of Interior, through FWS; and the U.S. Department of Commerce, through the National Oceanic and Atmospheric Administration (NOAA). DLNR collaborates

with the Office of Hawaiian Affairs in the perpetuation of Hawaiian cultural resources in the Monument.

The Papahānaumokuākea Marine National Monument Management Plan (MMP 2008) describes a comprehensive and coordinated management regime between all participating agencies to achieve the vision, mission, and guiding principles of the Monument and to address priority management needs over the next 15 years. The MMP was finalized in December 2008, and outlines six priority management needs including:

- Understanding and interpreting the Northwestern Hawaiian Islands
- Conserving wildlife and habitats
- Reducing threats to Monument resources
- Managing human uses
- Coordinating conservation and management activities
- Achieving effective Monument operations

Within the six priority management needs, there are action plans that consist of multiple strategies and activities to address one or more priority management needs and achieve desired outcomes. Invasive species are addressed within the Marine Conservation Science Action Plan, Migratory Birds Action Plan, Threatened and Endangered Species Action Plan, and in the Alien Species Action Plan. Generally, activities directed toward invasive species are monitoring, minimizing impacts, ecosystem restoration, and control and eradication where possible.

CONSISTENCY WITH FEDERAL AND STATE LAWS AND REGULATIONS

The analysis of the proposed action and alternatives in the Draft PEIS will include consideration of the need to implement rodent and mongoose control and eradication in compliance with applicable Federal and State laws and regulations, such as the ESA, the Clean Water Act, section 106 of the National Historic Preservation Act, the American Indian Religious Freedom Act, the Coastal Zone Management Act, DLNR's Hawaii State Comprehensive Wildlife Conservation Plan (Mitchell 2005), DLNR's watershed protection initiative, the Service's Pacific Islands Fish and Wildlife Office Strategic Plan (Service 2012), and the Management Plan for the Papahanaumokuakea Marine National Monument (NMFS 2008). The Draft PEIS will support a phased decision-making process that provides compliance for some of the statutory and regulatory requirements listed above at the programmatic level, and will attempt to identify and describe other requirements that must be deferred until a subsequent site-specific proposal is developed.

Each implementing entity would be responsible for ensuring that all applicable statutory and regulatory requirements are met for a specific project.

The following are detailed descriptions of some of the most important laws and regulations specific to rodent and mongoose control:

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

The Draft PEIS will conduct analyses of the risks and benefits, effectiveness of, and mitigation measures for the use patterns and the rodenticides considered. The use of rodenticides is regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA, 7 U.S.C. § 136) via the registration of labels by the EPA. Each label describes the permitted use for an individual rodenticide product and must be supported by rigorously collected and analyzed efficacy and environmental safety data. Rodenticides are registered for use on commensal rodents such as house mice (*Mus musculus*), Norway rats (*Rattus norvegicus*), and black (roof) rats (*R. rattus*) in and around residences, agricultural buildings, and industrial facilities, and agricultural pests such as prairie dogs (*Cynomys* spp.), voles (*Microtus* spp.) and ground squirrels (*Spermophilus* spp.) in rangeland and crops.

The conservation uses of rodenticides were adapted from their long history of use in forestry and crop agriculture. The aerial application of 1080 (sodium fluoroacetate) was once standard practice on both public and private forestry lands in the U.S. (Cone 1967, Radwan 1970). By the early 1970s, 1080 was being replaced by the two first generation anticoagulant rodenticides, diphacinone and chlorophacinone, which were aerially broadcast over large areas in northern California (Passof 1974). Many registrations are currently maintained for use in Christmas tree farms, and tree and forestry plantations, and fruit tree and nut orchards: zinc phosphide and chlorophacinone for use against voles; zinc phosphide, chlorophacinone, and strychnine for use against pocket gophers (3 genera and 13 species in the U.S.); and chlorophacinone for use on mountain beavers (*Aplodontia rufa*) (Arjo and Bryson 2007). Application methods vary by label, but include hand and aerial broadcast, bait stations and spot-baiting. Examples of these labels are in Appendices 5-7.

The FIFRA Registration Process

Much of what follows is taken from EPA's Office of Pesticide Programs (OPP) Label Review Manual, EPA's Pesticide Registration Manual, EPA's Pesticide Regulations, and from FIFRA.

The process of registering a pesticide is a scientific, legal, and administrative procedure through which EPA reviews and approves the language that appears on the draft pesticide label submitted by a registrant. The label must specify the ingredients of the pesticide; the particular site, crop, or animal on which it is to be used; the amount, frequency, and

timing of its use; environmental hazards; precautionary statements; and storage and disposal practices. All labels bear the language 'It is a violation of Federal law to use this product in a manner inconsistent with its labelling' (40 CFR 156.10), which serves as notice to the user that they can be held legally liable for disregarding any part of the label.

Labels originate from a registrant, the entity responsible for drafting a label, submitting the supporting data, and maintaining its registration. Registrants do not have to be the manufacturer of a product, but must have the approval and cooperation of the manufacturer as a subregistrant. The majority of rodenticide registrations are sponsored by pesticide companies for large, profitable uses in commensal (in and around buildings, including homes and schools) and agricultural settings, including forestry. In addition, there are a number of labels registered to USDA-APHIS and state agencies for agricultural, public health and wildlife damage control purposes.

Under 40 CFR 158.30, EPA has flexibility to require, or not require, data and information for the purposes of making regulatory judgments for pesticides. It is the applicant's obligation to demonstrate to EPA that the product is effective and safe for the environment when used according to the label (40 CFR 158.120). The registrant must provide data from studies that comply with EPA's testing guidelines, known as Good Laboratory Practices (GLP). GLP, described in 40 CFR 160, are intended to ensure the quality and integrity of data supporting pesticide registrations.

All of the labels considered in the Draft PEIS are subject to EPA label review. Conservation use often is a 'new use' (40 CFR152.3) for the rodenticide active ingredient or the specific product under consideration. New use patterns include 'any additional use pattern that would result in a significant increase in the level of exposure, or a change in the route of exposure, to the active ingredient of man or other organisms.' In its Risk Mitigation Decision for Ten Rodenticides (2008), EPA treated the island conservation uses of rodenticides as distinct from other use patterns, and did not evaluate their associated risks. The EPA issues in the Federal Register a notice of receipt of each application for registration of a new product that proposes a new use.

Furthermore, rodenticides are one of the categories of pesticides for which EPA requires efficacy data to be submitted to support the directions for use on the label (Label Review Manual Ch 4-G1(c)). Efficacy data generally consist of initial laboratory trials (bioassays) to determine how much of a rodenticide formulation results in a high percentage of mortality in groups of individuals of the pest species, and then field studies to document effectiveness under actual use conditions. Based on these studies, the registrant drafts the label language specifying the target species and directions for use. The proposed label text may be modified as a result of the science review conducted by OPP staff.

At present, only the DPN-50 (50 ppm diphacinone) conservation use label is supported by a complete set of efficacy data conducted under Good Laboratory Practices (GLP) standards for Polynesian and black rats in Hawai‘i (Swift 1998, Dunlevy *et al.* 2000, Spurr *et al.* 2003b, Spurr *et al.* 2013). Despite its long and widespread use, no field efficacy studies have been done to support the Ramik® Mini Bars bait station label for conservation use. The label directions for that product are based on movement studies of the two rat species in Hawaiian forests (Lindsey *et al.* 1999, Scheffler *et al.* 2012), and a field trial using standard broadscale bait station practices for conservation purposes in New Zealand (Gillies *et al.* 2006).

It is important to test a rodenticide bait formulation on specific populations of the target species for efficacy whenever possible. Populations of rodent and mongoose species on islands may have genetically-based physiological differences from populations elsewhere that make them more or less susceptible to a rodenticide compound. This was illustrated for Hawai‘i when Tobin *et al.* (1993) found that cholecalciferol was not very effective against Hawaiian populations of Norway and black rats but caused high mortality when the study was replicated on Norway rats at NWRC’s facilities in Colorado.

In evaluating a pesticide registration application, EPA assesses a wide variety of potential human health and environmental effects associated with use of the product. Studies can be required to evaluate whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish, and plants, including endangered species and non-target organisms, as well as possible contamination of surface water or ground water from leaching, runoff, and broadcast drift (EPA 1998). FIFRA also requires the periodic review of existing registrations to ensure pesticides continue to meet the most current scientific and regulatory standards (EPA 2008, FIFRA Science Advisory Panel 2011).

The directions for use on the label reflect the Agency’s determination that the use of the product in the manner prescribed does not cause unreasonable adverse effects on the environment under FIFRA. If the Agency determines that the pesticide, when applied in accordance with the label’s directions for use, warning and cautions, or in accordance with a widespread and commonly recognized practice, may generally cause, without additional regulatory restrictions, unreasonable adverse effects, the Agency will classify the pesticide as a Restricted Use Pesticide (RUP) (FIFRA 3(D)(1)(c)). RUPs can only be applied by, or under the direct supervision of, someone who is a certified applicator. Commercial certified applicators, including anyone authorized to use or directly supervise use of Restricted Use Pesticides, must be trained and must pass the Certified Pesticide Applicator’s test appropriate for the type of pesticide and use circumstance involved. Such training and testing is administered by each State’s pesticide regulatory authority. All field (noncommensal) uses of rodenticides registered for conservation uses on islands are Restricted Use Pesticides.

There are four provisions under FIFRA by which uses of pesticides can be approved. The most general type of registration is under Section 3 of FIFRA, which allows the label to be used throughout the U.S. and its territories and possessions. The states and territories (if they have a pesticide regulatory agency, such as Guam EPA) have authority to regulate pesticides, implemented under laws and regulations unique to each state or territory, but stepped down from FIFRA. Before a label registered under Section 3 can be used in a particular state or territory, the registrant must submit it to the non-Federal authority (eg., HDOA) for licensing. Licensing is not automatic; states and territories have the authority to restrict or deny uses previously approved by the EPA.

Under Section 24(c) of FIFRA, known as Special Local Need (SLN) registrations, the states and territories can register additional uses of Section 3 -registered pesticides to address pest problems within their jurisdictions. All SLNs must be forwarded to EPA for label review after they have been reviewed and approved by the state or territorial authority. A state-registered product may be used as soon as the state registers it. However, an SLN registration may be denied "on reasonable grounds" by EPA within 90 days of its issuance or subsequently under certain circumstances that are set forth in 40 CFR §162.154.

Under Section 18 of FIFRA, EPA can permit the immediate unregistered use of a pesticide in a specific geographic area for a limited time if emergency pest conditions exist for which no pesticide is registered. Exemptions can be approved for reasons of public health, severe agricultural damage, or the new introduction of a destructive invasive species. The applicant must draft a temporary label and collect data to support the safety and efficacy of its use, with the understanding that the applicant will seek either a Section 3 or 24(c) registration if the pest conditions continue. If the data are not submitted to EPA the label will generally not be renewed once it has reached its expiration date.

An Experimental Use Permit (EUP) issued by EPA under Section 5 of FIFRA allows field testing of an unregistered use of a pesticide to allow data to be collected in support of registration. An EUP is required from EPA for experimental field tests on greater than 10 acres of land or more than one acre of water. The State of Hawai‘i Pesticides Branch issues a state EUP for sites less than those sizes under HAR 4-66-45 through 51. The person conducting the application must be a Category 10 Certified Pesticide Applicator. Data must be collected and submitted to the agency that issued the EUP to fulfill the requirements of the EUP. With minor exceptions, any use of a pesticide not covered by an EUP, a Section 18 emergency exemption, or a registered label is a violation of state and Federal pesticide laws.

The EPA is required by a number of statutes (FIFRA, MBTA, ESA, and the Bald and Golden Eagle Protection Act (BGEPA)) to ensure that the use of a pesticide label does not result in mortality to non-target species. The process of registration of a pesticide

label with the EPA and the licensing of its use at the state or territorial level must include a determination of what effects, if any, the proposed use would have on ESA-listed species. The EPA has conducted formal consultations with FWS under Section 7 of the ESA on the effects of rodenticides under specific use patterns (e.g., USFWS 1993, 2012a, b, entire), resulting in substantial changes to labels. Section 7 consultations were not conducted between FWS and EPA for the three Section 3 labels for conservation use. The Hawaii Pesticides Branch has EPA- delegated authority to conduct informal consultations (meaning take of a listed species is determined to not be likely to occur) with PIFWO. All Section 24(c) registrations of rodenticides in Hawai‘i, including the conservation use of Ramik® Mini Bars, have undergone Section 7 consultations. These consultations resulted in an enforceable provision on the conservation use label that requires all proposed uses to be reviewed and approved by FWS to ensure that conservation uses are safe and effective.

At the user level, misuse of a pesticide resulting in take of a protected species can be prosecuted under the above statutes.

The application for Section 3 registration of DPN-50 for conservation use on islands was supported by a large set of data demonstrating its safety for human health, nontarget species, and the environment, with many studies conducted in Hawai‘i. Chlorophacinone has use patterns in agriculture, including aerial broadcast in Mainland U.S. environments. These chlorophacinone registrations are supported by a set of studies that met EPA’s requirements for evaluating its environmental fate and transport (EPA 1998), which could be used as part of a data set to support conservation use labels. Additional data specific to a conservation use pattern, and specific to Hawai‘i, would be needed to support registrations for the conservation use of chlorophacinone that could be used in Hawai‘i.

Prior to the two brodifacoum Section 3 registrations for conservation, brodifacoum was limited to application in bait stations and/or only in and around structures. Although the commensal use patterns are supported by some studies on environmental fate and transport, EPA did not require all of the studies needed to evaluate safety to nontarget species and the environment because of the limited risk from this use pattern (EPA 1998). No additional studies on the risk posed by the new use pattern of brodifacoum were submitted in support of the conservation labels for brodifacoum.

Studies are underway with all three rodenticides to address concerns regarding toxicity to Hawaiian reef fish and the leaching potential of the rodenticides in Hawaiian soils.

All data specific to Hawai‘i in support of rodenticide labels evaluated for use under this Draft PEIS have been generated by two Federal agencies: USGS BRD and USDA-WS. Only these two agencies have the expertise and institutional controls for data quality, including GLP standards, to ensure that rodenticide labels in Hawai‘i are supported by sound efficacy and safety data.

The PEIS will develop standards for the types of efficacy and safety studies that will support the applications for new labels not currently licensed or registered in Hawai‘i, as well as the standards for data quality for those studies.

Regulation of Devices under FIFRA

FIFRA Section 2h defines a device as ‘any instrument or contrivance (other than a firearm) which is intended for trapping, destroying, repelling, or mitigating any pest or any other form of plant or animal life (other than man and other than bacteria, virus, or other microorganism on or in living man or other living animals); but not including equipment used for the application of pesticides when sold separately therefrom’. FIFRA does not require the registration of pesticidal devices. Devices, however, are subject to a number of FIFRA’s provisions including, labeling requirements and establishment number identifying the location where the device was produced (40 CFR 152.500). EPA excluded from regulation ‘devices that depend for their effectiveness more upon the performance of the person using the device than on the performance of the device itself; and devices that operate to entrap vertebrate animals’ (FR Notice Nov 19, 1976), including rat and mousetraps. EPA determined that Goodnatures® meet the definition of devices regulated under FIFRA because the force supplied is from the carbon dioxide gas firing the piston, and because the animal is not entrapped by the device. The company that makes this product is registered with EPA as a pesticide-producing establishment, and is subject to the labeling requirements in 40 CFR Part 156. A device is considered to be misbranded and subject to enforcement action if:

- the labeling bears any statements, designs, or graphic representations that are false or misleading (see 40 CFR 156.10(a)(5));
- its packaging or wrapping does not conform to standards established pursuant to FIFRA section 25(c)(3) (as of 2010, such standards have yet to be established for devices);
- it is an imitation of, or is offered for sale under the name of another device;
- the label fails to bear the establishment number of the establishment where it was produced;
- any required information is not prominently displayed on the label;
- it lacks adequate directions for use; or
- it lacks an adequate warning or caution statement.

Because Goodnatures® are manufactured in New Zealand and shipped directly to customers within the conservation community in Hawai‘i, they are subject to U.S. Customs regulations at 19 CFR 12.1(b) related to the implementation of FIFRA sec 17.

These require that for devices produced by foreign manufacturers and imported into the U.S., an importer must submit to EPA a Notice of Arrival of Pesticides and Devices (EPA Form 3540-1) for review and determination as to whether the shipment should be sampled and/or permitted entry into the U.S.

Animal Welfare and Animal Cruelty Statutes

State and Federal laws cover the ethical treatment of animals in Hawai‘i. The Federal Animal Welfare Act (7 U.S.C. § 2131 *et seq.*) (AWA) and the regulations promulgated thereunder by the Secretary of Agriculture (9 C.F.R. 1.1-4.10) apply to field research with wild animals. Some of the uses of traps, multikill devices and rodenticides considered in the Draft PEIS will require field studies to gather efficacy data and develop SOPs. Whereas the AWA excludes rats and mice bred for use in research (7 U.S.C. §2132), it does not exempt wild rats and mice, and excludes from exemption “any study that involves an invasive procedure, harms, or materially alters the behavior of an animal under study.” This is explicitly clarified in the Licensing and Registration Guidelines published by USDA (2004), which states that “Wild species of rats and mice are regulated.” The Guidelines also state that “included under research, testing, teaching, or experimentation are: Investigations on animal propagation and control-such as wildlife ecology.” The term “research facility” is defined under 7 sec 2132 (e) to mean “any … institution, organization, or person that uses or intends to use live animals in research, tests, or experiments, and that … (2) receives funds under a grant, award, loan, or contract from a department, agency, or instrumentality of the United States for the purpose of carrying out research, tests, or experiments. Institutions using any regulated live animals for research, testing, teaching, or experimentation must register with the USDA as "research facilities." Registration requires an Institutional Animal Care and Use Committee (IACUC) and an annual report that is filed with USDA. The report must state the number and species of regulated animals that were used, if any painful experiments were conducted, and an explanation as to why it was necessary to omit pain relief (USDA 2004). Annual reports are subject to Freedom of Information Act (FOIA) requests.

Federal agencies themselves are not required to register with USDA, but are still responsible for complying with all USDA standards of animal care and for submitting an annual report to USDA (USDA 2004). The two Federal agencies in Hawaii that conduct research with wild rodents and mongooses, USGS-PIERC and USDA-APHIS-NWRC, comply with the AWA. All research conducted by these agencies and used to support the SOPs and analyses in the Draft PEIS have been conducted according to IACUC-reviewed and approved protocols.

Under HRS §711-1109, the offense of cruelty to animals in the second degree specifically excludes ‘vermin, or other pests’. However, it was revised in 2011 by the “Peacock Bill”, which became Act 226, to state that “the handling or extermination of any insect,

vermin, or other pest is conducted in accordance with standard and acceptable pest control practices…"

The American Society of Mammalogists and the American Veterinary Medical Association have guidelines for live- and kill-trapping, and for euthanasia (Sikes *et al*. 2011, AVMA 2013). The Draft PEIS will evaluate the humaneness of the proposed methods to determine their consistency with standards described in the literature (e.g. Mason and Littin 2003), the AWA, Hawaii's law, and these professional guidelines, and will establish standards for the humane and ethical treatment of the target animals. Agencies and academic institutions have policies regarding compliance with AWA standards.

Other Laws and Regulations

In addition, the following federal and state laws and regulations, Presidential Executive Orders (EOs) and federal and state plans will be evaluated in the Draft PEIS:

- Coastal Zone Management Act/ HRS 205A Coastal Zone Management consistency with Hawai‘i Enforceable Policies for pesticides, endangered species, historic preservation and water quality
- State of Hawai‘i Code for Pesticide Control HRS 149 A/ HAR 4-66
- Federal and State Endangered Species Act HRS 195D-4/ HAR 13-124
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA) and EO *Guidance for Protection of Migratory Birds*
- State of Hawai‘i Wildlife Sanctuaries HAR 13-125
- Federal National Historic Preservation Act (NHPA) and Hawai‘i Historic Preservation Act HRS 6E and HRS 343 (Cultural Impact Assessment)
- Subsistence Uses per Endangered Species Act, MMPA, MBTA and EO 12899 ("Environmental Justice")
- Native Hawaiian Rights per HRS 174C, Kuleana Act of 1850, 1839 Law of Kamehameha, State Constitution, Burial Laws HRS 6E, Federal Native American Graves Repatriation Act (NAGRPA), Federal Archaeological Resources Protection Act and Hawai‘i Historic Preservation Act
- Federal Clean Water Act and HRS 342-D/ HAR 11-54
- Magnusen-Stevens Fishery Conservation and Management Act/ Essential Fish Habitat

- Papahānaumokuākea Marine National Monument (Northwestern Hawaiian Islands):
    - Antiquities Act of 1906 (16 USC 431-433)
    - Migratory Bird Treaty Act of 1918, as amended (16 USC 703-712)
    - Historic Sites, Buildings, Objects and Antiquities Act of 1935, 16 USC §461-462, 464-467
    - Fish and Wildlife Act of 1956, as amended (16 USC 742a-742m)
    - National Historic Preservation Act of 1966, as amended through 2006, 16 USC § 470 *et seq*.
    - National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee
    - Refuge Recreation Act of 1966, as amended (16 USC 460k-460k-4)
    - National Marine Sanctuaries Act of 1972, as amended (16 USC 1431-1445c)
    - Coastal Zone Management Act of 1972, as amended (16 USC § 451 *et seq*.)
    - Marine Mammal Protection Act of 1972, as amended (16 USC 1361-1421h)
    - Endangered Species Act of 1973, as amended (16 USC 1531-1544)
    - Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (16 USC 1801-1882)
    - Fish and Wildlife Improvement Act of 1978, as amended (16 USC 7421)
    - Archeological Resources Protection Act of 1979 (16 USC § 470 aa-mm)
    - Abandoned Shipwreck Act of 1987, 43 USC § 2101-2106
    - Native American Graves Protection and Repatriation Act of 1990, as amended, 25 USC § 3001 *et seq*.
    - National Wildlife Refuge System Improvement Act of 1997 (16 USC §§ 668dd-ee)
    - Sunken Military Craft Act of 2004, 20 USC § 113 Note, PL 108-375, Div. A. Title XIV, §§ 1401-02, Oct. 28, 2004, 118 Stat. 2094
    - Lacey Act and Amendments of 1981 and 1988 (16 USC § 3371 *et seq*., 18 USC § 42)

- Northwestern Hawaiian Islands Marine National Monument, 50 CFR Part 404, August 29, 2006
- Papahānaumokuākea Marine National Monument Provisions, (PSSA Designation) Federal Register: December 3, 2008 (Vol. 73, No. 223 [Pages 73592-73605])
- Hawaiian Islands Reservation, February 3, 1909 – Executive Order 1019
- Administration of the Midway Islands, November 1, 1996 - Executive Order 13022 (61 FR 56875)
- Coral Reef Protection, June 11, 1998 – Executive Order 13089 (63 FR 32701)
- Invasive Species, February 3, 1999 – Executive Order 13112 (64 FR 6183)
- Marine Protected Areas, May 26, 2000 – Executive Order 13158 (65 FR 34909)
- Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, December 4, 2000 Executive Order 13178 (65 FR 76903) and January 18, 2001 Executive Order 13196 (66 FR 7395)
- Establishment of the Northwestern Hawaiian Islands National Monument, June 15, 2006 – Presidential Proclamations 8031 (71 FR 36443)
- Amending Proclamation 8031 of June 15, 2006, To Read, "Establishment of the Papahānaumokuākea Marine National Monument, February 28, 2007 – Presidential Proclamation 8112 (72 FR 10031)
- Designation of the Battle of Midway National Memorial, September 13, 2000 – Department of the Interior Secretary's Order 3217
- Hawaii Organic Act of April 30, 1900 (c339, 31 Stat.141 § 2)
- Hawaii Admission Act of March 18, 1959 (Pub. L. 86-3, 73 Stat. 4 § 2)
- Constitution of the State of Hawai'i, Article XI, §§ 1,2,6, and 9 and Article XII § 7
- Hawaii Revised Statues, Title 1 – Chapter 6E, Sections 6E-1 and 6E-7; Title 12, Chapter 171, Section 171-3, Chapter 183D, Section 183D-4, Chapter 187A, Section 187A-8, Chapter 188, Sections 188-37 and 188-53
- Hawaii Administrative Rules, Title 13, Chs. 60.5, 95, 126, 275-284, and 300, Humpback Whale National Marine Sanctuary
- Hawai'i Strategic Plan for Invasive Species 2008-2013

- Hawai‘i State Comprehensive Wildlife Conservation Plan
- County General Plans and Policies (Maui, Honolulu, Hawai‘i, Kaua‘i Counties)

Many of these programmatic compliance and consistency analyses should be sufficient for most site-specific projects. However, each project will need to conduct analyses for site-specific impacts to historic and cultural resources, water quality, endangered species, pertinent land management and use plans and other laws and regulations specific to the site. However, these project-level site-specific analyses will be substantially simpler, based on and tiered to the programmatic analyses presented within the PEIS.

NECESSARY PERMITS FOR CONTROL AND ERADICATION PROJECTS

The PEIS will conduct programmatic analyses for each of these permits and consultations that would then be used to frame and support project-level applications for permits and approvals.

For conducting any project-level actions on designated State Wildlife Sanctuaries, DOFAW may require a permit from DLNR per HAR 13-125-6, or may provide an exemption in order to remove invasive rodents from a seabird nesting area.

Pesticide-related Permits and Procedures

The Hawai‘i Pesticides Law, Chapter 149A, HRS, is the State of Hawaii’s statutory framework for regulating pesticide users and distributors. It is the basis for the pesticide rules developed and enforced by the Hawai‘i Department of Agriculture (HDOA), Pesticides Branch.

All of the conservation labels of rodenticides are classified as Restricted Use Pesticides (RUPs), and can only be applied by, or under the direct supervision of, a person who has passed the Commercial Pesticide Applicator’s test administered by the HDOA Pesticides Branch (§149A-31(3), HRS). Conservation users must be certified under Hawaii’s Applicator Certification Category 2 (Forest Pest Control), although an applicator conducting research in support of a rodenticide registration needs a Category 10 (Demonstration, Research and Instructional Pest Control) certification, and a helicopter pilot aerially applying rodenticides must be a Category 4 (Aerial Pest Control) certified applicator.

A certified applicator must have sufficient technical experience with the application method to be able to assure that the bait will be applied according to the label. Applications of RUPs are subject to inspection and enforcement by the HDOA Pesticides Branch. The certified applicator assumes personal liability for any violations found to

have occurred in conjunction with the application (§149A-31, HRS). In addition, the agency conducting the application may also be found liable. Depending upon the location and nature of the violation, enforcement action may be taken either by HDOA or by EPA.

Procedures for the procurement and use of the rodenticide products vary depending upon the label. Ramik® Mini Bars is a commensal product that can be purchased by the general public from retailers, for use in and around buildings according to label directions. To use this rodenticide under the conservation label, the applicator must be a certified pesticide applicator and working under an FWS-approved protocol as described above in the Registration Process section.

Under §149A-11, HRS, only pesticide dealers licensed by the HDOA Pesticides Branch can import Restricted Use Pesticides (RUPs) into the State, and sell or distribute them. As part of the requirements that a licensed dealer must fulfill, at least one employee must be a State-certified dealer's representative and maintain the required records for the RUPs related to their import, sale and distribution. USDA-APHIS-WS carries the license for DPN-50 in Hawai‘i and is the only dealer authorized by HDOA Pesticides Branch to import it into the state, and sell or distribute it within Hawai‘i. The other two nationally-registered conservation labels, for two brodifacoum products, have not been submitted by USDA-APHIS-WS for licensing in Hawai‘i, and they cannot be trans-shipped through Hawai‘i on their way to other islands outside of the State. All three of the nationally-registered conservation labels restrict the retail sale of the product to the three agencies listed on the labels (USDA, FWS, and NPS), which means that in Hawai‘i, USDA-APHIS-WS can sell DPN-50 only to FWS and NPS. Since these agencies are not licensed dealers, they cannot transfer or sell the bait to another entity.

The Hawai‘i Pesticides Branch requires a permit for the aerial application of an RUP (HAR section 4-66-64).

Any species not named on these conservation labels as a target species is considered to be a nontarget species (FIFRA Sec 2(ee)). Exposure of a nontarget species to the bait that occurs as a result of use under the Ramik® Mini Bars SLN must be reported within 24 hours to the Pesticides Branch, as directed on the label. Depending upon the severity of the incident, the registrant of any of the conservation labels may file an incident report with EPA under Section 6(a)(2) of FIFRA.

No special permits have been required to dispose of excess bait. It is not classified by the Hawai‘i Department of Health as Hazardous Waste. Excess rodenticide bait must be disposed of according to label instructions, and according to county regulations for landfills. A detailed disposal plan should be developed by bait users as part of project planning.

National Pollution Discharge Elimination System (NPDES) Permits for Pesticide Discharge per Section 404 of the Clean Water Act

Point source discharges of pesticides into waters of the U.S. are required to comply with NPDES. EPA developed a Pesticides General Permit (PGP), effective between October 31, 2011, and October 31, 2016, to provide coverage for four pesticide use patterns. EPA has determined that the conservation use of rodenticides is included in one of the patterns eligible for coverage (Animal Pest Control). The Hawai‘i Department of Health (DOH), Clean Water Branch (CWB) is responsible for implementation of the NPDES pesticides permit program in the State of Hawai‘i. The Department of Health (DOH) issued a new NPDES General Permit on October 21, 2012, (which expires on October 21, 2017) to authorize point source discharges from the application of pesticides (including insecticides, herbicides, fungicides, rodenticides, and various other substances to control pests) to State waters. This NPDES Pesticides General Permit is in Hawaii Administrative Rules (HAR), Chapter 11-55, Appendix M.

EPA Region 9 administers the PGP process for Waters outside of the State of Hawai‘i within the geographic scope of the Draft PEIS. Upon determining that a rodenticide use may result in discharge to Waters of the U.S., as defined in the PGP, which includes streams and the marine environment, an Operator (as defined in the PGP) must submit a “Notice of Intent” (NOI) to seek coverage for the discharge under the PGP, either to the CWB or EPA Region 9. NOIs may be reviewed by EPA and any interested parties at any time. EPA may delay authorization prior to a discharge being covered under the permit if the Agency determines, including based on information provided by other interested parties, that further review of Operator eligibility under the PGP is warranted. Once EPA or the CWB approves the NOI, the proposed discharge has coverage under the general permit.

The Air Force is the only Operator thus far to receive coverage for an aerial application of rodenticide under EPA’s PGP, for Wake Island in 2012. The other aerial applications in Hawai‘i and on other Pacific Islands within the Refuge System predated the PGP requirement.

Compliance with State and Federal Endangered Species Act Requirements

If the potential exists for a rodent or mongoose control or eradication project to cause the incidental take of a species listed under the Federal or State Endangered Species Acts, an incidental take permit would be required at the project level. The Hawai‘i Endangered Species Law and Incidental Take License must be accompanied by a Habitat Conservation Plan that provides measures for avoidance, minimization, mitigation, monitoring and net recovery benefit to the affected species. The state law is under the jurisdiction of DOFAW per HRS 195D. Potential impacts to federal and state-listed threatened and endangered species will be evaluated in the Draft PEIS.

Compliance with Migratory Bird Treaty Act (MBTA)

In a memorandum dated January 29, 2010, the Director of FWS explaining that incidental take of migratory birds during projects to eradicate or control invasive species is an appropriate purpose for which FWS could issue Special Purpose Miscellaneous permits under 50 CFR 21.27 if the project benefits migratory birds. The Service is instructed to 'cooperate with the action agency on the environmental review to ensure a thorough analysis of the impacts of the project, including issuance of the permit, on migratory birds and other nontarget species, and the overall benefits to migratory birds. The project design should include sound measures to avoid and minimize nontarget mortality.'

The IPM and Adaptive Management framework of this PEIS supports the intent of this memorandum and of these permits, and the information in the PEIS will facilitate the permitting process. Each future site-specific project tiered to the PEIS will evaluate whether take of migratory birds is likely to occur as a result of the rodent or mongoose control or eradication methods proposed for use by the project. During the planning phase of each site-specific project, the analyses in the PEIS on the risks to migratory birds from each method will assist with identifying which species could be affected, how many individuals for each species are likely to be taken, and which mitigation measures could reduce the take. The method(s) that have the lowest risk of take, and/or most effective mitigation measures, should be selected whenever possible. If take is still expected to occur, information from the PEIS analyses will then be included in the permit application. The analyses in the PEIS will also facilitate identification of benefits to each migratory bird species that are anticipated to occur as a result of the site-specific rodent or mongoose control or eradication project. The PEIS will develop standards for monitoring migratory birds, incorporating protocols from other sources as much as possible, so that the impacts on migratory bird populations from the methods used and the beneficial effects of predator removal can be quantified to determine the overall benefits to migratory birds. The monitoring will be used to adjust methods as needed during the project, consistent with the IPM and Adaptive Management approaches. Methods of rodent and mongoose removal may need to be adjusted or changed if take of migratory birds is higher than expected, or if the methods are not resulting in the expected benefits to migratory birds.

Compliance with the National Historic Preservation Act (Section 106)

Compliance would also be required regarding cultural and archaeological resources at a project level. Section 106 of the National Historic Preservation Act "requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Council a reasonable opportunity to comment to such undertakings". It also "seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency official and other parties, commencing at the early stages of project planning". The goal is to "identify historic

properties potentially affected by the undertakings, assess its effects and seek ways to avoid, minimize, or mitigate any adverse effects" (36 CFR 800). The coordination and integration of NEPA processes and Section 106 review will provide efficiencies, improve public understanding, and lead to more informed decisions.

The Draft PEIS is a Federal undertaking that requires Section 106 consideration. The Service has identified impacts that could occur as a result of the project's undertaking and will consult with the State Historic Preservation Officer and other parties, including but not limited to, the Office of Hawaiian Affairs, and Hui Malama I Na Kupuna O Hawaii Nei, to negotiate and execute a Section 106 agreement document. The Service will initiate the consultation process with the release of the Federal Notice of Intent. During the NEPA process, the Service will work with the Section 106 parties to identify, assess, and resolve any adverse effects to historic properties across Hawai'i.

In coordination with Section 106 consultation, the Service will consult with Native Hawaiian organizations to address issues regarding the American Indian Religious Freedom Act (AIRFA). AIRFA was enacted to protect and preserve the traditional religious rights and cultural practices and affirms the right of Native Americans to have access to their sacred places. Potential issues to be addressed under AIRFA include:

- the Polynesian rat has significance in Hawaiian culture, but is one of the species targeted for control;
- the removal of rodents and mongooses could increase the abundance of native species that are culturally important, thus making them more available for use in cultural and religious practices;
- conversely, not controlling rodents and mongooses may result in the loss of culturally important native species;
- some control methods could result in temporary restrictions on access to areas where cultural practices are conducted, but these impacts are temporary and do not result in physical changes to the land;
- control methods would need to be evaluated for sensitivity to Native Hawaiian cultural values.

Compliance with HRS 343 Cultural Impact Assessment

A cultural impact assessment (CIA) will be prepared pursuant to Chapter 343, HRS as amended and approved as Act 50 in 2000. This act required that "environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State" and that the "definition of 'significant effect' be amended to include adverse effects on cultural practices." The CIA will include

ethnographic surveys/interviews with individuals/groups on across the State to discuss the following:

- Background information of the role of ʻiole in Hawaiian culture
    - ʻiole references in the Kumulipo, ʻōlelo noʻeau, moʻolelo, mele, ʻoli, place names, rat-related artifacts, etc.
    - examples of the importance of ʻiole in Hawaiian culture
        - ʻAumākua, Sport hunting, Food source, etc.
- What role does the mongoose play in contemporary Hawaiian culture?
- Determine the importance of native species in Hawaiian culture
    - Examples of their uses
    - Importance of the relationship of species to the cultural identity of Hawaiians.
- Do people identify the ʻiole as the Polynesian rat, or does ʻiole means rodents in general (rats (*R. exulans, R. rattus,* and *R. norvegicus*) and mice)?
- Are native species and canoe plants being impacted by rats, mice, and/or mongooses?
    - Anecdotes/examples and pictures if available.
    - Are practitioners concerned about which species of rodent causes the damage that they observe?
- Ask the questions in the NOI published in the Federal Register on June 30, 2015:
    - What do you think about protecting native species and ecosystems from introduced rodents and mongooses?
    - Under what circumstances do you think they should be controlled and eradicated?
    - Are there additional criteria for evaluating methods for rodent and mongoose control and eradication that we have not considered?
    - Should the criteria for evaluating methods for rodent and mongoose control and eradication be modified in any way?
    - How would you balance these criteria when evaluating the methods?
    - What recommendations or suggestions would you make regarding the methods that are proposed for evaluation?

- Are there any other methods for rodent and mongoose control that should be included? If so, please describe them in sufficient detail so that they can be evaluated.
- Should any of the identified alternatives be modified?
- Are there any other alternatives that should be considered? If so, please describe them in sufficient detail so that they can be evaluated.
- Are there issues not included in the list above that should be addressed?
- The process of determining the significance of impacts to resources is unique to each resource, and is based upon the context and intensity of the impacts. The context refers to the setting of where the proposed action may occur, the affected areas or locations, the resource affected, and the proposed action's short and long-term effects. The intensity refers to the severity of the impact. The evaluation of significance will rely upon information received during scoping, and may be modified as information is revealed through the analyses. Are there resources for which you can identify criteria that should be used to begin to determine the significance of the impacts to these resources? Please include your thoughts on the context and intensity of the effects.

The CIA process will run parallel to the NEPA/HRS 343 process and will be presented as an Appendix in the Final PEIS.

Papahānaumokuākea Marine National Monument

Activities in Papahānaumokuākea Marine National Monument (Monument) are either prohibited, exempted, or regulated.

Prohibited activities include:

- Exploring for, developing, or producing oil, gas, or minerals within the Monument;
- Using or attempting to use poisons, electrical charges, or explosives in the collection or harvest of a Monument resource;
- Introducing or otherwise releasing an introduced species from within or into the Monument; and
- Anchoring on or having a vessel anchored on any living or dead coral with an anchor, anchor chain, or anchor rope.

Exempted activities can take place without a permit and include:

- Response to emergencies threatening life, property, or the environment;

- Law Enforcement activities;
- Activities and exercises of the Armed Forces (including the US Coast Guard); and
- Passage without interruption.

Permits may be issued for activities that:

- Further the understanding of the Monument resources and qualities through research;
- Further the educational value of the Monument;
- Assist in the conservation and management of the Monument;
- Allow Native Hawaiian practices;
- Allow a special ocean use;
- Allow recreational activities with the Midway Atoll Special Management Area

CHAPTER 4. IDENTIFICATION OF POTENTIAL IMPACTS

ISSUES IDENTIFIED TO BE EVALUATED IN THE DRAFT PEIS

The following issues have been identified through preliminary scoping for the Proposed Action, No Action Alternative, and other Alternatives. Criteria for determining the significance of impacts for each of these issues will be developed in the Draft PEIS, and each issue will be evaluated for direct, indirect, and cumulative impacts, and for short-term and long-term effects on the human environment.

With this notice, DOFAW requests comments, recommendations, and advice on issues, alternatives, and mitigation to be addressed in the Draft PEIS, including but not limited to:

- The potential to increase or decrease populations of native species, especially those that are rare;
- The potential to impact species protected under the Federal and State Endangered Species Acts, the Marine Mammal Protection Act, and the Migratory Bird Treaty Act, and other terrestrial species;
- The potential to impact populations of other non-target invasive species;
- The potential to impact game animals;
- The humaneness of rodent and mongoose control or eradication methods on target and non-target species;
- The potential to impact Native Hawaiian religious cultural rights and practices;
- The potential to impact the ability of Native Hawaiians to exercise their traditional and customary gathering rights for subsistence;
- The potential to impact archaeological and cultural resources; and
- The potential to counteract declines in population levels of native species that are also declining due to the effects of climate change.

In addition, the following issues specific to the use of rodenticides will be addressed:

- The potential for the use of each of the three rodenticides to impact soils, surface waters, and groundwater, including movement of rodenticides through water-based (e.g., riparian or stream) ecological systems;
- The potential for the use of each of the three rodenticides to impact freshwater fish and invertebrates;

- The potential for the use of each of the three rodenticides to impact marine species, including, but not limited to, fish, invertebrates, and corals;
- The potential for the use of each of the three rodenticides to impact essential fish habitat; and
- The potential for the use of each of the three rodenticides to cause human health impacts from consumption of meat from mammals, birds, fish and shellfish, and from drinking water.

CONSIDERATION OF MITIGATION AND RELATIONSHIP TO TIERED PEIS

Because criteria for evaluating the significance of the issues will be identified through the scoping process initiated by this Preparation Notice and the Federal Notice of Intent (published in the Federal Register on June 26, 2015), it is premature to identify and discuss specific mitigation measures. Furthermore, impacts that could result from implementing particular SOPs cannot be identified until the SOPs are described in the Draft PEIS. However, it is anticipated that some impacts associated with the proposed rodent and mongoose control methods could be significant. Therefore the Draft PEIS will propose and analyze standards to be established for mitigation measures, as well as propose and analyze specific mitigation measures that have been identified through the scoping process. The standards for use of mitigation measures will be based upon the nature of the anticipated impacts, the probability of the impacts occurring, and the characteristics of the areas where the impacts may occur. The standards for mitigation measures will be developed with regulatory agency and community input. The standards will address monitoring to determine the effectiveness of the mitigation measures and to identify any impacts that result from the implementation of the mitigation measures. The standards will require the identification of thresholds and triggers for requiring remedial measures as part of an adaptive management approach.

Site-specific projects will be subject to additional HRS 343 and/or NEPA compliance, which may rely on and tier to the analyses presented in the PEIS, including those related to mitigation measures and standards. Mitigation measures may also be developed to reflect site-specific circumstances, as long as they meet the standards set in the PEIS. The PEIS will identify impacts that would not require mitigation and impacts that cannot be mitigated without compromising the effectiveness of the rodent and mongoose control or eradication method. Under the latter circumstances, DOFAW and FWS could decide in the PEIS not to include such methods in our preferred alternative; or we could analyze whether there are different control methods with lesser impacts that could be used. Even if we ultimately include such methods as options in our proposed action, subsequent site-specific HRS 343 and/or NEPA compliance would evaluate the site-specific impacts.

The Draft PEIS will also evaluate the needs for any appropriate mitigation measures to protect archaeological and cultural resources during implementation of rodent and mongoose control or eradication projects pursuant to section 106 of the National Historic Preservation Act. Such mitigation would be developed in consultation with the Hawai'i State Historic Preservation Division, the Office of Hawaiian Affairs, and Native Hawaiian organizations. A Cultural Impact Assessment compliant with HRS 343, Act 50, will also be prepared. In addition, impacts to religious cultural rights and practices will be evaluated pursuant to the American Indian Religious Freedom Act (1996).

FINDINGS AND ENVIRONMENTAL IMPACT STATEMENT DETERMINATION

Impacts that could result from the use of rodent and mongoose control or eradication methods considered in the Draft PEIS would be analyzed using the following significance criteria listed under HAR §11-200-12:

- Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;
- Curtails the range of beneficial uses of the environment;
- Substantially affects the economic welfare, social welfare, and cultural practices of the community or State;
- Substantially affects public health;
- Involves a substantial degradation of environmental quality;
- Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;
- Substantially affects a rare, threatened, or endangered species, or its habitat;
- Detrimentally affects air or water quality or ambient noise levels;
- 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;

DOFAW and FWS have determined that many of the issues identified may meet some of the significance criteria listed above, and that an EIS is appropriate for evaluating the proposed approach to rodent and mongoose control and eradication.

CHAPTER 5. CONSULTED PARTIES

SUMMARY OF PARTIES CONSULTED

PIFWO staff have met with the Hawai‘i Department of Health Clean Water Branch, the Honolulu Board of Water Supply, and the Hawai‘i Department of Agriculture Pesticides Branch.

In addition, Ku‘iwalu, a public outreach consulting firm, was hired by the U.S. Army Garrison Hawai‘i to conduct an extensive statewide public outreach effort for obtaining information regarding issues and interest in a statewide program for controlling and eradicating invasive rodents in Hawai‘i, including the use of aerial broadcast of rodenticides. This effort began in late summer 2009 and continues into 2011 with the initiation of the PEIS. The effort focused on elected officials and native Hawaiian organizations, i.e. Office of Hawaiian Affairs, Association of Hawaiian Civic Clubs, Aha Kiole, and native Hawaiian individuals, i.e. cultural practitioners, leaders and organizations associated with the native Hawaiian communities, including local Aha Kioles.

August 3, 2009 - O‘ahu
Jonathan Scheuer, Director of Office of Hawaiian Affair’s Land Division
William Aila, Cultural Practitioner, Native Hawaiian fisherman

August 4, 2009 – Kaho‘olawe
Mike Naho‘opi‘i, Executive Director of the Kaho‘olawe Island Reserve Commission (KIRC)

August 10, 2009 - O‘ahu
Doc (Chuck) Burrows, Cultural Practitioner, KIRC, KHCC, ‘Ahahui o Mālama I Ka Lōkahi

August 13, 2009 – O‘ahu
Ka‘ena Point Project Team, Colette Machado, Office of Hawaiian Affairs (OHA) Trustee

August 18, 2009 – O‘ahu
Kailua Hawaiian Civic Club (KHCC)
Waimanalo Hawaiian Civil Club

August 24, 2009 – Big Island
Russell Kokubun, Big Island Senator

August 26, 2009
Leimomi Khan, President of the Association of Hawaiian Civic Clubs

September 2, 2009 - Maui
Mele Carroll, Maui Country Representative, Chair of the Native Hawaiian Legislative Caucus

September 3, 2009
Kanaka Council
-Jimmy Medeiros
-Rocky Jensen
-Palikapu Dedman
-Uncle Sam Kaʻalele
-Makaʻala Nakoa (Shelly Stephens)

September 28, 2009 – Hawaiʻi Island
Hannah Kihalani Springer, Cultural Practitioner, Former OHA Trustee, Kahu Kū Mauna
Yvonne and Keoki Carter, Cultural Practitioners
Namaka Whitehead, Ecologist with Kamehameha Schools Land Assets Division, KIRC

October 20, 2009 - Maui
Maui Department Land Natural Resources (DLNR) Land Managers and Land Board Members
-Jerry Edlao, BLNR Maui Member
-Skippy Hau, Maui Aquatic Biologist
-Russell Sparks, Maui Aquatic Resources Educational Specialist
-John Cumming, Maui/Molokai Branch District Manager
-Curtis, Maui Engineering Division
-Hinano Rodrigues, SHPD Cultural Specialist
-Michelle, KIRC Staff
-Kuhea Paracuelles, Maui County
Rhiannon Chandler, Maui Community Work Day Executive Director
Maui Conservation Alliance
-Art Medeiros
-Jennifer Higashino
-Jorden Jokiel
-Lissa Fox
-Kuhea Paracuelles

October 23, 2009 – Lānaʻi
Lānaʻi Community Meeting
-Winifred Basques, Aha Kiole for Lānaʻi
-Wally Morita, Lānaʻi DLNR
-George Purdy, Lānaʻi Fire Dept., Aha Kiole
-Christine Costeles, Pacific Cooperative Studies Unit
-Alberta DeJettey, Lānaʻi Today Newspaper

October 27, 2009 – Kauaʻi/Niʻihau
Ilei Beniamina, Aha Kiole for Niʻihau
Keith Robinson, Landowner of Niʻihau
Hokulani Cleeland, Teacher at Kekaha Charter School
Sharon Pomroy, Aha Kiole of Kauaʻi, Former DHHL
Uncle Tommy, Limahuli Preserve Volunteer

November 4, 2009
Associations of Hawaiian Civic Clubs

November 6, 2009
Komike Hoʻoupaʻa Native Rights Committee

February 1, 2010 – Oʻahu
Shad Kane, Cultural Practitioner, Kapolei Hawaiian Civic Club, Oʻahu Island Burial Council

February 8, 2010 – Molokaʻi
Walter Ritte, Cultural Practitioner
Emmett Aluli, Kahoʻolawe Island Reserve Commission Chair

In addition, the following people were contacted by Kuʻiwalu:
Lloyd Case
Hugh "Buttons" Lovell
Leslie Kuloloio
Tim Bailey
Pat Bily
Charlie Maxwell
Lori Buchanan
Mervin Dudoit
Vanda Hanakahi
Kanoho Helm
Irene Kaahanui
Joyce Kaopuiki
Ron Kimball
Wade Lee
Walter Naki
Lane Namakaeha
Kelson "Mac" Poepoe
Annelle Amaral
Mona Kapaku
Charlie Kapua
Curt Cottrell

Jennifer Goto Sabas
Neil Hannahs
Davianna McGregor
Randy Wickman

The Association of Hawaii Civic Clubs (AHCC), Maui County Cultural Resources Commission, and the Office of Hawaiian Affairs passed resolutions in support of the collaborative federal, state, and non-profic effort for the appropriate use of approved rodenticides, primarily diphacinone, for protecting and preserving native Hawaiian plants and animals subject to an approved environmental impact statement.

An informational brochure, titled "Kahea - Call to Action," was published by the Conservation Council for Hawai‘i and distributed to the organization's membership. It can be downloaded at http://removeratsrestorehawaii.org/more-information/.

QMark Research carried out a survey from June 22 to July 9, 2009 to obtain the public's perceptions concerning the protection of endangered species and controlling rats. A total of 1,037 Hawai‘i adult residents were surveyed via telephone. The survey helped identify areas of misinformation and lack of information about rodents, public perception of the methods of eradication, priority concerns related to conservation efforts and effective forms of communication.

WRITTEN COMMENTS RECEIVED FROM EARLY CONSULTATION

No written comments have been solicited or received by DLNR during early consultation.

PROVIDING COMMENTS

We are seeking comments, information and suggestions from the public, interested government agencies, Native Hawaiian organizations, the scientific community, and other interested parties regarding the objectives, proposed action, and alternatives that we have identified and described above. When submitting comments or suggestions, explaining your reasoning will help us evaluate your comment or suggestion. We are particularly interested in information related to the following questions:

(1) What do you think about protecting native species and ecosystems from introduced rodents and mongooses?

(2) Under what circumstances do you think they should be controlled and eradicated?

(3) Are there additional criteria for evaluating methods for rodent and mongoose control and eradication that we have not considered?

(4) Should the criteria for evaluating methods for rodent and mongoose control and eradication be modified in any way?

(5) How would you balance these criteria when evaluating the methods?

(6) What recommendations or suggestions would you make regarding the methods that are proposed for evaluation?

(7) Are there any other methods for rodent and mongoose control that should be included? If so, please describe them in sufficient detail so that they can be evaluated.

(8) Should any of the identified alternatives be modified?

(9) Are there any other alternatives that should be considered? If so, please describe them in sufficient detail so that they can be evaluated.

(10) Are there issues not included in the list above that should be addressed?

(11) The process of determining the significance of impacts to resources is unique to each resource, and is based upon the context and intensity of the impacts. The context refers to the setting of where the proposed action may occur, the affected areas or locations, the resource affected, and the proposed action's short and long-term effects. The intensity refers to the severity of the impact. The evaluation of significance will rely upon information received during scoping, and may be modified as information is revealed through the analyses. Are there resources for which you can identify criteria that should be used to begin to determine the significance of the impacts to these resources? Please include your thoughts on the context and intensity of the effects.

You may request to be added to the Service and DOFAW contact list for distribution of any related public documents. Information on the Draft PEIS is also available on the web at http://www.removeratsrestorehawaii. Special mailings, newspaper articles, and other media announcements will inform interested and affected persons, agencies, and organizations of the opportunities for meaningful involvement and engagement throughout the planning process for the proposed IPM approach, including notices of public scoping meetings and notices of availability of the Draft and Final PEIS. This notice will be provided to Federal, State, and local agencies, and Native Hawaiian and other potentially interested organizations, groups, and individuals for review and comment.

CHAPTER 6. LITERATURE CITED

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CHAPTER 8. APPENDIX

The following pages contain labels for the rodenticides discussed in this document.

RESTRICTED USE PESTICIDE

DUE TO HAZARD TO NON-TARGET SPECIES

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

For use by government conservation agencies and their authorized representatives only.

ACCEPTED

December 17, 2013

Under Hawaii Pesticides Law as Supplement to Product No. 9084.9

Ramik® Mini Bars
All-Weather Rat & Mouse Killer

EPA REG. NO. 61282-26
SLN No. HI-980005

ACTIVE INGREDIENT:	
Diphacinone (2-Diphenylacetyl-1, 3-Indandione)	0.005%
OTHER INGREDIENTS:	99.995%
TOTAL:	100.000%

SPECIAL LOCAL NEED SUPPLEMENTAL LABEL

For Distribution and Use Only in the State of Hawaii

For Control of Rodents and Mongoose

For use only in forests, wetlands, coastal areas, offshore islands, and other non-crop areas to protect native Hawaiian plants and animals

FOR CONSERVATION PURPOSES ONLY

This label is valid until December 16th, 2018, or until otherwise amended, withdrawn, cancelled, or suspended.

KEEP OUT OF REACH OF CHILDREN

CAUTION

ENVIRONMENTAL HAZARDS

This product is extremely toxic to mammals, birds and other wildlife. Dogs, cats and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten this bait. Do not apply directly to water or to intertidal areas below the mean high water mark. Do not allow bait to be exposed on soil surface. Do not contaminate water when disposing of equipment wash water.

See Federal label (EPA Reg. No. 61282-26) for complete precautionary statements.

If signs of poisoning or potential exposure to animals other than the target species on this label, and/or damaged or vandalized bait stations are discovered, bait must be removed from all bait stations or all of the bait stations removed. Report these adverse events to the Pesticides Branch of the Hawaii Department of Agriculture (HDOA) within 24 hours [Phone: (808) 973-9401]. Bait stations cannot be rebaited or placed back into the area without permission from HDOA and USFWS.

ALL users shall submit a written description of the proposed baiting program to the U.S. Fish and Wildlife Service, Pacific Islands Fish & Wildlife Office. Descriptions must be submitted **at least** six weeks prior to the proposed initiation of treatment. In addition to details of how the proposed use will comply with the label, the submittal should include a map of the locations of each bait station and the resource(s) to be protected, and a plan to monitor impacts on target species and resource response. Baiting cannot be initiated until the proposed use has been approved by the U.S. Fish and Wildlife Service. Submit to: U.S. Fish & Wildlife Service, Pacific Islands Fish & Wildlife Office, Rm. 3-122, 300 Ala Moana Blvd., Honolulu, HI 96850. Telephone: (808) 792-9459, Fax: (808) 792-9581. Proposals may be submitted via email to BaitStationReview@fws.gov.

STORAGE AND DISPOSAL

See Federal Label (EPA Reg. No. 61282-26) for "**STORAGE AND DISPOSAL**" text.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Persons using this product shall comply with all applicable directions, restrictions, and precautions found on this labeling and that of the label of the federally registered product (EPA Reg. No. 61282-26) upon which this use is based. This label must be in the possession of the user at the time of pesticide application.

READ THIS LABEL: Read this entire label and follow all use directions and precautions. To be used only for the sites, pests, and application methods described on this SLN label.

IMPORTANT: For use in tamper resistant bait stations only. Do not expose children, pets, or other non-target animals to rodenticides. To help prevent accidents:

1. When not in use, store this product in a location out of reach of children and pets.
2. **Apply bait in tamper-resistant bait stations only.** These stations must be resistant to destruction by dogs and children under six years of age, and must be used in a manner that prevents children from reaching into bait compartments and obtaining bait. Bait must be placed on rods within the bait stations so that it cannot be removed from the stations. In areas prone to vandalism or where feral pigs are present, bait stations must be anchored to the ground or in trees to prevent access to the bait.
3. Dispose of product container, unused, spoiled and unconsumed bait, and damaged bait stations, as specified on the Federal label (EPA Reg. No. 61282-26).

USE RESTRICTIONS: For the control only of Indian Mongoose (*Herpestes auropunctatus*), roof (black) rats (*Rattus rattus*), Norway rats (*R. norvegicus*), Polynesian rats (*R. exulans*), house mice (*Mus spp.*), and other invasive rodents in native ecosystems, such as forests, wetlands, coastal areas, and offshore islands, and other non-crop areas, to protect native Hawaiian plants and animals.

Do not apply bait in a manner in which it may contaminate water sources. Do not apply bait in flood prone areas if flooding is expected to occur during the treatment period.

APPLICATION DIRECTIONS: Bait stations must be placed in one of the following configurations: a square or rectangular grid, a grid based on triangular equidistant points, or a circular web configuration. New placements must be stocked with 16 ounces of bait (16 blocks) until bait remains in the stations for several subsequent checks. Bait stations must be checked frequently enough to maintain an uninterrupted supply of fresh bait. Under most conditions, stations must be checked at no greater interval than every 14 days. New placements may need to be checked as often as every other day, until bait take declines. New placements also need to be checked more frequently to ensure there are no problems with nontarget exposure or vandalism. During periods when an independent monitoring method (such as tracking tunnels or chew cards) indicates that target species activity is increasing, the frequency of checking stations may need to be increased. Bait stations must contain no fewer than 8 blocks of fresh bait. Replace contaminated or spoiled bait. Do not use bait stations for mouse or rat control during a mouse population irruption.

FOR RATS and MONGOOSE: A buffer of bait stations must extend a minimum of 225 meters (740 feet) in all directions for rats and 550 m (1800 feet) for mongoose beyond the boundary of the resource to be protected. The presence of a coastline or pest-proof fence bordering the resource on one or more sides would permit the truncation of the prescribed buffer in the direction of the water or fence. Intervals between stations within the grid must be 25 to 50 meters (75 to 150 feet), with allowances where localized on-the-ground conditions preclude adherence to this distance.
FOR MICE: A buffer of bait stations must extend a minimum of 100 meters (328 feet) in all directions beyond the boundary of the resource to be protected. The presence of a coastline or pest-proof fence bordering the resource on one or more sides would permit the truncation of the prescribed 100 meter buffer in the direction of the water or fence. Intervals between stations within the grid must be 4 to 25 meters (13 to 82 feet), with allowances where localized on-the-ground conditions preclude adherence to this distance.

Check area for dead animals and spilled bait each time stations are visited. Using waterproof gloves, collect and dispose of any dead animals and spilled bait. Spoiled or uneaten bait and dead animals must be removed from the site and disposed of in a secured, covered trash receptacle or taken to an approved waste disposal facility.

Bait stations must display the name and phone number of the certified applicator. Treated areas shall be posted with warning signs stating, "*This area has bait stations containing diphacinone poison to control rodents and/or mongooses. If you have any questions, please call* (Complete the sign with the name and phone number of the certified applicator and their affiliation). "

24(c) Registrant:
HACCO, Inc.
110 Hopkins Drive
Randolph, WI 53956

Issue Date:	December 17, 2013
Expiration Date:	December 16, 2018
EPA SLN:	HI-980005

Appendix 2

ENVIRONMENTAL HAZARDS

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

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 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 on site or at an approved waste disposal facility.

PLASTIC CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after use. Offer for recycling, if available. Otherwise, puncture and dispose of in a sanitary landfill, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

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

IMPORTANT: Do not expose children or pets to this product. Take all appropriate steps to limit exposure to and impacts on nontarget species, especially those for which special conservation efforts are planned or ongoing. To help to prevent accidents:

1. Store product not in use in a location out of reach of children and pets.
2. Apply bait only as specified on this label and in strict accordance with the **"USE RESTRICTIONS"** and **"APPLICATION DIRECTIONS."** For applications involving bait stations, the bait stations must be tamper-resistant. The bait stations must deny access to bait compartments by children, pets, and other non-target species larger in body size than the type(s) of rats or mice being targeted by the bait program. Lock and secure bait stations, as necessary, to exclude such nontarget species. In locations where captive or feral livestock occur, either remove and exclude such animals from the application site prior to treatment or make sure that the bait stations used are capable of denying them access to bait compartments, and
3. Dispose of product container, and unused, spoiled and unconsumed bait as specified on this label.

USE RESTRICTIONS: This product may be used only 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 for conservation purposes on islands, grounded vessels or vessels in peril of grounding. This product may be applied only using bait stations, burrow baiting, canopy baiting or 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 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, 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.

Diphacinone-50: Pelleted Rodenticide Bait for Conservation Purposes

Fish Flavored, Weather-resistant Rodenticide for Control or Eradication of Invasive Rodents on Islands or Vessels for Conservation Purposes

ACTIVE INGREDIENT:	
Diphacinone: (2-Diphenylacetyl-1,3-Indandione)	0.005%
INERT INGREDIENTS:	99.995%
TOTAL	100.000%

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS

HAZARD TO HUMANS AND DOMESTIC ANIMALS

Caution: 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 a detergent and hot water, wash all implements used for applying bait. Do not use these implements for mixing, holding or transferring food or feed.

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	• Call a poison control center, doctor, or 1-800-222-1222 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 the poison control center or doctor.
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, doctor, or 1-800-222-1222 immediately for treatment advice.

- **Note to Physician:** If ingested, administer Vitamin K_1, intramuscularly or orally as indicated in bishydroxycoumarin overdose. Repeat as necessary based on monitoring of prothrombin times.

For a medical emergency involving this product, call 1-800-222-1222.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
4700 River Road, Unit 149
Riverdale, MD 20737-1237

EPA Reg. No 56228-35
EPA Est. No. (61282-WI-1) or (056228-GU-1)

Net Contents: _____

Batch Code No.: _____

Department of Agriculture
STATE OF HAWAII
LICENSED
PERIOD 2014-2016 LIC. NO. 8600.1

Department of Agriculture
STATE OF HAWAII
LICENSED
PERIOD 2011-2013 LIC. NO.

DIRECTIONS FOR USE

(continued from left panel)

APPLICATION DIRECTIONS:

Bait Stations: Tamper-resistant bait stations must be used when applying this product on grounded vessels or vessels in peril of grounding or when used in areas of human habitation. See Item 2) under **"IMPORTANT."** regarding the performance characteristics needed for 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 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 2 to 4 meters. Placements should be made in a grid over the area for which rodent control is desired. Larger placements (up to 2 ounces) may be needed at points of very high mouse activity. 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.

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 to seed-eating birds and other 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 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 g to 200 g) 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 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.

Aerial and Ground Broadcast: Broadcast applications are prohibited on vessels or in areas of human habitation. Broadcast bait pellets by helicopter or manually at a rate of 10 to 12.5 lbs. of bait per acre (11.1 to 13.8 kg/ha) per treatment. Make a second broadcast application typically 5 to 7 days after the first application, depending upon local weather conditions, at a rate no higher than 12.5 lbs. (13.8 g/ha) of bait per acre. In situations where weather or logistics only allow one bait application, a single application may be made at a rate no higher than 20.0 lbs. bait per acre (22.5 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 met:

- 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.

If rat activity persists after broadcast application, 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 station or burrow baiting, continue with broadcast baiting, limiting such treatments to areas where active signs of rats 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. Dead animals and spilled bait may be buried on site if the depth of burial makes excavation by nontarget animals extremely unlikely.

USDA APHIS revised 11/23/2009

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.

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.: _____

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-25W CONSERVATION

PELLETED RODENTICIDE BAIT FOR CONSERVATION PURPOSES

For control or eradication of invasive rodents in wet 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.
If on skin or clothing	-Do not give anything by mouth to an unconscious person. -Take off contaminated clothing. -Rinse skin immediately with plenty of water for 15-20 minutes.
If inhaled	-Call a poison control center or doctor for treatment advice. -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.
If in eyes	-Call a poison control center or doctor for further treatment advice. -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 wet 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.

EPA Reg. No. 56228-36
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. 56228-36

Net Weight _____

Batch Code No.: _____

061282-00045.20120823

RESTRICTED USE PESTICIDE

DUE TO HAZARD TO NON-TARGET SPECIES

For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

Ramik® Brown

Weather-Resistant Rodenticide

For use in and around structures and in terrestrial non-food/non-feed areas to control commensal rats and mice in Fruit Tree and Nut (Pecans, Almonds, Walnuts, Filberts/Hazelnuts) orchards, Christmas Tree Farms, Tree Plantations, and Commercial Nurseries to control voles.

ACTIVE INGREDIENT:	
Diphacinone (2-Diphenylacetyl-1,3-Indandione)	0.005%
OTHER INGREDIENTS:	99.995%
TOTAL:	100.000%

EPA Reg. No. 61282-45

EPA Est. No. 61282-WI-01

ACCEPTED AUG 27 2012

KEEP OUT OF REACH OF CHILDREN

CAUTION

Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under:

EPA Reg. No: 61282-45

Net Contents:

~~20 lbs. (bulk product)~~
40 lbs. (bulk product)
50 lbs. (bulk product)
60 lbs. (bulk product)

Manufactured By:
HACCO, Inc.
110 Hopkins Drive
Randolph, WI 53956

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed or absorbed through the skin. Causes moderate eye irritation. Avoid contact with eyes, skin, or clothing. Keep away from children, domestic animals and pets.

Personal Protective Equipment (PPE):
All handlers (including applicators) must wear long-sleeved shirt, long pants, shoes, socks and water-proof gloves. Any person who retrieves carcasses or unused bait following application of this product must wear waterproof gloves.

User Safety Requirements
Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash hands thoroughly after applying the bait and before eating, drinking, chewing gum, using tobacco or using the toilet and change into clean clothing.

FIRST AID HAVE LABEL WHEN OBTAINING TREATMENT ADVICE	
If Swallowed	• Call a poison control center, or doctor, or **1-800-498-5743** 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 the poison control center or doctor.
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, or **1-800-498-5743** immediately for 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, or **1-800-498-5743** immediately for treatment advice.
NOTE TO PHYSICIAN If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. If ingested, administer Vitamin K_1, intramuscularly or orally. Repeat as necessary based on monitoring of prothrombin times.	
TREATMENT FOR PET POISONING If animal eats bait, call veterinarian or **1-800-498-5743** at once. **NOTE TO VETERINARIAN** **Anticoagulant Diphacinone:** For animals ingesting bait and/or showing poisoning signs (bleeding or elevated prothrombin times), give Vitamin K_1.	
For 24-hour emergency information on this product, call 1-800-498-5743 (US & Canada) or 1-651-523-0318 (all other areas).	

ENVIRONMENTAL HAZARDS

This product is extremely toxic to mammals, birds and other wildlife. Dogs, cats and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten this bait. Do not apply directly to water or to intertidal areas below the mean high water mark. Do not allow bait to be exposed on soil surface. Do not contaminate water when disposing of equipment wash water or rinsate.

ENDANGERED SPECIES CONSIDERATION

Notice: The use of this product may pose a hazard to Federally designated endangered/ threatened species. It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species. Consult the nearest U.S. Fish and Wildlife Service regional office or the appropriate State Agency for current information on habitats occupied by endangered species.

Whooping Crane (*Grus americana*)

Do not use this product in habitats occupied or occasionally visited by whooping cranes during the period from 30 days before the expected arrival of cranes to 30 days after the time of their usual departure.

Black-footed Ferret (*Mustela nigripes*)

Do not use this product within 7 kilometers (4.34 miles) of any prairie dog town to limit risks to the black-footed ferret from exposure to Zinc Phosphide or destruction of its prey base, unless the colony is an isolated black-tailed prairie dog town less than 80 acres in size or an isolated white-tailed prairie dog town less than 200 acres in size, or unless the town had been appropriately surveyed, using methods acceptable to the U.S. Fish and Wildlife Service, and found by the FWS not to be suitable site for ferret reintroductions.

Gray Wolf (*Canis lupus*) and Grizzly Bear (*Ursus actos horribilus*)

Unless the local U.S. Fish and Wildlife Service office has determined that there are no gray wolves or grizzly bears in the general vicinity of bait applications in Montana and Wyoming, do not apply this product outdoors within occupied habitat of these species.

Attwater's Greater Prairie Chicken (*Tympanuchus cupido attwateri*)

Do not use this product in the present occupied range of the Attwater's Greater Prairie Chicken in the following counties: Aransas, Austin, Brazoria, Colorado, DeWitt, Ft. Bend, Galveston, Goliad, Hams, Refugio, Victoria, Waller, and Wharton (Texas).

Yellow-Shouldered Blackbird (*Agelaius xanthomaus*) and Puerto Rican Plain Pigeon (*Columba inornata wetmorei*)

This product must not be used in the following areas in Puerto Rico except in tamper-proof bait boxes:
(1) within 6.3 miles (10 kilometers) of Central Aquirre, Lago Cidra, Ceiba, San German
(2) within 9.4 miles (15 kilometers) of La Esperanza, south of Highway 2 from city of Mayaguez to the city of Ponce and all Mona Island

Utah Prairie Dog (*Cynomy parvidens*)

Do not use this product in critical habitat of the Utah Prairie Dog (Utah).

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*)

Do not use this product in critical habitat within 0.5 miles of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to confluence of the Sacramento River and the San Joaquin River (California)

Morro Bay Kangaroo Rat (*Dipodomys heermanni morroensis*)

Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay (California)

Giant Kangaroo Rat (Dipodomys ingrens)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: Fresno, Kern, Kings, Merced, Monterey, San Benito, San Luis Obispo, Santa Barbara and Tulare (California)

Tipton Kangaroo Rat (*Dipodomys nitratoides nitratoides*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: Kern, Kings and Tulare (California)

Fresno Kangaroo Rat (*Dipodomys nitratoides exilis*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: Kern, Kings, Madera and Merced (California)

Stephan's Kangaroo Rat (*Dipodomys stephens*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: San Bernardino, San Diego and Riverside (California)

San Bernardino Kangaroo Rat (*Dipodomys merriami parvus*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: San Bernardino and Riverside (California)

Northern Idaho Ground Squirrel (*Spermophilus brunneus brunneus*)

Do not use this product within 0.5 miles in critical habitat of the Northern Idaho Ground Squirrel in Adams and Valley counties, Idaho.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
READ THIS LABEL: Read this entire label and follow all use directions and use precautions.
Use only for the sites, pests, and application methods described on this label.
IMPORTANT: Do not expose children, pets or other non-target animals to rodenticides. To help to prevent accidents:

Note: Bait stations are mandatory for outdoor-above-ground use.
Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait.

STRUCTURES AND TERRESTRIAL, NONFOOD/ NONFEED AREAS FOR NORWAY RAT, ROOF RAT AND HOUSE MOUSE CONTROL

IMPORTANT: Do not expose children, pets or other non-target animals to rodenticides. To help to prevent accidents:

1. Store product not in use in a location out of reach of children and pets.
2. Apply bait in locations out of reach of children, pets, domestic animals and non-target wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and by children under six years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining bait. If bait can be shaken from stations when they are lifted, units must be secured or otherwise immobilized. Even stronger stations are needed in areas open to hoofed livestock, raccoons, bears or other potentially destructive animals, or in areas prone to vandalism.
3. Dispose of product container, and unused, spoiled and unconsumed bait as specified on this label.

Note: Bait stations are mandatory for outdoor-above-ground use. Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait.

USE RESTRICTIONS:

IN AND AROUND BUILDINGS AND STRUCTURES

This product may only be used to control Norway rats, roof rats, and house mice in and within 100 feet of man-made structures constructed in a manner so as to be vulnerable to commensal rodent invasions and/or to harboring or attracting rodent infestations. Examples of such structures include homes and other permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port of terminal buildings and related structures around and associated with these sites. Fence and perimeter baiting, beyond 100 feet from a structure as defined above, is prohibited. This product must not be applied directly to food or feed crops. Do not broadcast bait

Inside Burrows:
This product may also be applied to active rodent burrows to control Norway rats and roof rats *within or beyond* 100 feet of buildings and man-made structures, provided that infestations of these rodents have been confirmed. Because Norway/roof rat infestations may occur in areas farther than 100 feet from buildings and man-made structures when the rodents have ample supplies of food and cover, efforts should be made to remove food trash, garbage, clutter, and debris. Bait must be placed not less than 6 inches into active Norway/roof rat burrows. Do not broadcast bait.

TERRESTRIAL, NONFOOD/NONFEED AREAS:
This product may also be used in the following areas: river banks, irrigation ditches, gullies, railroad tracks, fences, and sanitary landfills. All placements must be in tamper-resistant bait stations or deeply into rat burrows.
Note: This weather-resistant bait may be placed at the above sites, even if wet or damp. Do not place bait in areas where there is a possibility of contaminating food/feed or surfaces that come in direct contact with food/feed. Do not broadcast bait.

SELECTION OF TREATMENT AREAS:
Determine areas where rats and/or mice will most likely find and consume the bait. Generally, these areas are along walls, by gnawed openings, in or beside burrows, in corners and concealed places, between floors and walls, or in locations where rodents or their signs have been observed. Protect bait from rain or snow. Remove as much alternative food as possible.

APPLICATION DIRECTIONS: Wear waterproof gloves.
Norway and Roof Rats
Place 4 to 16 oz. of bait per placement. Place bait at 15- to 30-foot intervals. Maintain an uninterrupted supply of fresh bait for at least 10 days or until signs of rat activity cease.

House Mice:
Apply ¼ to ½ oz. (1-2 level tablespoons) of bait at 8- to 12-foot intervals. Larger placements (up to 2 oz.) may be needed at points of very high mouse activity. Maintain an uninterrupted supply of fresh bait for at least 15 days or until signs of mouse activity cease.

Follow-up
Replace contaminated or spoiled bait immediately. Wearing waterproof gloves, collect and dispose of all dead rodents and leftover bait properly. To prevent reinfestation, limit sources of rodent food, water, and harborage as much as possible. Where a continuous source of infestation is present, maintain permanent bait stations and replenish with census or toxic bait as needed.

FRUIT TREE ORCHARDS (BEARING AND NON-BEARING) FOR PINE AND MEADOW VOLE CONTROL

USE RESTRICTIONS: For control of pine and meadow voles in pome fruit (apples, pears) and stone fruit (peaches, nectarines) tree orchards in these states. Aerial application is only permitted in those following states where aerial is listed next to the state name.

Connecticut	Michigan/aerial
Georgia	Missouri
Idaho/aerial	Montana/aerial
Massachusetts	North Carolina
New Hampshire	South Carolina
Ohio/aerial	Utah/aerial
Oregon/aerial	Virginia/aerial
Pennsylvania/aerial	Vermont/aerial
Washington/aerial	West Virginia/aerial

Timing: Apply after fall harvest (including drops), before new spring growth, and during which three days of rain-free and snow-free weather are expected.

Grazing: Do not graze animals in treated areas.

Hay: Do not use hay cut after application for feed or bedding.

Bare Ground and Unspecified Sites: Do not apply over bare ground or crops unspecified above.

Application Type: Apply only by hand spot baiting and ground broadcasting and aerial broadcast (for those states indicated).

PRE-APPLICATION DIRECTIONS:
Prior to application, examine orchard floor to locate trails and runways systems to be treated.

APPLICATION DIRECTIONS:
Hand Spot Baiting: Place about 1-1/2 oz. of bait in each active hole, trail, or runway at each tree site (10 lbs/acre). Cover each placement with grass or shingle to avoid exposing nontarget organisms.
Ground & Aerial Broadcasting: For aerial application only in those states specified above. For ground application use a commercially-made seed or fertilizer spreader. Uniformly apply 20 lb of bait per acre for Pine Voles and 10 lb of bait per acre for Meadow Voles. To avoid exposing nontarget organisms, clean up any bait in piles and return bait to application equipment or dispose of as specified under "Pesticide Disposal."

POST-APPLICATION INSTRUCTIONS:
If populations are high, make a second application 1-2 months after the first application.

NUT ORCHARDS (PECANS, ALMONDS, WALNUTS, FILBERTS/HAZELNUTS) FOR PINE AND MEADOW VOLE CONTROL

USE RESTRICTIONS: For control of pine and meadow voles in Nut Orchards in the following states:

Idaho	Ohio	Montana
Oregon	Washington	

Timing: Apply after fall harvest (including drops), before new spring growth, and when three, rain-free days are expected. For other USE RESTRICTIONS, PRE-APPLICATION, APPLICATION, AND POST-APPLICATION DIRECTIONS, see use directions for pine and meadow voles in fruit orchards above.

CHRISTMAS TREE FARMS, COMMERCIAL NURSERIES, AND TREE PLANTATIONS FOR PINE AND MEADOW VOLE CONTROL

USE RESTRICTIONS: For control of pine and meadow voles in Christmas Tree Farms, Commercial Nurseries, and Tree Plantations in the following states:

Georgia	Michigan	Missouri
North Carolina	South Carolina	Washington

Timing: Apply when three, rain-free days are expected. For other USE RESTRICTIONS, PRE-APPLICATION, APPLICATION, AND POST-APPLICATION DIRECTIONS, see use directions for pine and meadow voles in fruit orchards above.

STORAGE AND DISPOSAL

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

Pesticide Storage: Store in original container in a cool, dry place inaccessible to children and pets. Keep containers closed and away from other chemicals.

Pesticide Disposal: Dispose of wastes resulting from the use of this product in trash or at an approved waste disposal facility.

Container Handling: Nonrefillable container. Do not reuse or refill this container.

Plastic Containers: Triple rinse (or equivalent) then offer for recycling or reconditioning; or puncture and dispose of in a sanitary landfill; or incineration.

Paper Containers: Dispose of empty container by placing in trash, at an approved waste disposal facility or by incineration.

Fiber Box with Plastic Bag Liner: Complete empty bag into application equipment by shaking and tapping sides and bottom of bag. Then dispose of empty bag in a sanitary landfill or by incineration. If box is contaminated and cannot be reused, dispose of in the same manner.

Fiber Drum with Liner: Complete empty liner into application equipment by shaking and tapping sides and bottom of liner. Then dispose of empty bag in a sanitary landfill or by incineration. If fiber drum is contaminated, puncture and dispose of in the same manner.

DISCLAIMER: To the extent permitted by applicable law, seller makes no representation or warranty, either express or implied, for results due to misuse, improper handling or improper storage of this material. Nor does Seller assume any responsibility for injury to persons, crops, animals, soil or property arising out of misuse, improper handling or improper storage of this material.

OR

LIMITED WARRANTY

To the extent permitted by applicable law, Neogen Corporation makes no warranty concerning uses which extend beyond the use of the product under normal conditions in accord with the statements made on this label. To the extent permitted by applicable law, Neogen Corporation shall not be liable for (1) any consequential, incidental or special damages related in any way to this product or its uses, or (2) any damages related in any way to resistance to pesticides.

OR

CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

NOTICE: Read the entire Directions for Use and Conditions of Sale and Limitation of Warranty and Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

To the extent permitted by applicable law Manufacturer and Seller warrant that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, subject to the inherent risks referred to above, when used in accordance with directions under normal use conditions. To the extent permitted by applicable law this warranty does not extend to the use of this product contrary to label instructions, or under abnormal conditions or under conditions not reasonably foreseeable to or beyond the control of Seller or Manufacturer, and Buyer and User assume the risk of any such use. To the extent permitted by applicable law, MANUFACTURER AND SELLER MAKE NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.
To the extent permitted by applicable law, in no event shall Manufacturer or Seller be liable for any incidental, consequential or special damages resulting from the use or handling of this product. TO THE EXTENT PERMITTED BY APPLICABLE LAW THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE EXCLUSIVE LIABILITY OF MANUFACTURER AND SELLER FOR ANY AND ALL CLAIMS, LOSSES, INJURIES OR DAMAGES (INCLUDING CLAIMS BASED ON BREACH OF WARRANTY, CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, SHALL BE THE RETURN OF THE PURCHASE PRICE OF THE PRODUCT OR, AT THE ELECTION OF THE MANUFACTURER OR SELLER, THE REPLACEMENT OF THE PRODUCT.

Manufacturer and Seller offer this product, and Buyer and User accept it, subject to the foregoing Conditions of Sale and Limitations of Warranty and Liability, which may not be modified except by written agreement signed by a duly authorized representative of Manufacturer.

For non-emergency (e.g., current product information),
Call: **1-800-621-8829**

Code (NI.RE.) NI.RE.

Ramik® is a Registered Trademark of HACCO, Inc.

Alternate Brand Names: Ramik® Brown kills rats and mice

Optional Marketing Statements: Made in the U.S.A.
<American Flag Graphic>

KEEP OUT OF REACH OF CHILDREN
PRECAUTIONARY STATEMENTS

Hazard to Humans and Domestic Animals

CAUTION: Harmful if swallowed, absorbed through the skin, or if inhaled. Avoid contact with eyes, skin or clothing. Avoid breathing dust. Keep away from children, domestic animals and pets. All handlers (including applicators) must wear long-sleeved shirt, long pants, shoes, socks, and waterproof gloves. Any person who retrieves carcasses or unused bait following application of this product must wear waterproof gloves.

USER SAFETY REQUIREMENTS: Follow manufacturer's instructions for cleaning/maintaining washables. If no such instructions for washables, use detergent and hot water. Remove clothing immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash hands thoroughly after applying bait and before eating, drinking, chewing gum, using tobacco or using the toilet and change into clean clothing.

FIRST AID

Have this label with you when obtaining treatment advice.

If swallowed: Call a poison control center or doctor 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 the poison control center or doctor.

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.

If on skin or clothing: Take off contaminated clothing. Rinse skin with plenty of cool water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

TREATMENT FOR PET POISONING:

If animal eats bait, call veterinarian at once.

NOTE TO PHYSICIAN OR VETERINARIAN:

Contains chlorophacinone, an anticoagulant. For humans or dogs that have ingested this product, or have obvious poisoning symptoms (bleeding) or prolonged prothrombin times, give Vitamin K_1 by intramuscular or oral administration. Check prothrombin time every 3 days until values return to normal.

ENVIRONMENTAL HAZARDS: This product is extremely toxic to fish and wildlife. Dogs and predatory and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten the bait. Do not apply where raptors are actively feeding on voles. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATIONS

NOTICE: It is a Federal offense to use any pesticide in a manner that results in the death of an endangered species. Use of this product may pose a hazard to endangered or threatened species. Before applying this product, applicators must obtain information regarding the occurrence of endangered species and use limitations for this product. You may call EPA's "Endangered Species Hotline" at 1-800-447-3813 to obtain an "Interim Measures" pamphlet for your county. You may also consult your local agricultural extension office or state pesticide lead agency to determine if there are any requirements for use of this product.

STORAGE AND DISPOSAL

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

Pesticide Storage: Store in original container in a cool, dry place inaccessible to children and pets.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Handling: This is a nonrefillable container. Do not reuse or refill this container. Completely empty container, then dispose of empty container in trash or at an approved waste disposal facility.

WARRANTY: To the extent consistent with applicable law, seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

EPA Reg. No. 7173-242
EPA Est. No. 7173-WI-1

RESTRICTED USE PESTICIDE
DUE TO HAZARD TO NONTARGET ORGANISMS

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's Certificate.

rozol®

VOLE BAIT

FOR CONTROL OF VOLES (*Microtus spp.*)
IN ORCHARDS, NONCROP AREAS, NURSERIES
AND TREE & FORESTRY PLANTATIONS

Active Ingredient: chlorophacinone	0.005%
inert Ingredients	99.995%
Total	100.000%

KEEP OUT OF REACH OF CHILDREN
CAUTION:

See side panel for additional precautionary statements.

LIPHATECH®

Liphatech, Inc.
3600 W. Elm Street
Milwaukee, WI 53209
(800) 351-1476

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL and follow all use directions and precautions. Only use for sites, pests, and application methods specified on this label.

VOLE CONTROL IN FRUIT TREE ORCHARDS (BEARING AND NONBEARING):

USE RESTRICTIONS: For control only of voles in pome fruit (apple, pear) and stone fruit (peach, cherry, apricot, plum, prune, and nectarine) tree orchards. Apply after fall harvest (including drops), before new spring growth, and during which three consecutive days of rain-free and snow-free weather are expected. Do not apply within 50 feet of any body of surface water or where raptors are actively feeding on voles. Do not apply over bare ground or crops not specified above. Do not allow animals to graze in treated areas. Do not use hay cut after application for feed or bedding. To avoid exposing nontarget organisms, follow the instructions in the "Pesticide disposal" section to ensure proper clean up of any bait for reuse or disposal. Apply only by **hand spot baiting** and **ground broadcasting.** Do not apply aerially. In Colorado, Florida, New York and Vermont, only apply by **"Hand Spot Baiting."**

APPLICATION DIRECTIONS: Before application, examine orchard floor to locate trails and runway systems to be treated. **Hand spot baiting:** Place 1-1/2 ounces of bait, (6 tablespoons,) in each active hole, trail or runway, (do not exceed 10 lbs per acre). Cover each placement with grass or shingle to avoid exposing nontarget organisms, or place bait in a tamper resistant bait station.

Ground broadcast baiting: Using a commercial spreader, uniformly apply 10 lbs per acre. If populations are high, make a second application 1 - 2 months after the first.

In states east of the Mississippi River, infestations of pine vole (*Microtus pinetorum*) may require higher application rates of 20 lbs per acre. The maximum application rate is 40 lbs per acre per year for Pine voles, and 20 lbs per acre per year for other voles.

VOLE CONTROL IN NURSERIES, TREE AND FORESTRY PLANTATIONS, CHRISTMAS TREE FARMS, AND BORDER AREAS/BUFFER STRIPS ADJACENT TO CROPS:

USE RESTRICTIONS: For control of only voles in commercial nurseries, tree and forestry plantations, Christmas tree farms, and border areas and buffer strips adjacent to crops (within 100 feet of the edge of the cropland). This product must not be applied directly to food or feed crops except as specified above. Do not apply within 50 feet of any body of surface water or where raptors are actively feeding on voles. Do not allow animals to graze in treated areas. Do not use hay cut after application for feed or bedding. To avoid exposing nontarget organisms, follow the instructions in the "Pesticide disposal" section to insure proper clean up of any bait for reuse or disposal. Apply only by **hand spot baiting** and **ground broadcasting.** Do not apply aerially. In Colorado, Florida, New York and Vermont, only apply by **"Hand Spot Baiting."** In Florida, only use this product where Pine voles are known to occur and only apply by **"Hand Spot Baiting."**

APPLICATION DIRECTIONS: Before application, locate vole trails, runway systems and harborage areas to be treated. **Hand spot baiting:** Place 1-1/2 ounces (6 tablespoons) of bait in each active hole, trail or runway (do not exceed 10 lbs per acre). Cover each placement with grass or shingle to avoid exposing nontarget organisms, or place bait in a tamper resistant bait station.

Ground broadcast baiting: Using a commercial spreader, uniformly apply 10 lbs per acre. If populations are high, make a second application 1 - 2 months after the first. In states east of the Mississippi River, infestations of pine vole (*Microtus pinetorum*) may require higher application rates of 20 lbs per acre. The maximum application rate is 40 lbs per acre per year for Pine voles, and 20 lbs per acre per year for other voles.

VOLE CONTROL IN LAWNS, GOLF COURSES, PARKS, OTHER ORNAMENTAL TURF AREAS, ORNAMENTAL FLOWER AND SHRUB GARDENS: Hand Spot Bait only: Do not apply by aerial or ground broadcast. For control of only voles (*Microtus spp.*) in lawns, golf courses, parks, other ornamental turf areas, ornamental flower and shrub gardens. Place 1/2 to 1 ounce, (2 to 4 tablespoons,) of bait in each active hole, trail or runway in areas where voles have been observed or are known to forage. If non-target animals/birds are present, place bait in tamper-resistant bait stations. Also apply under tarps used to provide winter protection for turf areas. Apply only one bait spot per trail or runway. If additional vole control is needed, a second application may be made 1 to 2 months after the first application. The maximum application rate is 10 lbs per acre per application, and 20 pounds per acre per year. Do not apply to golf courses or turfgrass areas in the state of California.

WARRANTY: To the extent consistent with applicable law, seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions. (071612)

SPECIMEN LABEL

RESTRICTED USE PESTICIDE

DUE TO HAZARD TO NON-TARGET SPECIES

For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

PROZAP® ZINC PHOSPHIDE PELLETS

For use in rangeland, pastures, alfalfa, timothy, barley, potatoes, wheat, sugar beets, sugarcane, grape vineyards, fruit and nut tree orchards, macadamia nut orchards, in and around buildings, and other sites to control the species listed in the use directions

ACTIVE INGREDIENT:
Zinc Phosphide 2.0%
OTHER INGREDIENTS:.....98.0%
TOTAL 100.0%

EPA Reg. No. 61282-49 PA Est. No. 61282-WI-01

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
CAUTION: Harmful if swallowed, absorbed through the skin, or inhaled. Causes moderate eye irritation. Avoid breathing dust. Avoid contact with eyes, skin, or clothing.

Personal Protective Equipment:
All handlers, including loaders and applicators, must wear long sleeve shirt, long pants, shoes, socks, and waterproof gloves.
In addition, persons loading pellets or baits into aircraft or mechanical ground equipment and persons loading/applying with a hand-pushed or hand-held equipment, such as a push-type spreader or cyclone spreader, must wear a dust/mist filtering respiration (MSHA/NIOSH approval number prefix TC-21C or a NIOSH-approved respirator with a R, P, or HE filter) and protective eyewear.
Any person who retieves carcasses or unused bait following application of this product must wear waterproof gloves.

User Safety Requirements:
Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash hands thoroughly after applying bait and before eating, drinking, chewing gum, using tobacco or using the toilet, and change into clean clothing.

FIRST AID
HAVE LABEL WHEN OBTAINING TREATMENT ADVICE

If you experience signs and symptoms such as nausea, abdominal pain, tightness in chest, or weakness, see a physician immediately. For information on health concerns, medical emergencies, or pesticide incidents, call the National Pesticide Information Center at 1-800-858-7378.

If Swallowed:	• Call a Poison Control Center, doctor, or **1-800-498-5743** immediately for treatment advice or transport the patient to the nearest hospital. • Do not give any liquid to the patient. • Do not administer anything by mouth. • Do not induce vomiting unless told to do so by the poison control center or doctor.
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, doctor, or **1-800-498-5743** immediately 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, doctor, or **1-800-498-5743** immediately for 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, doctor, or **1-800-498-5743** immediately for treatment advice.

TREATMENT FOR PET POISONING
If animal eats bait, call veterinarian at once.

NOTE TO PHYSICIAN OR VETERINARIAN

Contains the Phosphine-producing active, Zinc Phosphide. Probably mucosal damage may contraindicate the use of gastric lavage. For animal ingesting bait and/or showing poisoning signs, induce vomiting by using hydrogen peroxide. Sodium bicarbonate can be given orally to neutralize the stomach acidity. The stomach and intestinal tract can be evacuated, oxygen administered and cardiac and circulatory stimulants given. See Inside Booklet for additional precautionary statements.

For 24-hour emergency information on this product, call 1-800-498-5743 (US & Canada) or 1-651-523-0318 (all other areas).

ENVIRONMENTAL HAZARDS

This product is extremely toxic to birds, fish and other wildlife. Wildlife feeding on treated bait may be killed. Dogs, cats, and other predatory and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten this bait. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high-water mark. Do not apply where runoff is likely to occur. Do not contaminate water by cleaning of equipment or disposal of wastes.

ENDANGERED SPECIES CONSIDERATION

Notice: The use of this product may pose a hazard to Federally designated endangered/threatened species. It is a Federal offense to use any pesticide in a manner that results in the death of a member of an endangered species. Consult the nearest U.S Fish and Wildlife Service regional office or the appropriate State Agency for current information on habitats occupied by endangered species.

Whooping Crane (*Grus americana*)

Do not use this product in habitats occupied or occasionally visited by whooping cranes during the period from 30 days before the expected arrival of cranes to 30 days after the time of their usual departure.

Black-footed Ferret (*Mustela nigripes*)

Do not use this product within 7 kilometers (4.34 miles) of any prairie dog town to limit risks to the black-footed ferret from exposure to Zinc Phosphide or destruction of its prey base, unless the colony is an isolated black-tailed prairie dog town less than 80 acres in size or an isolated white-tailed prairie dog town less than 200 acres in size, or unless the town had been appropriately surveyed, using methods acceptable to the U.S. Fish and Wildlife Service, and found by the FWS not to be suitable site for ferret reintroductions.

Gray Wolf (*Canis lupus*) and Grizzly Bear (*Ursus acots horribilus*)

Unless the local U.S. Fish and Wildlife Service office has determined that there are no gray wolves or grizzly bears in the general vicinity of bait applications in Montana and Wyoming, do not apply this product outdoors within occupied habitat of these species.

Attwater's Greater Prairie Chicken (*Tympanuchus cupido attwateri*)

Do not use this product in the present occupied range of the Attwater's Greater Prairie Chicken in the following counties: Aransas, Austin, Brazoria, Colorado, DeWitt, Ft. Bend, Galveston, Goliad, Hams, Refugio, Victoria, Waller, and Wharton (Texas).

Yellow-Shouldered Blackbird (*Agelaius xanthomus*) and Puerto Rican Plain Pigeon (*Columbia inornata wetmorei*)

This product must not be used in the following areas in Puerto Rico except in tamper-proof bait boxes:

(1) within 6.3 miles (10 kilometers) of Central Aquirre, Lago Cidra, Ceiba, San German

(2) within 9.4 miles (15 kilometers) of La Esperanza, south of Highway 2 from city of Mayaquez to the city of Ponce and all Mona Island

Utah Prairie Dog (*Cynomys parvidens*)

Do not use this product in critical habitat of the Utah Prairie Dog (Utah).

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*)

Do not use this product in critical habitat within 0.5 miles of salt marsh vegetation and/or brackish water wetlands which are located: 1) near or adjacent to San Pablo Bay and San Francisco Bay, or 2) in the Sacramento River below or adjacent to the confluence of the Sacramento River and San Joaquin River (California).

Morro Bay Kangaroo Rat (*Dipodomys heermanni morroenis*)

Do not use this product in critical habitat within 2.5 miles of Baywood Park which is located on Morro Bay (California).

Giant Kangaroo Rat (*Dipodomys ingens*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: Fresno, Kern, Kings, Merced, Monterey, San Benito, San Luis Obispo, Santa Barbara and Tulare (California).

Tipton Kangaroo Rat (*Dipodomys nitratoides nitratoides*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: Kern, Kings and Tulare (California).

Fresno Kangaroo Rat (*Dipodomys nitratoides exilis*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: Kern, Kings, Madera and Merced (California).

Stephan's Kangaroo Rat (*Dipodomys stephens*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: San Bernardino, San Diego and Riverside (California).

San Bernardino Kangaroo Rat (*Dipodomys merriami parvus*)

Follow the Interim Measures for protecting endangered species in the California Endangered Species Bulletin for the following California counties: San Bernardino and Riverside (California).

Northern Idaho Ground Squirrel (*Spermophilus brunneus brunneus*)

Do not use this product within 0.5 miles in critical habitat of the Northern Idaho Ground Squirrel in Adams and Valley counties, Idaho.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL: Read entire label and follow all use directions and use precautions. Use only for the sites, pests, and application methods described on this label.

USES ASSOCIATED WITH BUILDINGS AND STRUCTURES TO CONTROL NORWAY RATS, ROOF RATS, AND HOUSE MICE

IMPORTANT: Do not expose children, pets or other non-target animals to rodenticides.
To help to prevent accidents:

1. Store product not in use in a location out of reach of children and pets.
2. Apply bait in locations out of reach of children, pets, domestic animals and non-target wildlife, or in tamper-resistant bait stations. These stations must be resistant to destruction by dogs and by children under six years of age, and must be used in a manner that prevents such children from reaching into bait compartments and obtaining bait. If bait can be shaken from bait stations when they are lifted, units must be secured or otherwise immobilized. Even stronger bait stations are needed in areas open to hoofed livestock, raccoons, bears, or other potentially destructive animals, or in areas prone to vandalism.
3. Dispose of product container, and unused, spoiled, and unconsumed bait as specified on this label.

Note: Bait stations are mandatory for outdoor, above-ground use. Tamper-resistant bait stations must be used if children, pets, non-target mammals, or birds may access the bait.

USE RESTRICTIONS:

In and Around Buildings and Structures

This product may only be used to control of Norway rats, roof rats and house mice in and within 100 feet of man-made structures constructed in a manner so as to be vulnerable to commensal rodent invasions and/or to harboring or attracting rodent infestations. Examples of such structures include homes and other permanent or temporary residences, food processing facilities, industrial and commercial buildings, trash receptacles, agricultural and public buildings, transport vehicles (ships, trains, aircraft), docks and port or terminal buildings and related structures around and associated with these sites. Fence and perimeter baiting, beyond 100 feet from a structure as defined above, is prohibited. This product must not be applied directly to food or feed crops. Do not broadcast bait.

Inside Burrows

This product may be applied to active rodent burrows to control Norway rats, and roof rats *within or beyond* 100 feet of buildings and man-made structures, provided that infestations or these rodents have been confirmed. Because Norway/roof rat infestations may occur in areas father than 100 feet from buildings and man-made structures when the rodents have ample supplies of food and cover, efforts should be made to remove food trash, garbage, clutter and debris. Bait must be placed not less than 6 inches into active Norway/roof rat burrows. Do not broadcast bait.

SELECTION OF TREATMENT AREAS: After removing as much alternate food as possible, determine dry, acid-free areas where rats will most likely find and consume the bait. Generally these areas are along walls, by gnawed openings, in or beside burrows, in corners and concealed places, between floors and walls, or in locations where rats and mice or their signs have been observed.

APPLICATION DIRECTIONS

RATS: Apply 1 to 2 teaspoon amounts of bait per placement. For outdoor use, place bait in active rat burrows or tamper-resistant bait stations. Maintain an uninterrupted supply of fresh bait until all signs of feeding have stopped. Do not treat the same area at less than 30 day intervals.

HOUSE MICE: Apply 1 teaspoon amount of bait at each placement location. Space placements at 8- to 12-foot intervals. Larger placements (up to 2 level teaspoons may be needed at points of very high house mouse activity. Maintain an uninterrupted supply of fresh bait for at least 15 days or until there are no longer signs of new feeding by house mice.

FOLLOW-UP: Using waterproof gloves, collect and properly dispose of all dead animals and excess bait properly in accordance with "Pesticide Disposal" instructions. Use detergent and hot water to wash spoons for application into burrows. Do not use spoon for mixing, holding or transferring food or feed. To discourage reinfestation, limit sources of rodent food, water, and harborage as much as possible.

USES ASSOCIATED WITH AGRICULTURAL SITES

Use Restrictions for all Agricultural Sites

- Do not apply this product in a way that will contact workers or other persons, either directly or through drift.
- Only protected handlers may be in the area during application.
- Keep all other persons out of the treated area during this application.
- Do not apply on roads, near residential areas, or over water.
- Do not broadcast over crops unless use directions specifically permit aerial application.
- Apply bait on warm clear days.

Disposal of Spilled Bait, Leftover Bait Information Applicable for All Agricultural Uses

1. Spilled and Excess Bait: Wearing waterproof gloves clean up any spilled bait immediately and collect excess bait from application equipment. If bait cannot be applied according to label directions, properly dispose of it according to the "Pesticide Disposal" text.

2. Carcasses: Wearing waterproof gloves, bury carcasses of ground squirrels (18 inches deep) in holes dug on site or in inactive burrows. Cover and pack with soil. Alternately, use other disposal methods that state and local authorities allow.

FRUIT AND NUT TREE ORCHARDS (DORMANT)

VOLES AND WHITE FOOTED MOUSE

USE RESTRICTIONS: For control of Meadow (*Microtus pennsylvanicus*), Prairie (*M. ochrogaster*), Pine (*M. pinetorum*), California (*M. californicus*), Oregon (*M. oregoni*), Mountain (*M. montanus*), and Townsend's (*M. townsendi*) Voles and White-footed Mouse (*Peromyscus leucopus*) in pome fruit (apple, pear), stone fruit (peach, cherry, apricot, plum, prune, nectarine), and nut tree orchards (almonds, walnuts, pistachios, pecans, filberts). Apply only after fall harvest (including drops), before new spring growth and when no rain or snow is expected for three consecutive days. Do not graze animals in treated areas

HAND BAITING: Place bait near bases of each infested tree at 2-4 locations, either on surface trails or at mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass over bait. Do not allow bait to be exposed on bare ground. Do not disturb the runway system. Apply teaspoon amount (4 grams) per placement, 2 - 3 lb/A (0.04 - 0.06 lb ai/A).

TRAILBUILDER: Set equipment to drop one teaspoon quantity of bait (4 grams) at 4-5 foot intervals in the artificial trail, made by the machine, just inside the drop line on both side of the trees. Apply at the rate of 2 - 3 lb/A (0.04 - 0.06 lb ai/A).

GROUND BROADCAST: Broadcast evenly by cyclone seeder or by hand. Concentrate in areas with heaviest vegetative cover. Do not broadcast on bare ground. Apply at the rate of 6 - 10 lb/A (0.12 - 0.2 lb ai/A).

AERIAL BROADCAST: Do not broadcast on bare ground. Apply at the rate of 6 - 10 lb/A (0.12 - 0.2 lb ai/A).

GROUND SQUIRRELS

USE RESTRICTIONS: For control of California ground squirrels (*Spermophilus beecheyi*) and Richardson's ground squirrels (*S. richardii*) in pome fruit (apple, pear), stone fruit (peach, cherry, apricot, plum, prune, nectarine), and nut tree orchards (almonds, walnuts, pistachios, pecans, filberts). Apply only after fall harvest (including drops), before new spring growth and when no rain or snow is expected for three consecutive days. Do not graze animals in treated areas

PREBAITING (Mandatory): Prebait with a 50/50 mixture of ground corn and wheat to enhance acceptance by California and Richardson's ground squirrels. Apply the Prebait mixture at 6 lbs per acre 1-2 days prior to using Prozap® Zinc Phosphide Pellets.

HAND BAITING: Apply 4 grams (one teaspoon) of bait on the ground near active burrows.

BAITING: Treat once during treatment period. Broadcast bait using hand or ground-driven dispensing devices not to exceed 6 lbs per acre (0.12 lb ai/A). Dispose of excess bait from application equipment by burial.

POCKET GOPHERS

USE RESTRICTIONS: For control of plains pocket gophers (*Geomys bursarius*), southeastern pocket gophers (*G. pinetis*), yellow-faced pocket gophers (*Pappogeomys castanops*) and pocket gophers (*Thomomys spp.*) in pome fruit (apple, pear), stone fruit (peach, cherry, apricot, plum, prune, nectarine), and nut tree orchards (almonds, walnuts, pistachios, pecans, filberts). Bait must be applied directly into pocket gopher's underground burrow systems or into underground tunnels created by burrow-builder machines. Do not apply bait above ground.

HAND BAITING: Follow the directions indicated below to locate and treat pocket gophers' burrow systems.
Locating Underground Runways: Use a specially designed gopher probe, a metal rod, a strong smooth stick, or other suitable implement to probe the ground 10 to 15 inches away from fan-shaped gopher mounds. Begin probing on the flat side of the fan. When the main runway has been entered, the probe will drop about 2 inches due to decreased resistance from soil.
Applying Bait to Runways: Using a long-handled spoon or mechanical probe, drop one teaspoon (4 grams) of bait into the main runway at each baited point. Cover the opening with sod, a rock, or soil to exclude light. Take care not to cover bait with soil. Depending upon mound density, make two to five bait placements per burrow system. Recover and bury all spilled bait. Applied in this manner, one pound of bait will treat one to eight acres, depending upon the number of pocket gopher burrow systems present.

BURROW BUILDER: Follow manufacturer's instructions for the type of equipment used. Calibrate equipment to drop a teaspoon quantity (4 grams) of bait at 4-5 foot intervals in the artificial burrow made by the machine. Apply at a rate of 2-3 lbs. of bait per acre (0.04 – 0.06 lb ai/A). Pick up and dispose of all spilled bait according to "Pesticide Disposal" instructions.

MACADAMIA NUT ORCHARDS AND ADJACENT NONCROP AREAS

USE RESTRICTIONS: For control of roof rats (*Rattus rattus*) in macadamia nut orchards and adjacent noncrop areas. Do not graze animals in treated areas.

SPOT TREATMENT: Bait must be placed in bait stations 1) on the ground at tree bases or 2) or in trees. Place 1-2 teaspoons (4-8 grams) of bait per bait stations. Uneaten bait must be removed from trees prior to shaker harvest or from ground prior to mechanized harvest. Orchards may be treated up to 30 days prior to a harvesting round.

BURROW TREATMENT: Place 1-2 teaspoons (4-8 grams) of bait in each burrow. No preharvest interval is required, provided nuts are not retrieved from burrows.

BROADCAST BAITING: Broadcast at the rate of five (5) pounds of bait per acre (0.1 lb ai/A) in orchard using a ground device or by hand. Aircraft may be used to treat adjacent noncrop areas if the Hawaii Dept of Health recommends and supervises such applications. The number of applications shall not exceed four (4) per year. The total amount of bait applied shall not exceed 20 pounds per acre (0.4 lb ai/A) per year.

NONBEARING NURSERY STOCK, CONIFER/CHRISTMAS TREE, POPLAR/COTTONWOOD, ORNAMENTAL, AND NONBEARING FRUIT TREE PLANTATIONS

USE RESTRICTIONS: For control of meadow voles, prairie voles, pine voles, California voles, Oregon voles, mountain voles, and Townsend's voles (*Microtus spp*.) in nursery stock, and conifer/Christmas tree, poplar/cottonwood, ornamental, and non-bearing fruit tree plantations. Do not apply by air.

BROADCASTING BAITING: Under infested nursery stock, conifer/Christmas trees, poplar/cottonwood trees, ornamental trees, or non-bearing fruit trees, broadcast bait evenly by cyclone seeder or by hand. Concentrate in areas with the heaviest vegetative cover. Do not broadcast on bare ground. Apply at a rate of 6-10 lbs. per acre (0.12 - 0.2 lb ai/A).

HAND BAITING: Near the base of infested nursery stock, conifer/Christmas trees, poplar/cottonwood trees, ornamental trees, or non-bearing fruit trees, place teaspoonful quantities (4 grams) of bait at 2-4 locations, either on surface trails or at the mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass over bait.
Do not allow bait to be exposed on bare ground. Do not disturb the runway system. Bait at a rate of 2-3 lbs. per acre (0.04 – 0.06 lb ai/A) of infested stock.

NON-RESIDENTIAL LAWNS, ORNAMENTALS, GOLF COURSES, AND PARKS

VOLES

USE RESTRICTIONS: For control of meadow voles, prairie voles, pine voles, California voles, long-tailed voles, Oregon voles, mountain voles and Townsend's voles (*Microtus spp.*) in lawns, ornamentals, golf courses, parks, and nurseries. Bait must not be applied on roads, over water or where plants are grown for food or feed.

HAND BAITING: For voles, place teaspoonful quantities (4 grams) of bait, either on surface trails or at the mouth of holes leading to underground burrow systems. Cover bait artificially (e.g., mats, boards) or by pulling overhanging grass over bait. Allow bait to fall through to the ground surface but do not apply bait to bare ground. Do not place bait in heaps or piles.

BAIT STATIONS: Place bait in tamper-resistance bait stations if children, pets, or nontarget mammals or birds may access the bait.

POCKET GOPHERS

USE RESTRICTIONS: For control of plains pocket gophers (*Geomys bursarius*), southeastern pocket gophers (*G. pinetis*), yellow-faced pocket gophers (*Pappogeomys castanops*) and pocket gophers (*Thomomys spp.*) in lawns, ornamentals, golf courses, and parks. Bait must not be applied on roads, over water or where plants are grown for food or feed.
Bait must be applied directly into pocket gopher's underground burrow systems or into underground tunnels created by burrow-builder machines. Do not apply bait above ground.

HAND BAITING: Follow the directions indicated below to locate and treat pocket gophers' burrow systems.
Locating Underground Runways: Use a specially designed gopher probe, a metal rod, a strong smooth stick, or other suitable implement to probe the ground 10 to 15 inches away from fan-shaped gopher mounds. Begin probing on the flat side of the fan. When the main runway has been entered, the probe will drop about 2 inches due to decreased resistance from soil.
Applying Bait to Runways: Using a long-handled spoon or mechanical probe, drop one teaspoon (4 grams) of bait into the main runway at each baited point. Cover the opening with sod, a rock, or soil to exclude light. Take care not to cover bait with soil. Depending upon mound density, make two to five bait placements per burrow system. Recover and bury all spilled bait. Applied in this manner, one pound of bait will treat one to eight acres, depending upon the number of pocket gopher burrow systems present.

BURROW BUILDER: Follow manufacturer's instructions for the type of equipment used. Calibrate equipment to drop a teaspoon quantity (4 grams) of bait at 4-5 foot intervals in the artificial burrow made by the machine. Apply at a rate of 2-3 lbs. of bait per acre (0.04 – 0.06 lb ai/A). Pick up and dispose of all spilled bait according to "Pesticide Disposal" instructions.

ALFALFA

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles and Townsend's voles (*Microtus spp.*) in alfalfa. All applications must occur shortly after a cutting of the hay, and/or prior to the next growth's attaining a length of 2 inches. Alfalfa forage from treated areas must not be harvested until it reaches maturity. This use is restricted to Montana, California, Idaho, Oregon, and Washington.

BROADCAST BAITING: This product may be broadcast by air or ground-driven dispensing devices. Apply at a rate of up to 10 lbs. per acre (0.2 lb. ai/A). For voles, make two applications per year separated by a minimum interval of 25 days. A maximum of 20 lbs per acre (0.4 lb ai/A) may be applied per year. Do not apply by air when wind velocity exceeds 10 mph. Do not apply in piles or permit piles to be formed by equipment.

TIMOTHY AND TIMOTHY / ALFALFA AND MIXTURES PRODUCED FOR HAY

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles, and Townsend's voles (*Microtus spp*) in timothy and timothy/alfalfa mixtures. Do not apply by air. Do not apply to actively growing timothy or timothy/alfalfa mixtures. This use is restricted to California, Idaho, Oregon and Washington. Do not apply to timothy or timothy/alfalfa mixtures within 60 days of harvest. Do not graze animals in treated areas.
BROADCAST BAITING: Broadcast bait using by hand, cyclone seeder, or ground-driven dispensing devices. A maximum of 2 applications by ground may be made at the rate of 5 to 10 lbs. per acre (0.1-0.2 lb ai/A), one in the fall after the last cutting and one in the spring when timothy and timothy-legume mixtures are still dormant. Do not apply in piles or permit piles to be formed by equipment. A maximum of 20 lbs (0.4 lb ai/A) per acre may be applied annually.

TIMOTHY PRODUCED FOR SEED

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles, and Townsend's voles (*Microtus spp.*) in timothy during the non-growing season. Do not apply by air. Do not apply to actively growing timothy or timothy/alfalfa or timothy/clover mixtures. A minimum of 158 days must pass between an application of Prozap® Zinc Phosphide Pellets and any livestock foraging activity. This use is restricted to Idaho, Oregon and the state of Washington. Do not graze animals in treated areas.

BROADCAST BAITING: This product may be broadcast by hand, cyclone seeder, or ground-driven dispensing devices at rates of up to 10 lbs (0.2 lb active ingredient) per acre during crop dormancy. A maximum of 20 lbs per acre (0.4 lb ai/A) may be applied annually.

GRAPE VINEYARDS

USE RESTRICTIONS: For control of deer mice (*Peromyscus maniculatus*), white-footed mice (*P. leucopus*), Oldfield mice (*P. polionotus*, except for threatened or endangered subspecies), meadow voles, prairie voles and pine voles (*Microtus spp.*), and meadow jumping mice (*Zapus hudsonius*) in grape vineyards. Do not use this product in areas of Alabama and Florida that are occupied by threatened or endangered subspecies of the Oldfield mouse. Do not graze animals in treated areas.

BROADCAST BAITING: Broadcast bait evenly on the ground between the rows by cyclone seeder or by hand. Wear rubber gloves during hand-broadcast operations. Apply bait at a rate of 6-10 lbs. per acre (0.12-0.2 lb ai/A). Do not apply by air.

RANGELAND, PASTURES, AND ADJACENT NONCROP AREAS

KANGAROO RATS

USE RESTRICTIONS: This product may only be used to control Ord's kangaroo rat (*Dipodomys ordii*), Banner-tailed kangaroo rat (*D. spectabilis*) and Merriam's kangaroo rat (*D. merriami*) in rangeland, pastures and adjacent noncrop areas.

BAITING: Place one tablespoon (12 grams) of bait at 2 locations on opposite sides of mounds in feeding runs within 3 ft of active burrow entrances.

GROUND SQUIRRELS

USE RESTRICTIONS: For control of California ground squirrels (*Spermophilus beecheyi*) and Richardson's ground squirrels (*S. richardii*) in rangeland, pastures and adjacent noncrop areas. Product must not be applied on roads, near residential areas, over water or where placnts are grown for food or feed.

PREBAITING (Mandatory): Prebait with a 50/50 mixture of ground corn and wheat to enhance acceptance by California and Richardson's ground squirrels. Apply the Prebait mixture at 6 lbs per acre 1-2 days prior to using Prozap® Zinc Phosphide Pellets.

HAND BAITING: Apply 4 grams (one teaspoon) of bait on the ground near active burrows.

BAITING: Treat once during treatment period. Broadcast bait using hand or ground-driven dispensing devices not to exceed 6 lbs per acre (0.12 lb ai/A). Dispose of excess bait from application equipment by burial.

BUSHBERRIES AND CANEBERRIES

USE RESTRICTIONS: For control of meadow voles, prairie voles, and pine voles (*Microtus spp.*) in bushberries (highbush and lowbush blueberries, currants, elderberries, gooseberries and huckleberries) and in caneberries (blackberries, red raspberries, black raspberries, loganberries, and cultivars or hybrids of these caneberries). Only apply this product in the dormant season: after final harvest and not later than the beginning of leaf emergence in the spring. Do not apply when ground is snow covered. Do not apply by air. Minimum preharvest interval is 70 days.

BROADCAST BAITING: This product may be broadcast by cyclone seeder, or by hand. When applying by hand, throw tablespoon amounts (12 grams) into heavy cover along bushes, rocky outcrops, and fence lines. Make up to 2 applications at a minimum interval of 21 days, at the rate of 6 to 10 lbs per acre (0.12-0.2 lb ai/A) per application. Maximum application per growing season is 20 lbs per acre (0.4 lb ai/A).

CUCURBITS, REDUCED TILLAGE AND NO-TILL CORN

USE RESTRICTIONS: For control of prairie voles (*Microtus ochrogaster*), meadow voles (*M. pennsylvanicus*), house mice (*Mus musculus*), deer mice (*Peromyscus maniculatus*) white-footed mice (*P. leucopus*), Ord's kangaroo rats (*Dipodomys ordii*), banner-tailed kangaroo rats (*D. spectabilis*), Merriam's kangaroo rats (*D. merriami*), and cotton rats (*Sigmodon hispidus*) in reduced tillage and no-till corn and in cucurbits, including and limited to chayote, Chinese waxgourd, citron melon, cucumber, gherkin, edible gourd, *Momordica spp.*, muskmelon, pumpkin, squash [summer and winter], and watermelon. Only in-furrow treatments are permitted for these crops. Do not broadcast bait. Do not apply this product within the occupied habitats of the endangered species or subspecies of kangaroo rats.

IN-FURROW APPLICATION ONLY: Equipment designed for in-furrow treatments must be used to apply this product in cucurbits, reduced tillage and no-till corn. Make one application pre-planting, or at-planting, at a rate of 4 to 6 lbs. of bait per acre (0.08-0.12 lb/A). Collect and remove excessive quantities of bait deposited on surface soil or crop residues during spills or equipment malfunctions.

CALIBRATION / ROW

Row spaces Inches	4 lbs/A Rate oz. Per 1000 ft	5 lbs / A rate oz. Per 1000 ft	6 lbs / A rate oz. Per 1000 ft
20	2.5	3.1	3.7
30	3.7	4.6	5.5
36	4.4	5.5	6.6
38	4.7	5.8	6.9

BARLEY

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles, and Townsend's voles (*Microtus spp.*) in growing-season and preplant applications in barley. Do not apply this product to barley within 50 days of harvest. This use is restricted to Montana, Idaho, Oregon and Washington. Do not graze animals in treated areas.

BROADCAST BAITING: This product may be broadcast by air or ground-driven dispensing devices. Apply bait at a rate up to 6 lbs. (0.12 lb active ingredient) per acre. If voles are being targeted, a second bait application may be made after a minimum interval of 25 days. A maximum of 12 lbs (0.24 lb active ingredient) per acre may be applied per year. All applications must be made prior to the boot stage.

BEANS (DRY)

USE RESTRICTIONS: For control of prairie voles (*Microtus ochrogaster*), meadow voles (*M. pennsylvanicus*), house mice (*Mus musculus*); deer mice (*Peromyscus maniculatus*), white-footed mice (*P. leucopus*), and Ord's kangaroo rats (*Dipodomys ordii*), in dry beans during the growing season. Do not apply by air. Do not apply this product to dry beans within 30 days of harvest. This use is restricted to Idaho, Oregon and Washington.

BROADCAST BAITING: T his product may be broadcast by hand or ground-driven dispensing devices at a rate of 6 lbs. (0.12 lb. active) per acre. No more than one application per growing season is permitted.

SUGAR BEETS

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles and Townsend's voles (*Microtus spp.*) in growing-season and preplant applications in sugar beets. Do not apply this product to sugar beets within 30 days of harvest. This use is restricted to Idaho, Oregon and Washington.

BROADCAST BAITING: This product may be broadcast by air or ground-driven dispensing devices. Apply bait at rates up to 10 lbs. per acre (0.2 lbs. ai/A) at planting. A second application may be made at the same rate. The maximum annual application rate is 20 lbs per year (0.4 lb. ai/A).

POTATOES

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles, and Townsend's voles (*Microtus spp.*) in growing-season and pre-plant applications in potatoes. Do not apply this product to potatoes within 30 days of harvest. This use is restricted to Idaho, Oregon and Washington.

BROADCAST BAITING: This product may be broadcast by air or ground-driven dispensing devices. Apply bait once at a rate up to 10 lbs per acre (0.2 lb ai/A), or make two separate applications at rates of up to 5 lbs per acre (0.1 lb ai/A). The maximum annual application rate is 10 lbs per acre (0.2 lb ai/A).

WHEAT

USE RESTRICTIONS: For control of meadow voles, long-tailed voles, California voles, Oregon voles, mountain voles, and Townsend's voles (*Microtus spp.*) in growing-season and preplant applications in wheat. Do not apply this product to wheat within 50 days of harvest. This use is restricted to Montana, Idaho, Oregon and the state of Washington. Do not graze animals in treated areas.

BROADCAST BAITING: This product may be broadcast by air or ground-driven dispensing devices. Apply bait at a rate of up to 6 lbs. per acre (0.12 lb. ai/A) per acre. If voles are being targeted, a second application may be made within 25 days. The maximum application rate per year is 12 lbs. per acre (0.24 lb. ai/A) per acre.

SUGARCANE

USE RESTRICTIONS: For control of Polynesian rats (*Rattus exulans*), Norway rats (*R. norvegicus*), roof (*R. rattus*), rice rats (*Oryzomys palustris*), Florida water rats (*Neofiber alleni*), and cotton rats (*Sigmodon hispidus*) in sugarcane fields. Do not graze animals in treated areas.

PREBAITING (Strongly Recommended): Prebaiting with three pounds of untreated steamed crimped oats per acre one or two weeks prior to using toxic bait may enhance bait acceptance by rats.

BAITING: Broadcast bait by aircraft, ground-driven devices, or by hand at the rate of 5 lbs. of bait per acre (0.1 lb ai/A). For a **36** month cycle crop, the maximum number of applications is **4** per crop or 20 lbs per acre (0.4 lb ai/A) per crop, and the preharvest interval (PHI) is 30 days. For a **24** month cycle crop, the maximum number of applications is **4** per crop or 20 lbs per acre (0.4 lb ai/A) per crop, and the PHI is **90** days. For a **12** month cycle crop, the maximum number of application is **2** per crop or 10 lbs per acre (0.2 lb ai/A) per crop, and the PHI is **90** days. For all crop cycles, the retreatment interval is **30** days.

AIRPORT GRASSES

USE RESTRICTIONS: Use this product to reduce potential air-strikes with birds feeding on voles (*Microtus spp*) on grassy areas at military airfields. All applications must occur within one to three days after cutting the grass. Do not apply to grass longer than 7.5 inches tall. Do not apply to bare ground or to any paved areas. Do not use grass as feed or forage for livestock.

BROADCAST BAITING: This product may be broadcast by ground driven devices only. Apply Prozap® Zinc Phosphide Pellets at a rate of up to 10 pounds (0.2 lb ai/A) per acre. A second application may be made at a minimum interval of 30 days. 2nd application must follow the mowing and grass length use restriction above. A maximum of 20 pounds (0.4 lb ai/A) may be applied per year.

STORAGE AND DISPOSAL

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

PESTICIDE STORAGE: Store only in original container, in a cool, dry place inaccessible to children and pets. Keep containers closed and away from other chemicals.

PESTICIDE DISPOSAL: Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER HANDLING: Nonrefillable container. Do not reuse or refill this container. Offer for recycling if available. Completely empty bag by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. If container is not to be recycled, then dispose of bags in an approved waste disposal facility or by incineration.

DISCLAIMER

DISCLAIMER: To the extent consistent with applicable law, seller makes no representation or warranty, either express or implied, for results due to misuse, improper handling or improper storage of this material. Nor does Seller assume any responsibility for injury to persons, crops, animals, soil or property arising out of misuse, improper handling or improper storage of this material.

OR

LIMITED WARRANTY

To the extent consistent with applicable law, Neogen Corporation makes no warranty concerning uses which extend beyond the use of the product under normal conditions in accord with the statements made on this label. To the extent consistent with applicable law, Neogen Corporation shall not be liable for (1) any consequential, incidental or special damages related in any way to this product or its uses, or (2) any damages related in any way to resistance to insecticides.

OR

CONDITIONS OF SALE AND LIMITATION OF WARRANTY AND LIABILITY

NOTICE: Read the entire Directions for Use and Conditions of Sale and Limitation of Warranty and Liability before buying or using this product. If the terms are not acceptable, return the product at once, unopened, and the purchase price will be refunded.

Manufacturer and Seller warrant that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated in the Directions for Use, subject to the inherent risks referred to above, when used in accordance with directions under normal use conditions. This warranty does not extend to the use of this product contrary to label instructions, or under abnormal conditions or under conditions not reasonably foreseeable to or beyond the control of Seller or Manufacturer, and Buyer and User assume the risk of any such use. To the extent consistent with applicable law, MANUFACTURER AND SELLER MAKE NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

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For non-emergency (e.g., current product information)
Call: **1-800-621-8829**

Manufactured By:
HACCO, Inc.
110 Hopkins Drive
Randolph, WI 53956

Optional Marketing Statements: Made in the U.S.A.
<American Flag Graphic>

Code (NR.RE.) NT.RE.

Item No.:	0283390
Net Contents:	50 lbs. (1/8" pellets)
UPC:	023626 04200 (1)
Format:	UPC-A
Label:	LA 220206 BK 220150

Item No.:	0077140
Net Contents:	50 lbs. (3/8" pellets)
UPC:	023626 04200 (1)
Format:	UPC-A
Label:	LA 220206 BK 220150