ANACAPA ISLAND RESTORATION PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

National Park Service

Channel Islands National Park

Ventura County, California

October, 2000

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Responsible Official

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Abstract

This Final Environmental Impact Statement (FEIS) was prepared in accordance with the Department of the Interior National Environmental Policy Act (NEPA) regulations, and the National Park Service NEPA guidelines (NPS-12). As required by NEPA, this FEIS is necessary because actions proposed as part of this FEIS are considered a major federal action significantly affecting the quality of the human environment.

Channel Islands National Park in coordination with the Island Conservation and Ecology Group formulated the proposed action to mitigate the ecological degradation that is occurring on Anacapa Island from the impacts of the non-native Black Rat. The purpose of the proposed action is to eradicate rats from Anacapa Island and keep it and Santa Barbara Island, Prince Island and Sutil Island rat-free. Maintaining rat-free islands would improve seabird-nesting habitat and would aid in the recovery of crevice nesting seabirds such as the Xantus' Murrelet and Ashy Storm-Petrel.

The proposed action involves the aerial and hand placed ground application of a bait containing the rodenticide brodifacoum into all rat territories on Anacapa Island. Application of the rodenticide would occur during the fall of the year to minimize disturbance and exposure to other affected resources on the island. The Park conducted extensive "scoping" on the proposed action. As a result of comments from interested public, federal and state agencies, and conservation groups on the proposed action, the Park identified three significant environmental issues. The significant environmental issues are: 1) Efficacy on target species; 2) Impacts on non-target species; and 3) Impacts to the public and visitor use.

To address these significant environmental issues, the Park prepared five alternatives to the proposed action. Each alternative was developed to respond to the environmental issues identified. The Park also considered many other alternatives and methods to eradicate the Black Rat on Anacapa Island; however, many of the methods failed to meet the purpose and need of the project.

As part of this FEIS the Park described the "Affected" environment for the project. This section describes what is currently known about the status and the trend of affected island resources. The affected environment included the physical setting of the island, terrestrial resources, and marine resources.

For full disclosure, the Park prepared an analysis of the environmental consequences that would occur should any of the alternatives presented be chosen for implementation.

No sooner than 30 (thirty) days after release of this FEIS a Record of Decision (ROD) will be executed. Release of the FEIS is expected on or around October 13, 2000. John Reynolds, Regional Director, Pacific West Region, is responsible for the final decision. Tim Setnicka, Superintendent, Channel Islands National Park, is responsible for plan implementation and monitoring of all activities.

Glossary of Terms and Abbreviations

AIRP	Anacapa Island Restoration Project
ATTC	American Trader Trustee Council
EC_{50}	Effective Concentration. The concentration at which 50% of an exposed test population is affected sublethally.
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
ESA	Endangered Species Act
ft	Foot. 1 ft = 30 centimeters or 12 inches
g	Gram. 1 g = 0.035 oz.
GMP	NPS General Management Plan
GPS	Global Positioning System
ha	Hectare. 1 ha = 2.47 acres
ICEG	Island Conservation and Ecology Group
kg	Kilogram. 1 kg = 2.205 pounds
LC_{50}	LC - Lethal Concentration. Concentration of active ingredient that could cause death in 50% of an animal test population. Presented as mg active ingredient per unit volume.

LD_{50}	LD – Lethal Dose. Acute oral dose required to cause death in 50% of an animal test population. Presented as mg active ingredient per kg body weight (mg/kg).
LOC	Level of Concern. See text.
mg	Milligram. 1/1000 of a gram.
NEPA	National Environmental Policy Act
NPS	National Park Service
ppm	Parts per million
PT	Prothrombin time. A measure of blood clotting time.
RMP	NPS - Resources management plan
RQ	Risk Quotient = Exposure/Toxicity. See text.
USFWS	US Fish and Wildlife Service

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SUMMARY OF THE FINAL ENVIRONMENTAL IMPACT STATEMENT

Introduction

This Final Environmental Impact Statement analyzes the effects of implementing proposed actions that accomplish the following objectives: 1) eradication of the introduced Black Rat on Anacapa Island; 2) adopt an emergency response plan for accidental introductions of rodents on Anacapa, Santa Barbara, Prince, and Sutil Islands; and 3) incorporate a prevention strategy to reduce the potential for rodents to be accidentally introduced to Park islands. The proposed action was developed in concert with the Island Conservation and Ecology Group and is based on other successful island rat eradication efforts worldwide. Actions to manage existing and potential Black Rat infestations is necessary because of the ecological impacts Black Rats are having on Anacapa Island, and the potential negative impact they would have if introduced to other Park islands.

Public Involvement

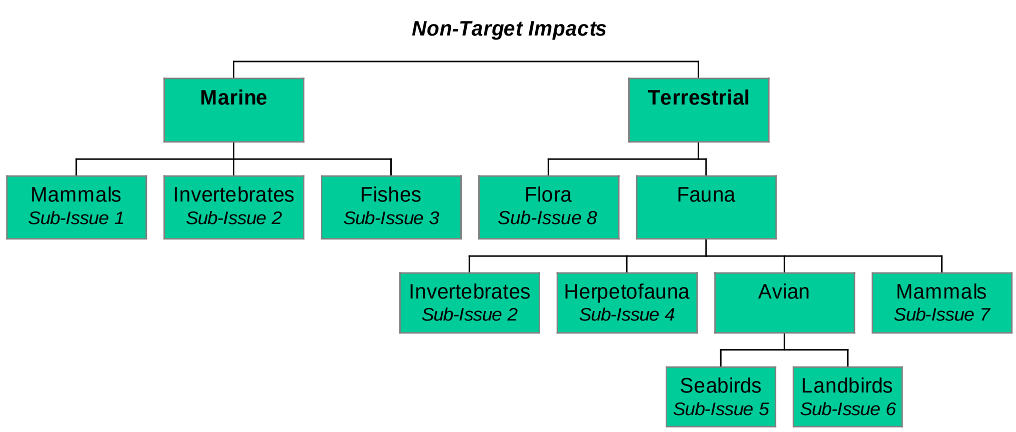
In compliance with the National Park Service National Environmental Policy Act (NEPA) implementing regulations, the Park conducted "scoping" on the proposed action. Scoping involved contacting interested publics, regulatory agencies with oversight concerns, conservation groups, and worldwide experts in the field of vertebrate pest ecology. The Park used several methods to solicit comment on the proposed action including letters, public meetings, web-site, press releases, and press, radio and television advertisements.

Environmental Issues

Based on internal and external comments on the proposed action the Park concluded that the analysis would need to address three significant environmental issues. These issues are: 1) Efficacy on Target species; 2) Impacts to Non-target species; and 3) Effect on public use and visitation.

Issue	Description
Target Species Efficacy	Efficacy for this analysis is defined as how well the alternative would meet the 100% eradication objective.
Non-Target Species:	Impacts to non-target species are separated into two categories: physical disturbance and toxicological risk. Physical disturbance may occur from the activities associated from baiting, and monitoring. Toxicological risk will analyze both primary (direct) exposure and secondary (indirect) exposure.
Public Use/ Visitation	Anacapa Island is the most visited of all the islands in the Park. Although camping is allowed on East Anacapa, day trips via the concessionaire boats is the most common visitation that occurs on the island.

The issue "Impacts to Non-target species" is a broad category that incorporates several sub-issues. The sub-issues are the species groups that may be impacted by the proposed action. The following taxonomic hierarchy identified the species groups that may be impacted by the project:



Alternatives

After identifying the significant environmental issues associated with the proposed action, the Park began developing alternatives by modifying the eradication strategies to address the environmental issue concerns. In all, six alternatives were developed, including the "No Action" alternative.

Summary of Alternatives.

Alternative	East Anacapa		Middle Anacapa		West Anacapa		Active Ingredient	Concentration (ppm)
	Top	Cliff	Top	Cliff	Top	Cliff		
1 (No Action)	NA	NA	NA	NA	NA	NA	NA	NA
2 (Preferred)	Aerial/ Hand	Aerial/ Hand	Aerial/ Hand	Aerial/ Hand	Aerial/ Hand	Aerial/ Hand	Brodifacoum	25
3	Bait Stn	Aerial	Bait Stn	Aerial	Aerial	Aerial	Brodifacoum	25
4	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Bromadiolone	50
5	Bait Stn	Aerial	Bait Stn	Aerial	Aerial	Aerial	Bromadiolone	50
6	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Diphacinone and Brodifacoum	50 and 25

Several methods and techniques were rejected from consideration. Exclusive use of bait stations (elevated and ground) was rejected because of the steep cliffsides on Anacapa Island and the problems associated with placing bait stations in all of the rat territories on the island, including the steep cliffsides. Studies cited in the analysis documented that not all rats could access the elevated bait stations. Several alternate rodenticides were also considered, but were rejected because: 1) they had not been used previously in successful island eradication; 2) they had potential to cause bait shyness; 3) they could not cope with the potential "Warfarin resistant" rats; and 4) there is no antidote for some of the rodenticides. Exclusive use of trapping, and introduction of predators were both rejected because they failed to meet the purpose and need.

Environmental Consequences

For each environmental issue, the Park analyzed the potential effects that may occur should one of the six alternatives be implemented. For Issue 1 (Efficacy), analysis focused on the probability of a successful eradication for each alternative. Factors considered in the analysis included the toxicology of the rodenticide, bait composition and delivery into the ecosystem, and local factors. From an efficacy standpoint, Alternative Two (preferred action) offers the highest probability of success in eradicating rats from the island.

For Issue 2 (Non-Target Impacts), each alternative was analyzed for potential physical disturbance, as well as the toxicological effects of the proposed rodenticide on non-target species. The physical impacts were restricted to short-term disturbance to landbird, seabird, and marine mammal species.

Toxicological impacts were analyzed for a wide range of species that may be present in the project area. The effects analysis included both primary exposure (direct consumption of the bait containing the rodenticide), and secondary exposure (species who feed on animals that have been directly exposed) impacts. Mitigation measures were incorporated for species at risk of exposure. The presence of the endemic deer mouse on Anacapa Island presented a logistical challenge because they are at risk of exposure to the rodenticide, but must be protected to ensure a viable population remains on the island. Actions to ensure that a viable population of the endemic Anacapa deer mouse remain on the island are incorporated into each action alternative.

For Issue 3 (Public Use and Visitation), each alternative was analyzed for its potential to expose island visitors to rodenticides, and the potential impacts to visitor enjoyment and visitation. Rodenticide exposure to the public, although considered to be a very low risk was analyzed in detail to quantify the potential risk. Mitigation measures are presented to minimize this risk further. In addition, the use of bait stations (as opposed to broadcast spreading of bait) around public areas was built into all of the action alternatives. Rodenticide bait will not be used inside structures. The structures on east islet were rodent proofed in 1999, snap traps will be used to determine if rodents are getting into the buildings. Indoor snap trapping would begin prior to island-wide baiting operations. The 2-3 day restriction around the application period would preclude island visitation to East Anacapa during the slowest part of the visitation year.

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CHAPTER ONE

PURPOSE AND NEED

Chapter Contents

Introduction

Channel Islands National Park has prepared this Final Environmental Impact Statement to document environmental impacts that would be associated with eradication, prevention, and emergency response management actions associated with non-native rat (*Rattus)* species. Specifically, this FEIS will cover proposed management actions in the following three areas: 1) Eradication of the Black Rat (*Rattus rattus)* on Anacapa Island; 2) An emergency response plan for dealing with accidental introductions of rats on Anacapa, Santa Barbara, Prince, and Sutil Islands; and 3) A prevention strategy to reduce the potential for rats to be accidentally introduced to Park islands. This FEIS includes analysis of effects for six alternatives, including the consequences of not eradicating the Black Rats from the Island, or not reacting to or preventing rat introductions to Park islands.

This Final EIS is based on direction contained in the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations 40 CFR 1500-1508, and the National Park Service NEPA implementation guideline (NPS-12).

The Final EIS will also document the Park's obligation to meet other federal laws including: The National Historic Preservation Act; Federal Water Pollution Control Act (Clean Water Act); Clean Air Act; Coastal Zone Management Act; Marine Mammal Protection Act; and the Endangered Species Act.

CEQ regulations require a Notice of Availability (NOA) be made to the Federal Register that a final EIS has been completed. The Park will wait at least 30 days from the Federal Registers publishing of the NOA before signing a record of decision.

Channel Islands National Park General Management Plan (GMP) provides direction for management of the Park. Decisions and direction identified in these documents are incorporated by reference. This EIS is "tiered" to the GMP as permitted by 40 CFR 1502.2.

General Management Plan Direction

The General Management Plan (GMP) completed in 1985 defines management direction for the natural resources within the Park. In this GMP specific objectives are stated for Anacapa, San Miguel, and Santa Barbara Islands. Objectives from the GMP which support the Anacapa Island Restoration Project include:

- Restore altered ecosystems as nearly as possible to conditions they would be in today had natural ecological processes not been disturbed.
- Develop an awareness of threats that impact or have the potential to impact Park resources.
- Actively respond, as a land management agency, to these potential threats.

In addition to stating general management objectives, the plan identifies specific objectives for island resources. Management guidelines to meet objectives were also described in the Plan. Black Rats are specifically mentioned in the GMP. The objective stated for Black Rat management is "eradication". The *action* to meet this objective calls for the Park to initiate an eradication program on East Anacapa Island. Under the criteria established by the GMP for rat eradication, such a program must:

a) Be effective

b) Be selective for rats

c) Have the least possible effect on native mouse populations and other forms of plant and animal life

d) Present the lowest risk to visitors and staff

e) Be economical and simple to maintain

Alternatives proposed in this analysis meet these criteria to varying degrees.

The Resources Management Plan (RMP) also identifies this project as a necessary action to perpetuate natural processes and resources within the Park. The RMP flows from the General Management Plan (1985) and Statement for Management (1991). The RMP is the Park's strategic plan for the long-range management of its resources and a tactical plan identifying short-term projects.

Purpose & Need and Proposed Action

Purpose

The purpose of the proposed action is to eradicate rats from Anacapa Island and keep it and all Park islands rat-free. Eradicating rats from Anacapa Island would improve seabird-nesting habitat and could aid in the recovery of some species such as the Xantus' Murrelet and Ashy Storm-Petrel.

Need for Action

Introduced Species and the Importance of Island Ecosystems

It is now widely accepted that current rates of species extinctions are dramatically higher than background rates (Raup 1988), that most current extinctions can be directly attributed to human activity (Diamond 1989), and that for ethical, cultural, aesthetic, and economic reasons, this current rate of extinction is cause for considerable concern (Ehrlich 1988, Ledec and Goodland 1988). The causes of anthropogenic extinctions can be roughly divided into four broad categories: non-sustainable use of resources, habitat destruction, pollution, and introduction of non-native species.

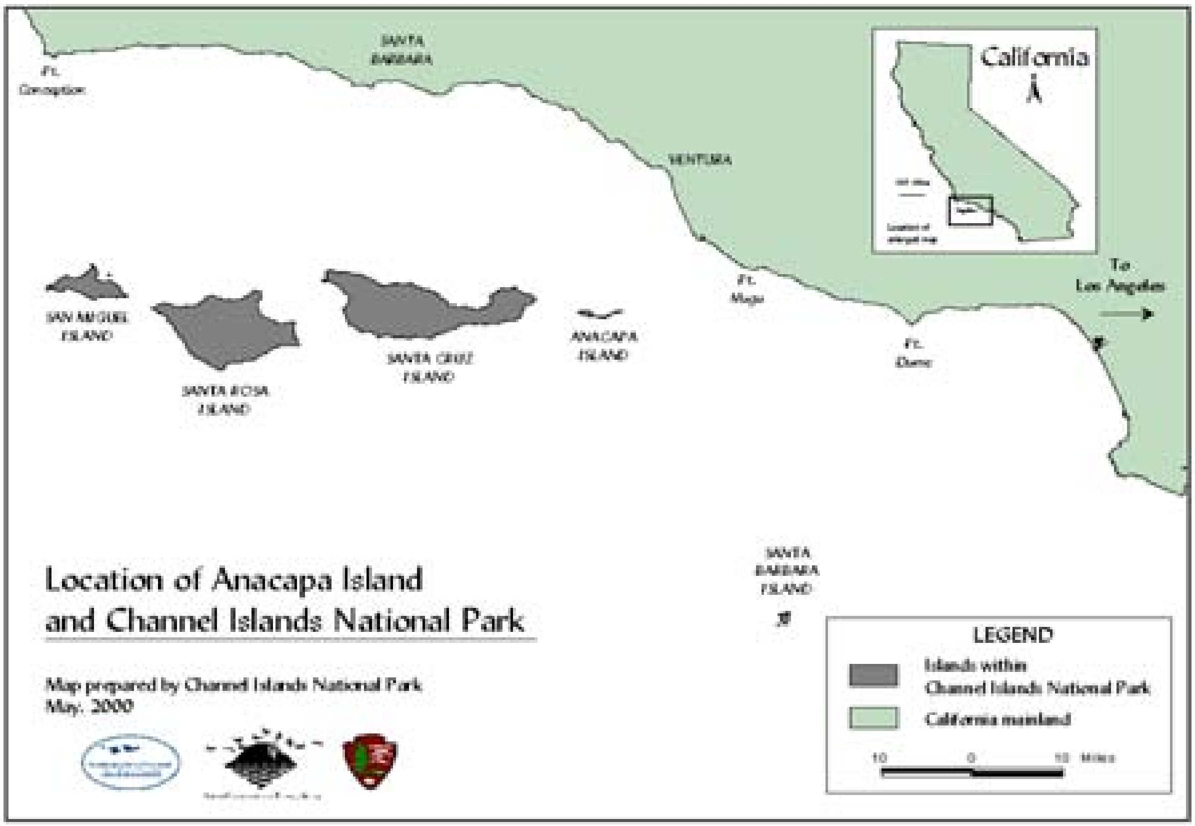
Problems in the first three categories are often acute and can directly affect human welfare on an observable time scale. These qualities have made them the focus of public environmental concern. The introduction of non-native species has received less publicity and professional attention (Coblentz 1990, Soulé 1990); however, introduced species are responsible for 39% of all recorded animal extinctions since 1600 for which a cause could be attributed (World Conservation Monitoring Centre 1992). Thus, some impacts of introduced species are irreversible (reviewed by Groves and Burdon 1986; Mooney and Drake 1986; and Hengeveld 1989) and at least as devastating as the other categories (Atkinson 1985, 1989, Soulé 1990). Once established, introduced species often become permanent in ecological time unless intentionally removed (Tershy and Croll 1994).

Island ecosystems are particularly vulnerable to both extinctions and the impacts of introduced species (Diamond 1985, 1989, Olson 1989). Of the 484 recorded animal extinctions since 1600, 75% have been island endemics (World Conservation Monitoring Centre 1992). Introduced species were completely or partially responsible for 67% these extinctions (based on the 147 island species for which the cause of extinction is known, calculated from World Conservation Monitoring Centre 1992).

Islands are important to the conservation of biodiversity for four reasons:

1) A large percentage of their biota are endemic species and subspecies (Darwin 1859, Elton 1958);

Figure 1: Location Map of Anacapa Island.



2) They are important breeding areas for seabirds, pinnipeds, and sea turtles, which forage over thousands of square kilometers of ocean but are dependent on relatively small amounts of protected land on islands for breeding and nesting;

3) Many islands are sparsely inhabited or uninhabited by humans, keeping socioeconomic costs of protection low;

4) the species and ecological communities on islands have evolved in natural fragments, making them less susceptible than continental species to the problems of habitat fragmentation caused by small reserve size.

In summary, by restoring and protecting islands, functioning unmanaged ecosystems can be maintained without large expenditures for land acquisition or significant conflict with local human populations (Tershy and Croll 1994).

Introduced Commensal Rats

There are three species of rats in the genus *Rattus* which are commensal with humans and which have been introduced to islands throughout the world. In order of decreasing size they are: the Norway or Brown Rat (*R. norvegicus)*, the ship or Black Rat (*R. rattus)*, and the Pacific or Polynesian Rat (*R. exulans)*. They have different dietary preferences, distributions and histories of introduction, but all three species are omnivorous, behaviorally plastic, have high reproductive rates, and can survive in a variety of habitats (Atkinson 1985, Moors et al. 1992). These traits make them ideally suited to survive on a variety of predator free islands. At least one of the three species occurs on an estimated 82% of all island groups, with *R. rattus* being the most common introduced rat (Atkinson 1985).

Impacts of Introduced Rats on Island Ecosystems

The most obvious impacts of introduced rats on island ecosystems are extinctions of endemic species. Introduced rats (*Rattus* spp) are responsible for an estimated 40 - 60% of all bird and reptile extinctions (ICEG Analysis of World Conservation Monitoring Centre Data, Atkinson 1985). They have caused extinctions of endemic mammals and invertebrates on the Galapagos and elsewhere (Andrews 1909, Brosset 1963, Daniel & Williams 1984, Meads et al. 1984).

Even if extinctions do not occur, rats can have ecosystem wide effects on the distribution and abundance of native species through direct and indirect effects. For example, comparisons of rat-infested and rat-free islands, or pre and post rat eradication experiments, have shown that rats depressed the population size and recruitment of birds (Thibault 1995, Cambell 1991), reptiles (Whitaker 1973, Towns 1991, Cree et al. 1992), plants and terrestrial invertebrates. Rats have also been shown to affect the abundance and age structure of intertidal invertebrates (Navarrete & Castilla 1993).

Each of the three species of commensal *Rattus* have been implicated in extinctions and prey populations changes. Due to their different natural histories, however, each species has slightly different impacts. For example *R. norvegicus* tends to have a greater impact on adult burrow nesting seabirds than does *R. rattus*, but less of an impact on tree nesting birds (Atkinson 1985). Consequently, the introduction of new *Rattus* species should be avoided, even to islands which already have introduced rats (Moors et al. 1992).

Rats on Anacapa Islands

The three Anacapa islets have been subjected to introduced cats, sheep, rabbits, and rats. All but the rats have been successfully eradicated. The Black Rat was introduced to the Anacapa Islands prior to 1939 (Sumner & Bond 1939) probably in supplies transported onto the island for sheep ranching or lighthouse construction, or from a ship wreck (Collins 1980). Research on the Anacapa Island by Main et al. (1972), Collins (1979), Erickson & Halvorson (1990), and Howald et al. (1997) demonstrate that Black Rats:

1) Are most abundant in the coastal areas and canyons on the islands;
2) Breed from April through September;
3) Feed on native mammals, reptiles, insects, intertidal invertebrates, birds, and plants.

It is believed that the most significant impact rats have on Anacapa Island is on the breeding populations and breeding success of the colonial nesting seabirds, the Xantus' Murrelet (*Synthliboramphus hypoleucus*) and Ashy Storm-Petrel (*Oceanodroma homochra*). These two species are California Species of Special Concern (http://www.dfg.ca.gov/endangered/birds.html) and a federal (USFWS) Species of Concern (http://www.fws.gov/r9mbmo/reports/speccon/tblconts.html). Species of concern are a "high priority for additional research and conservation actions,…" (http://www.fws.gov/r9mbmo/reports/speccon/mgmtrec.html). The California Channel Islands host large proportions of the world populations of these rare species.

Predatory mammals such as rats and cats have been identified by McChesney and Tershy (1998) as the main cause of long-term decline in Xantus' Murrelet populations. The relatively small size of the adults and crevice nesting behavior makes them susceptible to predation by rats. Introduced rats prey on adults, chicks and eggs of many seabirds. Recent surveys of Anacapa Island have found abundant evidence of rat use of cliffs which coincides with preferred murrelet nesting habitat (G.

McChesney, pers. comm., Erickson and Halvorson 1990). Evidence of recent nesting activity by murrelets was found at only 0.4% of potential nesting sites investigated on Anacapa Island (as compared to a 30% success rate on Santa Barbara Island, and with no introduced rats), and all eggs found showed evidence of mammalian predation (G. McChesney, unpub. data). Murrelets utilizing Anacapa are largely restricted to areas inaccessible to rats, such as sea caves, although abundant nesting habitat is found elsewhere. The removal of rats from Anacapa Island will provide a substantial increase in nesting habitat available to these species in California. Seabird colonial nesting likely has evolved in part from predation pressure (See McChesney and Tershy 1998), and Anacapa Island is only one of two of the California Channel Islands which historically has provided terrestrial predator free breeding habitat to seabirds. The other predator free island, Santa Barbara Island, currently supports a large colony of Xantus' Murrelets. Only small numbers of Xantus' Murrelets breed at the other Channel Islands. The abundance of nesting habitat at Anacapa Island for crevice nesting seabirds such as Xantus' Murrelet and Ashy Storm-Petrel, coupled with Anacapa's similarity to nearby Santa Barbara Island, suggest a potential for Anacapa to support large populations of these species (G. McChesney, pers. comm.). The restoration of Anacapa Island to an introduced predator free status likely will provide substantial benefits to these species. The removal of introduced rats from islands has been identified as a priority to ensure the recovery and long-term viability of Xantus' Murrelet populations (McChesney and Tershy 1998).

Proposed Action

Anacapa Rat Eradication

The technique proposed for eradicating rats on Anacapa Island is modeled after other island rat eradication projects that have successfully been completed worldwide. Due to the steep cliffs of the island, an aerial broadcast is necessary to deliver rodenticide to every rat's territory, a condition that has to be met to accomplish eradication. The formation of the islands through uplifting has made the cliffsides of Anacapa Island extremely unstable and dangerous to climb, and thus bait stations cannot be safely placed and maintained on the cliffsides. The cliffsides harbor the greatest density of rats and so for eradication to be accomplished adequate delivery of bait to cliffsides must be ensured. The placement of rodenticide into every rat's territory is critical to the success of the eradication and cliffsides need to be treated. Therefore, broadcast application (aerial and hand broadcast) would be the preferred method. Broadcast of the rodenticide bait would be carried out in all habitats across the island. The rat population size on Anacapa fluctuates between about 750 – 2,000, depending on local conditions. Application of rodenticide would be completed within 1-2 days.

A local certified agricultural pesticide applicator would be used for conducting the application. The applicator would have to meet the following criteria: 1) OAS and California Department of Agriculture certification for aerial application of rodenticide; 2) Helicopters equipped with differential GPS units to ensure even coverage across the island; 3) Experience in aerial activities in remote offshore Channel Islands National Park.

Bait would be broadcast at a maximum rate of 15 kg of 25 ppm bait/ha. A maximum of two applications is anticipated.

The chronology of eradication would begin with baiting in representative habitat within the project area. Representative habitat may include all of East Islet or smaller area on Middle Islet that allows for easy and unobtrusive access. Representative habitat contains prime rat habitat including intertidal areas, and dense vegetation sites. The objective of the initial eradication treatment is to conduct both effectiveness and validation monitoring of the project's objective and the alternative's proposed activities including mandated mitigation. This effort would be followed up with the completion of the island-wide eradication activities.

The window for bait application is November through December (late fall). Baiting may begin as early as 2000. The late fall period offers the optimum time to apply the bait for three reasons:

1) The endangered Brown Pelicans are not breeding on the island;
2) The rats are in decline due to lack of available food sources, which would cause them to eat the bait more readily.
3) The onset of the rainy season would expedite the degradation of any residual bait not consumed by the target species.

The chronology of proposed eradication activities is as follows:

2000 - 2001: During the application window of Nov-Dec, initiate eradication activities in representative habitat within project area.

2001 – 2002: Complete Island-wide eradication during the Nov/Dec application window.

After treatment of East Islet and approximately 20 ha of Middle Islet there may be a need to retreat intermittently Middle Islet to prevent rats from re-invading East Island from Middle Island.

This proposed action would require Federal Environmental Protection Agency (EPA) approval for use of rodenticide bait on the island. A complete description of the proposed action can be found in Chapter II – Alternatives section.

Emergency Response Plan

The emergency response plan (ERP) would be implemented under the following conditions:

1) When it is suspected that rats may be on Santa Barbara Island.
2) After the eradication effort on Anacapa Island has concluded.

The ERP has three main components with a decision process tied to each component. The first component (Detection) focuses on the verification of presence of the rat. This is done by intensive initial field investigation using normal rat detection techniques (chew bait blocks and sticks, trapping (live and snap, visual inspections, tracking tiles).

If rat presence is verified, the second component (Problem Evaluation) is a field investigation decision process that determines the extent of the rat problem, the terrain associated with the rat territory, and the affected resources within colonized area.

The third component (Problem Resolution) evaluates all of the factors (extent, terrain, affected resources) and through a decision process makes a recommendation on the course of action that is necessary to eradicate the rats. The decision process that takes place in all three components is fully described in Chapter II – Alternatives.

Prevention

All rat introductions to the Channel Islands have been through the assistance of humans.

The most common ways rats are introduced to the islands are:

1) Boats moored directly to the island or anchored nearby
2) Dinghies or other small boats pulled up on shore
3) Carried ashore in cargo such as foodstuffs, and building materials
4) Rafting ashore in flotsam
5) Shipwrecks
6) Planes and helicopters

Non-endemic mice are the most likely species to reach the islands because of their small size and habit of living in facilities and storerooms, and are more likely to escape detection. However, rats may occur more frequently on large fishing vessels and other boats.

To minimize the risk of rodent introductions to the Channel Islands, a set of standards would be implemented by the Park prior to conclusion of eradication activities on Anacapa Island. The minimum proposed standards for the prevention of rodent invasion to the Islands are as follows:

1) Rodent proof storage areas.
2) Rodent proof containers that haul equipment and supplies to the Islands.
3) Control rodents at all departure points, including planes, boats, and helicopters that transport people and materials to the Islands (Park will work with concessionaires to accomplish objectives when departure points are not under the control of the Park).
4) Inform and educate all people who visit the islands. This includes visitors, concessionaires, contractors, employees, permittees, and researchers.

Scope of the Proposed Action

This document focuses on three specific actions: 1) The activities that are necessary to eradicate rats from Anacapa Island, and 2) The activities necessary to respond to accidental rat introductions to Anacapa and Santa Barbara Island, and 3) Preventing rodent introductions to all Park Islands.

This EIS does not cover the eradication of rats from any other Park Island where rats have become established, specifically San Miguel Island. Any eradication activity on San Miguel Island would require additional NEPA analysis due to the unique environmental issues associated with the island. Santa Barbara and Anacapa Islands have similar resources and resource issues.

Decisions to be Made

For this EIS, the official responsible for making the decision on which alternative is selected is the National Park Service Regional Direction, Pacific West Region. The Regional Director, once the Final EIS has been completed, can decide to:

- Select one of the alternatives analyzed within the Final EIS, including the No-Action alternative; or,
- Modify an alternative (for example, combine parts of different alternatives), as long as the environmental consequences of the modified action have been analyzed within the Final EIS.

Factors the Regional Director will take into consideration in making a decision are:

- Does the alternative meet National Park Service guidelines and policies, including the Channel Islands General Management Plan?

- How well does the alternative meet the "Purpose and Need" for this project?
- How does the alternative respond to and/or resolve the environmental issues raised for this project?
- The nature and extent of public comment to the DEIS.

ANACAPA ISLAND RESTORATION PROJECT

CHAPTER TWO
ALTERNATIVES

Chapter Contents

Introduction

This chapter describes the six alternatives to be considered for implementation and identifies the significant environmental issues used to formulate these alternatives. The environmental issues were developed as a result of extensive "scoping" conducted for this analysis. The "scoping" actions that were conducted for this analysis are described in detail. In addition, this chapter includes the rationale for dismissing other methods/alternatives from further consideration. Chapter Four concludes with a comparison of alternatives.

Alternative Development Process

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

Taken together, these requirements determine the range of alternatives and provide the basis for the Deciding Official's informed decision, as required under NEPA. The Proposed Action, as stated in Chapter One, was the result of a resource analysis done by NPS resource management staff in collaboration with rodent eradication experts from the Island Conservation and Ecology Group (ICEG). This collaborative effort identified management actions necessary to respond to rat impacts on the Anacapa Island ecosystem.

The alternatives detailed below were developed to focus on the issues identified by resource specialists with the NPS, rat eradication experts and other rodent control experts, government regulatory agencies, and the general public. Chapter Five – Consultation and Coordination lists all individuals, agencies and organizations that provided substantive comment regarding the proposed action.

Internal Scoping and Public Involvement

The NEPA "scoping" process [40CFR 1501.7] was used to determine the scope of the analysis and to identify potential issues and opportunities related to the Proposed Action. A summary of the scoping and public involvement process for the proposed project and for the release of the Draft EIS is summarized in Chapter Five.

Below is a summary of the scoping that was conducted to identify the environmental issues to be considered for this project.

Proposed Action Internal Scoping

The Park has an extensive record of controlling rats on East Anacapa Island. Through these efforts, the Park has collectively gained knowledge about the issues surrounding the presence of rats on the island. In addition, the Park has funded scientific studies that focus on the ecology and control of rats within the Park.

Proposed Action External Scoping

External scoping refers to the effort the Park made to solicit input from the local public, organizations, other government regulatory agencies. A complete summary of the Park's scoping efforts can be found in Chapter Five.

The methods the Park used to solicit input included:

- Scoping Letter: A letter describing the proposed action was sent to individuals and organizations who expressed interest in the Park's management, and government agencies who might have oversight/regulatory concerns about the project.
- Public Meeting: On December 8, 1999 the Park hosted a public meeting. The Park paid for ads in three local newspapers announcing the meeting (Los Angeles Times, Ventura County Star, Santa Barbara Newspress). As part of this meeting the Park presented the need for the proposed action as well as the proposed action.
- Presentations: The Park made presentations to several local organizations.
- Website: The Park posted information regarding the project on its website.
- Direct Communication: The Park made direct communication to regulatory government agencies who may have oversight concerns regarding the project. A list of these agencies can be found in Chapter Five.

Significant Environmental Issues

Through the Scoping and Public Involvement Process the following significant environmental issues were identified. Significant issues are those that may require project-specific alternatives, mitigation measures or design elements to address the potential effects of the proposed activities.

The issues are grouped into three broad categories. Because these are broad categories, the "Non-target Impacts Issue" category will contain a number of sub-issues. Each issue category (-and/or sub-issue-) contains a summary statement that defines the scope of the issue for this project. In addition, for each issue category (and/or sub-issue), measurement indices are given to provide a preview of how the issue will be evaluated for direct, indirect, and cumulative effects for each alternative. The "Issue" categories are as follows:

- **Issue 1: Efficacy on Target Species**
- **Issue 2: Non-Target Impacts**
- **Issue 3: Public Safety and Visitation**

Issue 1: Efficacy on Target Population

Efficacy for this analysis is defined as how well the alternative would meet the 100% eradication objective.

<u>Measurement Indices</u>

- Chemical and toxicological properties of the rodenticide
- Composition of the bait and how it is applied
- Local environmental factors.

Issue 2: Impact to Non-Target Species

Chapter Four (Environmental Consequences) will analyze both the potential for exposure of non-target species to rodenticide residues and any physical disturbance from normal activities of non-target species caused by implementation of the project.

Physical disturbance may occur due to baiting activities, and crews walking around the island. For example, *Malacothrix squalida,* a listed species (endangered) under the endangered Species Act is located in the project area. As such the Park is required to consult with the USFWS on potential impacts the project may have on the species. Physical disturbance from monitoring activities is the only potential impact that may occur to this species

Rodenticide exposure, for the purpose of this analysis, can occur through direct bait consumption (primary exposure), secondarily (via carcasses containing rodenticide residues) and possibly tertiary exposure. Primary exposure occurs when organisms feed directly on the bait. Secondary exposure occurs when animals feed on primarily exposed organisms with residues in their tissue. Tertiary exposure is possible, through consumption of a secondarily exposed organism, but has not been thoroughly documented in the literature (Eason and Murphy 1999). For the purpose of this analysis, only primary and secondary exposure will be evaluated.

The first step in the process to determine which non-target species may be impacted by the proposed action was to identify all the known species within the project area. The species were then placed in a taxonomic classification to identify logical groups of species. Based on the risk assessments for the rodenticide (and other scientific studies) the groups of species that may be impacted were identified. These identified groups (See Table 1) will be carried forward in the analysis as "Sub-Issues".

The taxonomic classification for identification of sub-issues is necessary to provide a logical layout of "effects" when evaluating toxicological risk. This is because the toxicology of these rodenticides is consistent within the groups that have been identified. The sub-issues as derived from Table 1 is as follows:

Table 1. Project Area Species Taxonomic Classification

I. Marine
  A. Mammals (Sub-Issue 1)
  B. Invertebrates (Sub-Issue 2)
  C. Fishes (Sub-Issue 3)
II. Terrestrial
  A. Fauna
    1. Invertebrates (*combined with Sub-Issue 2)
    2. Herpetofauna (Sub-Issue 4)
    3. Avian
      a. Seabirds (Sub-Issue 5)
      b. Landbirds (Sub-Issue 6)
    4. Mammals (Sub-Issue 7)
  B. Flora (*Malacothrix squalida*) (Sub-Issue 8)

Sub-Issue 1: Marine Mammals

Two pinniped species (harbor seals, *Phoca vitulina*, and California sea lions, *Zalophus californianus*) haul out on the rocks and beaches around Anacapa Island. Harbor seals breed on the island between January and March. Both species may be disturbed by the baiting activities and possibly by some of the monitoring activities. Efforts would be made to minimize drift of bait into the marine environment; however, if bait does enter the ocean, marine mammals may be at risk of rodenticide exposure.

- Measurement Indices
  - *Exposure to Residues* – the effects discussion will focus on how the proposed action and alternatives would expose the marine mammals to rodenticide residues.

Sub-Issue 2: Invertebrates (Marine/Terrestrial)

Terrestrial invertebrates on Anacapa Island would likely consume carcasses of vertebrates exposed to the rodenticide, as well as any residual bait not consumed. Thus, there is potential for the transfer of residues into the food chain.

Rodenticide may enter the marine food chain if bait incidentally drifts into the intertidal/subtidal areas and is consumed by marine intertidal invertebrates.

- Measurement Indices
- *Exposure to Residues* – the effects discussion will focus on how the proposed action and alternatives will expose the invertebrate populations to rodenticide residues, and, will analyze those predators at risk.

Sub-Issue 3: Marine Fishes

The relative exposure of gamefish to the rodenticide is small; however, there is a risk of incidental drift of bait into the marine environment thus presenting a primary and possible secondary exposure risk.

Measurement Indices

- *Exposure to Residues* – the effects discussion will focus on how the proposed action and alternatives would expose gamefish to the rodenticide via bait ingestion using recent studies with placebo baits.

Sub-Issue 4: Herpetofauna

Anacapa is home to two species of reptiles, the Side-blotched lizard (*Uta stansburiana)* and the Southern Alligator lizard (*Elgarra multicarinata),* and one species of salamander – the Channel Islands Slender Salamander (*Batrachoseps pacificus).* These species are subject to primary and secondary exposure risk.

- Measurement Indices
  - *Exposure to Residues* – The effects discussion will focus on how the proposed action and alternatives would impact lizards and amphibian populations, with emphasis on population level impacts and inclusion of results from eradication programs elsewhere.

Sub-Issue 5: Seabirds

For the purpose of this analysis, the seabirds have been subdivided into two groups: the pelagic seabirds and roosting seabirds. The pelagic seabirds are those birds that reside offshore from Anacapa Island and only utilize the island for breeding, outside of the proposed baiting period. The roosting seabirds are those that utilize Anacapa for roosting during the proposed baiting period.

- Measurement Indices
  - *Federally Endangered Seabirds* – Roosting and nesting habitat for the endangered Brown Pelican exists within the analysis area. The effects discussion will describe how the proposed action and alternatives to the proposed action affect the Brown Pelican.
  - *Disturbance* – the effects discussion in the effects will focus on how the proposed action and alternatives would disturb seabirds.
  - *Exposure to Residues*– The effects discussion will focus on how the proposed action and alternatives would impact seabirds, with results from recent studies completed on Anacapa Island.

Sub-Issue 6: Landbirds

Some species of landbirds utilize Anacapa Island seasonally and others year round. For the purpose of this analysis, the landbirds have been divided into two groups: the birds of prey, (raptors); and passerines. Birds of prey are at risk of secondary exposure through consumption of primarily exposed organisms. The Passerines were subdivided further based on foraging strategy (i.e. omnivorous, insectivorous, and granivorous). While the insectivorous passerines are at risk of secondary exposure and the granivorous are at risk of primary exposure, the omnivorous passerines are at risk of both primary and secondary exposure.

- Measurement Indices
  - *Exposure to Residues* - The effects discussion will describe how the proposed action and alternatives to the proposed action may affect individual birds of prey and passerines.

Sub-Issue 7: Mammals

The endemic subspecies (unique to Anacapa Island) of the Deer Mouse (*Peromyscus maniculatus anacapae*) co-exists on Anacapa Island with the introduced rats. Mice share many characteristics with rats and thus, are at a high risk of primary exposure.

- Measurement Indices
  - *Exposure to Residues* – The effects discussion will focus on how the proposed action and alternatives would impact the Deer Mouse population, with emphasis on population level impacts and include the results of rodent control operations elsewhere.

Sub-Issue 8: Flora

The endangered Island Malacothrix (*Malacothrix squalida*) is an annual herb from the aster family. It is found on Santa Cruz Island and Middle Anacapa Island. This annual occurs on rocky coastal bluffs in coastal scrub (Junak et al. 1995). On Middle Anacapa Island the distribution is very limited. It is found in two locations, near the east and west end of Middle Anacapa Island. The presence of island malacothrix makes it highly susceptible to trampling from personnel walking on the island.

- Measurement Indices
- *Trampling* – The effects discussion will focus on how the proposed action and alternatives would impact the island malacothrix population, with emphasis on mitigation against damage.

Issue 3: Public Safety and Visitation

Anacapa Island is the most visited of all islands in the Channel Islands National Park. Visitors are only allowed access to East Island and Frenchy's Cove on West Island. East Island receives both day visitors and overnight campers. With the high visitation to the islands by the public there are two concerns: 1) potential exposure of the public to the rodenticide: and 2) impacts to visitors from closing the island during operations of the AIRP.

- Measurement Indices
  - *Exposure to Residues*: The effects discussion will focus on how the proposed action and alternatives would potentially expose the visiting public to the rodenticide, as well as the associated health risks of exposure.
  - *Visitor Impacts*: The effects discussion will focus on how the proposed action and alternatives would potentially impact visitors' enjoyment of the Park during AIRP operations.

Issues Dismissed from Analysis

The analysis considered the social impacts of implementing the proposed project. The analysis concluded that the proposed project would not change the local population's work, recreation, or social interactions. As such, executive order 12898 (environmental justice) does not apply to this analysis.

Similarly, this analysis does not affect floodplains (EO1508.27), or sacred sites

(EO13007). The Park has also determined that this analysis does not require analysis of energy requirements (1502.16), nor does it require a economic impact analysis (EO11821)

Alternatives Considered in Detail

Introduction

Development of the alternatives was strongly influenced by the significant environmental issues. In developing the alternatives, the Park consulted many outside experts in the field of vertebrate biology, toxicology, and avian biology. In addition to the six alternatives described below, many other alternatives were considered, but were eliminated from further study. These alternatives, along with the rationale for their dismissal, can be found at the end of this chapter under the heading, "Alternatives Considered but Dismissed". Because of the specific objective of this project, many alternatives were dismissed because they could not meet the objective of total eradication.

Eradicating rats from Anacapa Island, and the eradication of rats as a result of an accidental introduction are two distinct, but inter-related activities. The former comprises the actions being proposed for the eradication of the known and long-term persistent rat population on Anacapa Island. The latter comprises the activities that are being considered in response to the accidental introduction of rats to islands within the Park.

Features Common to All Action Alternatives

Effectiveness and Validation Monitoring

Effectiveness and validation monitoring would be required to be done for each action alternative prior to final treatment of Middle and West Islets. Effectiveness monitoring would be conducted to determine if the alternative's prescription is effective in meeting the stated eradication objective. Validation monitoring would be conducted to determine if the environmental effects of implementing the management action (including mitigation measures) are similar to the effects predicted in the EIS.

For each alternative, eradication would begin with baiting (consistent with the alternative) in a representative habitat within the project area. Representative habitat would be limited to East Islet as a whole, or a smaller area on Middle Islet.

Analysis of monitoring data would be done prior to proceeding with final treatment of Middle and West Islets. Evaluation of monitoring results would determine whether to:

- Modify the eradication activities
- Continue the proposed eradication activities

Monitoring results that lead to a modification of the project may require a supplemental EIS. The supplemental EIS and subsequent decision would need to be prepared prior to resumption of eradication activities. A supplemental EIS is necessary when substantial new information is discovered, and/or when change of activities result in substantial change in environmental effects that were not previously analyzed in the EIS.

Monitoring results that are consistent with the analysis provided in the FEIS would allow for the continuance of the proposed eradication activities without additional environmental compliance.

Non-native Rodent Introduction Prevention Plan

To minimize the risk of rodent introductions to the Channel Islands, a set of standards would be implemented by the Park. The minimum proposed prevention actions, which would become the Park's prevention plan, are as follows:

1) Rodent-proof storage areas.
2) Rodent-proof containers that haul equipment and supplies to the Islands.
3) Control rodents at all departure points, including planes, boats, and helicopters that transport people and materials to the Islands.
4) Inform and educate all people who visit the islands. This includes visitors, concessionaires, contractors, employees, permittees, and researchers.

Protection of Native Deer Mouse Population

The presence of the endemic Anacapa Deer Mouse represents a unique challenge to rat eradication. The conservation and management of Anacapa Island Deer Mice is a high priority for the AIRP. The genetic and morphological status of the Anacapa Deer Mouse has been investigated using genetics, morphometrics and computer modeling (Pergams et al. 2000). The results of this study has confirmed that the Anacapa Deer Mouse is a distinct subspecies that is genetically identical across all three islets. Thus, the Deer Mouse population can be managed as a whole population (one "evolutionarily significant unit" (ESU)) rather than a distinct population on each islet. Further, to maintain genetic diversity and ensure a viable population, 1000 mice across all three islets would need to be protected (Pergams et al. 2000). Management actions to protect the Deer Mouse population will include a protection plan that will be implemented prior to the eradication efforts. Consultation with *Peromyscus* and genetic experts from the Brookfield Zoo, Illinois and the University of Illinois is underway to develop a protection plan that will maintain genetic diversity and ensure a viable population of mice on each islet post eradication. The Effectiveness and Validation Program will aid in the development of an effective protection plan for the Anacapa Deer Mouse because it will identify problem areas that would allow changes to the final Deer Mouse protection plan. The final Deer Mouse protection plan would be implemented prior to completion of the baiting. The Deer Mouse protection plan may include one or a combination of the following:

1. *Laboratory captive holding/breeding on/off island:* Mice are live captured and transported to a laboratory holding facility either on island or on the mainland. About 350 mice from each islet are captured from each island and held. They would be released back on to the island over time.
2. *Move mice between islands:* Mice are moved from Middle and/or West Island to East Island in between treatment of East and Middle/West Islands. Thus, a viable population of mice are available on East Island for restocking Middle and West Islands after eradication.
3. *Fenced enclosures:* Mice are maintained in a fenced enclosure where rats are prevented from entering, and mice are prevented from entering or leaving. A complement of mice are maintained with rodent chow and water for a determinant period of time. Mice are released over time from the enclosure back into the Anacapa environment, restocking the island. The enclosure area would not be treated.

Rat Detection Response Plan

Reacting to a "rat-spill" from a shipwreck or some other introduction requires a rapid response, as does any appearance of rats on Anacapa Island following eradication, or on Prince, Sutil and Santa Barbara Islands. In the event of a shipwreck the Shipwreck Response Plan is a decision pathway to implement the Rat Detection Response Plan (Appendix A) – a plan to evaluate the extent of rodent introduction and implement an appropriate response. The Rat Detection Response Plan would be implemented if rats were introduced to the islands via shipment of goods or equipment.

Human Health

A buffer of approximately 10 meters around the campground, buildings and landing area on East Island would be established. This buffer would not be aerially treated, although, a perimeter of bait stations would be established approximately every 10-15 m. Each station would be uniquely labeled to identify its location. An appropriate warning label such as: "Anacapa Island Restoration Project. Rat Poison – Danger, Do Not Disturb. Contact Park Ranger or telephone 805-658-5720" on each station and a copy of the product label would also be included at each of these bait stations for reference.

Timing

To minimize both disturbance and potential ecotoxicological impacts, bait application would be restricted to September through December of each year.

The late fall period offers the optimum time to apply the bait for the following reasons: 1) endangered Brown Pelicans are not breeding on the island; 2) the rats are in decline due to food stress and therefore would eat the bait more readily; and 3) the onset of the rainy season would expedite the degradation of any residual bait not consumed by the target species.

Splitting the treatment of the islands into two years is beneficial for several reasons. First, it allows monitoring for efficacy, i.e. evaluate the feasibility of eradication at the maximum of 15 kg/ha sowing rate, and modify and improve operational procedures for year 2. Secondly, the Park can monitor impacts to non-target species on a smaller scale to identify further necessary mitigation measures.

Permits and Approval

EPA registration and approval would be required for implementation of any of the alternatives considered in this analysis (except the No Action alternative). Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), use of a non-registered rodenticide requires approval from the Federal EPA. A site-specific application label would be prepared for the AIRP project. Consultation and registration with the EPA is required before application.

Public Awareness

Posters outlining the project and warning visitors of the activities on the island would be posted on the mainland at the visitor center, on island at the landing cove and at the visitor center at East Anacapa Island.

Visitation Restriction

The operations of the eradication program will require that visitation be restricted for a short period. East Anacapa Island will be closed to all visitors for approximately 2-3 days. The restriction is necessary to allow the operations crews to implement the baiting operation including helicopter activity, evaluation, and monitoring of the environment.

After the operations are complete, the island will be open to day use visitors. East Anacapa will be closed to campers for approximately 5 days because the campground will be used for housing the post treatment monitoring crews.

Alternatives

Alternative One

No Action

Alternative One (no action) continues the existing rat management strategy on Anacapa Island. Implementation of this alternative would occur assuming that future Park budgets are similar to recent budgets. Analysis of the alternative is a requirement of the National Environmental Policy Act (NEPA) and National Park Service planning procedures.

The existing management strategy for managing the species *Rattus rattus* on Anacapa Island is found in the Park's General Management Plan. Specifically, the GMP states, "Based on research and experimentation, programs will be implemented to reduce to the extent feasible the impacts of introduced plant and animal species." From the late 1980's through the early 1990's, concentrated control activity occurred on Anacapa Island. This consisted of widely spaced, elevated bait stations using the rodenticide Warfarin. Since that time the Park has concentrated control efforts around the existing structures on East Island. No control measures have been taken outside of these areas due to budget, personnel, and compliance constraints.

Alternative Two (Preferred Alternative)

Aerial broadcast of a Rodent Bait Containing Brodifacoum

<u>Summary</u>

This alternative outlines the use of a rodent bait aerially broadcast from a hopper suspended under a helicopter, and broadcast by hand.

East Islet baiting would occur during the Nov/Dec treatment window and would be treated along with approximately 20 ha of Middle Islet to lower the probability of invasion by rats from Middle Islet to East Islet. The 20 ha section of Middle Islet may be treated intermittently to prevent re-invasion of East Islet. Middle Islet (including the section treated with East Islet) and West Islet would be treated during the application window of November thru December in the year following East Islet application. Bait would be applied in the following formulation:

<u>Active Ingredient:</u> Brodifacoum

<u>Concentration of Active Ingredient:</u> 25 ppm Brodifacoum

<u>Rate of application:</u> Bait would be broadcast at a maximum rate of 15 kg /ha

<u>Application:</u> Application would be completed by hand or aerial broadcast across 100% of the area of the islands. Hand broadcast would be carried out by or under the supervision of licensed applicators spreading bait by hand. Aerial broadcast would be carried out utilizing a hopper (dry slinger) suspended from a helicopter flying along a predetermined pathway programmed into a Differential GPS. Aerial baiting would be carried out using a licensed pesticide applicator.

<u>*Top of Island*</u>*:* Bait would be spread from a hopper suspended under a helicopter. The helicopter would fly at approximately 50 knots, approximately 25-50 m aboveground with the

hopper open and spreading bait. To ensure even coverage, the island would be flown twice: once in an East-West direction sowing at half the rate, then again on a North-South direction sowing bait at half the rate. Bait would be spread from the hopper in a 360-degree pattern. The number of passes over the island would be determined by the swath width which is a function of size of the bait pellet and speed with which it is propelled out of the hopper.

<u>Cliffsides</u>: Every effort would be made to prevent bait from drifting into the marine environment. The helicopter would fly along the top cliff edge to minimize drift of bait into the marine ecosystem. The helicopter also would be used to "trickle" bait to the larger offshore rocks with the helicopter hovering low, hopper turned off- gate open to ensure adequate coverage. In some cases, bait would be hand broadcast onto the cliffsides from above. In the cases of hard-to-reach offshore rocks and lower reaches of cliffsides, travel by boat for hand broadcast may be required.

<u>Number of applications:</u> A maximum of two applications is anticipated.

<u>Timing</u>

- *<u>Years 1-2</u>*: Initiate eradication by baiting in representative habitat during the November-December application window (either East Islet as a whole, or smaller area on Middle Islet) and conduct implementation and effectiveness monitoring. Monitor results and determine if changes are necessary. *Year 1* activities may begin during the 2000 Nov-Dec application window given that necessary compliance measures are completed.
- *<u>Years 2-3:</u>* If monitoring results prove favorable, proceed with island-wide eradication activities. East Islet bait broadcast including 20 ha of Middle Islet, subsequent year treatment of Middle and West Islet, including the 20 ha buffer on Middle Islet. If rats are detected on East Anacapa Island between treatment periods, the Rat Detection Response Plan may be implemented. If the problem evaluation demonstrates that rats are widespread on East Island, the whole island may be re-treated during the treatment of Middle and West Islands.
- *<u>Future:</u>* If rats are detected, the Rat Detection Response Plan would be implemented (See Appendix A).

Alternative Three

Bait Stations for Top of Island and Aerial Broadcast the Cliffsides with Brodifacoum

<u>Summary</u>

The primary objective of this alternative is to minimize primary exposure impacts to landbirds. This alternative outlines a stratified baiting technique where bait stations would be used on top of Middle and East Islands while aerial broadcast is used on West Island and the cliffsides of East and Middle Islands. The bait stations would be armed for one year prior to treatment of West Island and cliffsides of East and Middle Islands. Under this strategy, rats would have been removed from the top of the islet for one year prior to treating the cliffsides. West Island would not be treated with bait stations because of the steep terrain and potential disturbance to pelicans with frequent visits by operators.

The top areas of East and Middle Islets would be initiated in Year 1 with deployment and arming of bait stations. In Year 2, bait stations would be checked and re-armed, while the cliffsides of East and Middle and all of West Island would be treated by hand and aerial broadcast with a second generation anticoagulant.

Active Ingredient: Brodifacoum

Concentration of Active Ingredient: 25 ppm

Aerial Application:

- *Rate of Application*: maximum of 15 kg/ha
- *Number of Applications*: a maximum of two applications.

Bait Stations Application:

- *Rate of Application*: 6 bait blocks/station
- *Number of Applications*: re-armed until activity ceases

Bait Station Design and Construction: Bait stations would be standard lockable stations, similar to those used by professional pest control operators, but brightly colored to assist locating in dense shrubbery.

Bait Station Locations: Bait stations would be secured in place around the cliff edge at 25-50 m intervals completely encircling the top of the island. The remaining bait stations would be secured on top of the island, laid out on a grid (spacing at 50 x 50 m). Each station would be uniquely marked with a tag identifying its location and an appropriate warning such as "Anacapa Island Restoration Project: Rat Poison – Danger, Do Not Disturb. Contact Park Ranger or phone 805 658 5720".

Bait Station Arming and Checking: Each bait station would be armed on the same day once the program is initiated. Certified pesticide applicators would supervise the arming of each station with six bait blocks containing 25-ppm brodifacoum. Each station would be visited daily, checked, and bait replenished to the 6-block level as necessary until activity ceases (activity includes bait chewed or taken by rats). Data (number of blocks taken, chewed, added, or replaced) from each station would be collected and entered into a database for analysis. When activity (bait removal or consumption) ceases, bait stations would be checked and re-armed bi-weekly then monthly for one year, documenting bait take and rat sign in stations.

Timing:

- *Years 1-2*: Initiate eradication by baiting as prescribed in representative habitat during the Nov-Dec application window (either East Islet as a whole, or smaller area on Middle Islet) and conduct implementation and effectiveness monitoring. Monitor results and determine if changes are necessary. *Year 1* activities may begin during the 2000 Nov-Dec application window given that necessary compliance measures are completed.

- *Year 2-3*: If monitoring results prove favorable, proceed with island-wide eradication activities.

  Deploy and arm bait stations on the flat, accessible top of East and Middle Islets. The stations would be checked daily, and re-armed as necessary, until activity ceases. Continue monitoring stations on a bi-weekly then monthly basis. Refresh bait in stations on East and Middle Islands, aerially broadcast rodenticide bait containing 25 ppm brodifacoum on cliffsides of East and Middle Islands and the 100% aerial broadcast treatment of West Island. The application rate would be up to 15 kg/ha following procedures outlined in Alternative Two. Continue to check and re-arm bait stations at bi-monthly intervals for an additional year.

- *Year 2 - Future*: If rat sign is found, the Rat Detection Response Plan would be implemented (Appendix A).

Alternative Four

Aerial broadcast of a Rodent Bait Containing Bromadiolone

Summary

This alternative involved aerial broadcast of bromadiolone, a second-generation anticoagulant similar to brodifacoum. This alternative addresses the issue of potential impacts to non-target species.

The rodent bait would be aerially broadcast from a hopper suspended under a helicopter, and hand broadcast by workers of the Anacapa Island Restoration Project (AIRP).

The treatment of Anacapa Island would take place over a period of one year. East Anacapa would be treated in year one along with approximately 20 ha of Middle Anacapa Island to lower the probability of invasion by rats from Middle Islet to East Islet. The 20 ha section of Middle Island may be treated periodically to prevent re-invasion of East Island. Middle Island (including the section treated in year one) and West Island would be treated in year 2.

Active Ingredient: Bromadiolone

Concentration of Active Ingredient: 50 ppm

Rate of application: Bait would be broadcast at a maximum rate of 15 kg /ha.

Application: Application would be completed by hand or aerial broadcast across 100% of the area of the islands. Hand broadcast would be carried out by or under the supervision of licensed applicators spreading bait by hand. Aerial broadcast would be carried out (by a licensed pesticide applicator) utilizing a hopper (dry slinger) suspended from a helicopter flying along a predetermined pathway programmed into a Differential GPS.

Top of Island: Bait would be spread from a hopper suspended under a helicopter. The helicopter would fly at approximately 50 knots, approximately 25-50 m aboveground with the hopper open and spreading bait. To ensure even coverage, the island would be flown twice: once in an East-West direction sowing at half the rate, then again on a North-South direction sowing bait at half the rate. Bait would be spread from the hopper in a 360-degree pattern. The number of passes over the island would be determined by the swath width which is a function of size of the bait pellet and speed with which it is propelled out of the hopper.

Cliffsides: Every effort would be made to prevent bait drifting into the marine environment. The helicopter would fly along the top cliff edge to minimize drift of bait into the marine ecosystem. The treated area would be a portion of the top of the island and the cliffsides. In some cases, hand broadcast bait onto the cliffsides from above, or travel by boat to service the offshore rocks, islands, and lower reaches of the cliffsides may be necessary. The helicopter would be used to “trickle” bait the larger offshore rocks with the helicopter hovering low, hopper turned off- gate open to ensure adequate coverage.

Number of applications: A maximum of two applications is anticipated.

Timing:

- *Years 1-2*: Initiate eradication by baiting as prescribed in representative habitat during the Nov-Dec application window (either East Islet as a whole, or smaller area on Middle Islet) and conduct implementation and effectiveness monitoring. Monitor results and determine if changes are necessary. *Year 1* activities may begin during the 2000 Nov-Dec application window given that necessary compliance measures are completed.
- *Year 2-3*: If monitoring results prove favorable, proceed with island-wide eradication activities.

Initiate broadcast of bait onto East Island and the 20 ha buffer of Middle Island. Initiate broadcast of bait onto Middle and West Island including the 20 ha buffer on Middle Island. If rats are detected on East Anacapa Island between year one treatment and year 2 treatment, the Rat Detection Response Plan may be implemented. If the problem evaluation demonstrates that rats are widespread on East Island, the whole island may be re-treated during the treatment of Middle and West Islands. The 20 ha section of Middle Island may be treated periodically between year one and treatment year 2 to prevent re-invasion of rats to East Island. This 20 ha section of Middle Island would be re-treated during the treatment of Middle Island.

- *Year 2- Future*: If rats are detected, the Rat Detection Response Plan would be implemented (Appendix A)

Alternative Five

Bait Stations for Top of Island and Aerial Broadcast the Cliffsides with Bromadiolone

Summary

The primary objective of this alternative is to minimize primary exposure impacts to landbirds and spatially exclude Deer Mice from gaining access to bait in stations. This alternative outlines a stratified baiting technique where bait stations would be used on top of Middle and East Islands while aerial broadcast is used on West Island and the cliffsides of East and Middle Islands. The bait stations would be armed for one year prior to treatment of West Island and cliffsides of East and Middle Islands. Under this strategy, rats would have been removed from the top of the islet for one year prior to treating the cliffsides. West Island would not be treated with bait stations because of the steep terrain and potential disturbance to pelicans with frequent visits by operators.

The top areas of East and Middle Islets would be initiated in Year 1 with deployment and arming of bait stations. In Year 2, bait stations would be checked and re-armed, while the cliffsides of East and Middle and all of West Island would be treated by hand and aerial broadcast with a second generation anticoagulant.

Active Ingredient:

- Bait Stations: bromadiolone
- Aerial Broadcast: bromadiolone

Concentration of Active Ingredient: 50 ppm

Aerial Application:

- *Rate of Application*: 15kg/ha
- *Number of Applications*: a maximum of 2 applications is anticipated

Bait Stations Application:

- *Rate of Application*: Stations would be armed with 6 bait blocks per station
- *Number of Applications*: Stations would be re-armed until activity ceases.

Bait Station Design and Construction: Bait stations would be standard lockable stations, similar to those used by professional pest control operators, but brightly colored to assist locating in dense shrubbery.

Bait Station Locations: Bait stations would be secured in place around the cliff edge at 25 m intervals completely encircling the top of the island. The remaining bait stations would be secured on top of the island, laid out on a grid (spacing at 50 x 50 m). Each station would be uniquely marked with a tag identifying its location and an appropriate warning such as "Anacapa Island Restoration Project: Rat Poison – Danger, Do Not Disturb. Contact Park Ranger or phone 805 658 5720".

Bait Station Arming and Checking: Each bait station would be armed on the same day once the program is initiated. Certified pesticide applicators would supervise the arming of each station with six bait blocks containing 50-ppm bromadiolone. Each station would be visited daily, checked, and bait replenished to the 6 block level as necessary until activity ceases (activity includes, bait chewed or taken by rats). Data (number of blocks taken, chewed, added, replaced) from each station would be collected and entered into a database for analysis. When activity (bait removal or consumption) ceases, bait stations would be checked and re-armed bi-weekly then monthly for one year, documenting bait take and rat sign in stations.

Timing:

- *Years 1-2:* Initiate eradication by baiting as prescribed in representative habitat during the Nov-Dec application window (either East Islet as a whole, or smaller area on Middle Islet) and conduct implementation and effectiveness monitoring. Monitor results and determine if changes are necessary. *Year 1* activities may begin during the 2000 Nov-Dec application window given that necessary compliance measures are completed.

- *Year 2-3:* If monitoring results prove favorable, proceed with island-wide eradication activities.

  Deploy and arm bait stations on the flat, accessible top of East and Middle Islets. The stations would be checked daily, and re-armed as necessary, until activity ceases. Continue monitoring stations on a bi-weekly then monthly basis. Refresh bait in stations on East and Middle Islands stations, aerially broadcast rodenticide bait containing 25 ppm brodifacoum on cliffsides of East and Middle Islets and the 100% aerial broadcast treatment of West Island. The application rate would be up to 15 kg/ha following procedures outlined in Alternative Two. Continue to check and re-arm bait stations at bi-monthly intervals for an additional year.

- *Year 2 - Future*: If rat sign is found, the Rat Detection Response Plan would be implemented (See Appendix A).

Alternative Six

Aerial broadcast of a Rodent Bait Containing Diphacinone followed by a Rodent Bait Containing Brodifacoum

Summary

This alternative outlines the aerial broadcast of diphacinone, a first generation anticoagulant followed by a bait containing brodifacoum, a second-generation anticoagulant. This alternative addresses the issue of potential primary and secondary exposure impacts to non-target species.

The rodent baits would be aerially broadcast from a hopper suspended under a helicopter, and by hand.

East Islet baiting would occur during the November thru December window and would be treated along with approximately 20 ha of Middle Islet to lower the probability of invasion by rats from Middle Islet to East Islet. The 20 ha section of Middle Islet may be treated intermittently to prevent re-invasion of East Islet. Middle Islet (including the section treated with East Islet) and West Islet would be treated during the application window of November thru December in the year following East Islet application. Bait would be applied in the following formulation:

Active Ingredients: Diphacinone and Brodifacoum

Concentration of Active Ingredient:

- Diphacinone: 50 ppm
- Brodifacoum: 25 ppm

Rate of application**:**

- Diphacinone: 22-34 kg/ha
- Brodifacoum: 5-10 kg/ha

Application: The first application of diphacinone would be applied in two waves approximately 3-4 weeks apart.

Three to four weeks after final diphacinone application, the brodifacoum bait would be aerially broadcast at a rate of 5-10 kg/ha.

Application would be completed by hand or aerial broadcast across 100% of the area of the islands. Hand broadcast would be carried out with or under the supervision of licensed applicators spreading bait by hand. Aerial broadcast would be carried out utilizing a hopper (dry slinger) suspended from a helicopter flying along a predetermined pathway programmed into a Differential GPS.

Top of Island: Bait would be spread from a hopper suspended under a helicopter. The helicopter would fly at approximately 50 knots, approximately 25-50 m aboveground with the hopper open and spreading bait. To ensure even coverage, the island would be flown twice: once in an East-West direction sowing at half the rate, then again on a North-South direction sowing bait at half the rate. Bait would be spread from the hopper in a 360-degree pattern. The number of passes over the island would be determined by the swath width which is a function of size of the bait pellet and speed with which it is propelled out of the hopper.

Cliffsides: Every effort would be made to prevent bait drifting into the marine environment. The helicopter would fly along the top cliff edge to minimize drift of bait into the marine ecosystem. The treated area would be a portion of the top of the island and the cliffsides. In some cases, hand broadcast bait onto the cliffsides from above, or and travel by boat to service the offshore rocks, islands, and lower reaches of the cliffsides may be necessary. The helicopter would be used to "trickle" bait the larger offshore rocks with the helicopter hovering low, hopper turned off- gate open to ensure adequate coverage.

Number of applications: A maximum of two applications is anticipated.

Timing:

- *Year 1-2:* Initiate eradication by baiting as prescribed in representative habitat during the Nov-Dec application window (either East Islet as a whole, or smaller area on Middle Islet) and conduct effectiveness and validation monitoring. Monitor results and determine if changes are necessary. *Year 1* activities may begin during the 2000 Nov-Dec application window given that necessary compliance measures are completed.
- *Year 2-3*: If monitoring results prove favorable, proceed with island-wide eradication activities.

  Initiate broadcast of bait onto East Island and the 20 ha buffer of Middle Island. .Initiate broadcast of bait onto Middle and West Island including the 20 ha buffer on Middle Island. If rats are detected on East Anacapa Island between year one treatment and year 2 treatment, the Rat Detection Response Plan may be implemented. If the problem evaluation demonstrates that rats are widespread on East Island, the whole island may be re-treated during the treatment of Middle and West Islands.

- *Year 2- Future*: If rats are detected, the Rat Detection Response Plan would be implemented (See Appendix A)

Alternatives Considered and Rejected

Bait Stations

Under this alternative bait stations would have been placed on top as well as on cliffsides and shorelines of Anacapa Island. This was dismissed because of the steep topography and unstable cliffsides, would have made stations problematic. Moreover, vegetation would have been trampled and nesting pelicans disturbed. A detailed description of each reason follows.

Anacapa Island is composed of basalt and is partially volcanic in origin. As a result, the cliffsides are extremely unstable and rockfalls are not uncommon. The placement of bait stations would require project personnel to scale the cliffs using ropes. The instability of the cliffsides and high risk of rocks falling on, and severely injuring climbers resulted in this alternative being dismissed.

Bait stations would have to be serviced frequently by personnel, resulting in a high risk of erosion and trampling of native vegetation. A network of trails would be created that would result in long-term damage.

Disturbance to pelicans nesting on West Anacapa would be unavoidable because of the need to service bait stations. The pelicans are protected under the Endangered Species Act and regular disturbance could cause nest abandonment and nest failure resulting in low productivity.

Elevated Bait Stations

The use of elevated bait stations, designed by Erickson (1990) would have been used in any of the alternatives that required bait stations.

Erickson's (1990) laboratory study showed that only 93% (n=30) of roof rats could gain access to the bait in the stations. The purpose and need dictates that 100% be removed; therefore, elevated bait stations fail to meet the objective. In the field, rats were shown to readily use the stations; however, it was unclear if 100% of rats in the area were exposed to the bait. Although the elevated bait stations show promise for rat control where native mice are present, Erickson (1990) did not demonstrate that rats could be controlled or eradicated from Anacapa Island.

Using elevated bait stations would require personnel to dig PVC piping into the ground to support the stations. Where soil is present, PVC may be easily dug into the ground. However, Anacapa is very rocky (the majority of the island is exposed rock), thus digging holes for PVC would be near impossible. In addition to the logistical challenge the placement of stations across the islands and cliffsides would present, they also would cause disturbance to native vegetation and disturbance and possible damage to cultural sites (e.g. Chumash native middens, archaeological sites).

Alternate Rodenticides

The use of the other rodenticides registered with the US EPA were considered. The rodenticides were dismissed for one or more of the following reasons: 1) lack of proven effectiveness in island rat eradications; 2) potential for development of bait shyness in the rat population; 3) inability to cope with the potential "Warfarin resistant" rats; and 4) the unavailability of an antidote in case of human exposure. Each of these issues and the associated rodenticides are discussed below. For a summary of the registered rodenticides considered, see Table 2.

Previous island wide eradication projects (for islands greater than 10 ha) have only utilized brodifacoum, bromadiolone, and warfarin (Table 2). Bromethalin was used in conjunction with brodifacoum on one island. None of the other rodenticides have been used for island eradications.

The use of bromethalin and zinc phosphide if used extensively, could result in the development of "bait shyness". Bait shyness develops in a rat population when symptoms of exposure are associated with the bait presented such as bromethalin and zinc phosphide. Studies have demonstrated that even with pre-baiting, only 60- 70% of rats would be controlled with an acute rodenticide (Lund 1988). Any individual rat that survives a round of exposure is likely to avoid the bait in the future (Record and Marsh 1988). If rats were to survive a baiting application on Anacapa Island, the effort required to remove those individuals would be greater than if a non-acute rodenticide which does not induce bait shyness was used. Cholecalciferol may also lead to "bait aversion" because of the high concentrations in the final bait formulations (Prescott et al. 1992 in Kaukeinen et al. 2000)

An attempt to control and/or eradicate rats from Anacapa Island was carried out over a number of years in the 1980s and early 1990s. Many control methods were attempted including delivery of Warfarin via bait stations. The control of rats can be a strong selection agent, increasing the frequency of rats that cannot be killed via the control method used. Where populations of rats have been previously exposed to poison, some rats demonstrate bait avoidance behavior and others may be biochemically "resistant" to the anticoagulant used.

It is unknown if the population of rats on Anacapa Island contain individuals that would demonstrate bait shyness or are "Warfarin-resistant". If rats are resistant to Warfarin, the amount of bait used would require greater and greater amounts of warfarin to induce a toxic effect. It may be that "Warfarin resistant" individuals are insensitive to the other first generation anticoagulants such as diphacinone and chlorophacinone (Greaves 1994). Even if warfarin resistance is not present in a rat population, the use of first generation anticoagulants may not induce 100% mortality of the target species under standard EPA laboratory efficacy studies.

The use of rodenticides in the field does pose some degree of risk, albeit small (due to the fact that humans would have to intentionally ingest the bait, in large quantities to do harm), to humans on the islands. On Anacapa Island, bait would be applied to East Island, which visitors frequent, so there is some potential for visitors to be exposed to any rodenticide. However, the exposure to human visitors is extremely low. All of the rodenticides represent a risk of exposure. However, most have an antidote (Vitamin K1 for the anticoagulants, and calcitonin for cholecalciferol) which counteract the activity of the rodenticide. Of the acute rodenticides, symptoms would be measurable soon after ingestion. If sufficient quantities were consumed, immediate intervention would be required including medical evacuation. A major disadvantage of the acute rodenticides, from a human health perspective, is the lack of an antidote.

Table 2. Characteristics of rodenticides registered with the US EPA

Rodenticide	Category	Previous Success in Island Restoration	Activity	Ability to Induce Bait Avoidance[a]	Danger to Humans	Antidote Available?
Brodifacoum	Second Generation Anticoagulant	High	Single Feed	Very Low	Low	Yes
Difethialone	Second Generation Anticoagulant	No Data	Single Feed	Very Low	Low	Yes
Bromadiolone	Second Generation Anticoagulant	Low	Single Feed	Very Low	Low	Yes
Chlorophacinone	First Generation Anticoagulant	No Data	Multi-Feed	Low	Low	Yes
Diphacinone	First Generation Anticoagulant	No Data	Multi-Feed	Low	Low	Yes
Warfarin	First Generation Anticoagulant	Low	Multi-Feed	Low	Low	Yes
Bromethalin	Subacute	Low	Single Feed	High	High	No
Cholecalciferol	Subacute	No Data	Single Feed	Possible	Moderate	Yes
Zinc Phosphide	Acute	No Data	Single Feed	High	High	No

a See text for definition

Trapping

This alternative would have used live traps and/or kill (snap) traps to eradicate rats from Anacapa Island. This alternative was dismissed because it failed to meet the purpose and need and is technologically infeasible.

The use of live traps and/or kill traps to remove rats from an area is a strong selection agent and selects for rats that are “trap shy”. Thus, the frequency with which rats are trapped decreases with the increasing effort of trap placement. Therefore, a prohibitive financial and time investment would be required to trap the few remaining rats from Anacapa Island. This technique has not been successfully used on other islands and likely would result in a large control program that, in effect, would harvest the surplus rats.

The implementation of a trapping regime on Anacapa Island would require substantial labor and subsequent financial investment. Traps would have to be laid on the cliffsides and shoreline of the island to be successful. Staff servicing traps would be placed at risk of encountering numerous vector bone diseases from handling rodents and used traps. The effects of personnel scaling the cliffs has been discussed in the first alternative considered but dismissed (see above). There is also the high probability of capturing non-target species such as landbirds, seabirds and mice in the traps. Therefore, this alternative is infeasible to implement.

Introducing Predators

This alternative is one form of biological control that was recommended during the scoping period. The introduction of predators such as snakes and cats was recommended; however, this was dismissed because it fails to meet the purpose and need. It also would result in unreasonable damage to the environment, and does not conform to the Park's General Management Plan.

The introduction of cats to islands in order to control introduced rats has been attempted numerous times since European explorers began crossing the Atlantic and Pacific Oceans in search of riches. The introduction of a predator such as cats to control rats usually results in a greater impact on birds than if one or the other were present alone. When seabirds are present, cats have been demonstrated to prey heavily on seabirds (Keitt 1998, Atkinson 1985) taking fewer rats. When the seabirds leave the island, the cats turn to rats which artificially maintain the population at a higher level than if the rats were not present (Atkinson 1985). Thus, birds are impacted by both rats and the larger number of cats present due to the rats. Introduction of another species into an island ecosystem can have severe and permanent consequences (see Quammen 1996). The introduction of non-native species has been identified as the leading cause of species extinctions on islands (Tershy et al. 1997).

Summary of Alternatives

A summary of the major features of each alternative can be found in Table 3. The environmental impacts of implementing each alternative are discussed in Chapter Four. The alternatives differ in their approach to distribution of a rodenticide (aerial, bait station) across the island and the active ingredients used in the rodent bait.

Table 3. Summary of Alternatives for the Anacapa Island Restoration Project.

Alternative	East Anacapa		Middle Anacapa		West Anacapa		Active Ingredient	Concentration (ppm)
	Top	Cliff	Top	Cliff	Top	Cliff		
1 (No Action)	NA	NA	NA	NA	NA	NA	NA	NA
2 (Preferred)	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Brodifacoum	25
3	Bait Stn	Aerial	Bait Stn	Aerial	Aerial	Aerial	Brodifacoum	25
4	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Bromadiolone	50
5	Bait Stn	Aerial	Bait Stn	Aerial	Aerial	Aerial	Bromadiolone	50
6	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Diphacinone and Brodifacoum	50 and 25

ANACAPA ISLAND RESTORATION PROJECT

CHAPTER THREE
AFFECTED ENVIRONMENT

Chapter Contents

Introduction

This chapter focuses on portions of the environment that are directly related to conditions addressed in the alternatives. The description of the affected environment is not meant to be a complete description of the project area. Rather, it is intended to portray the significant conditions and trends of the resources that may be affected by the proposed project or its alternatives. Information in this chapter is based primarily on the Natural Resources Study conducted in 1979 by the Santa Barbara Museum of Natural History, inventory and monitoring data from the Park's resource management staff, independent research studies, and studies conducted as part of this proposed action. Other sources are noted where applicable.

This chapter is organized into four sections, which when taken together provide the most complete description of the island resources, including the human element. The four major components of this chapter are:

- Physical Environment
- Marine Environment
- Terrestrial Environment
- Human Uses and Values.

For the most part, geologic and climatological conditions, processes, and disturbances cannot be altered by management activities. Watershed, soil, and atmosphere conditions and processes, also part of the physiographic setting, can be modified by certain management activities. However, the management activities that are proposed in this analysis would not affect the physiographic settings.

Physical Environment

Setting

Off the coast of Southern California, eight ridges in the continental shelf rise above sea level, forming a series of islands. The four northern islands are located in the Santa Barbara Channel parallel to the coast south of Point Conception: the four southern islands are scattered offshore between Los Angeles and the Mexican border.

The Channel Islands vary greatly in size, distance from each other, and distance to from the mainland, creating an immense natural laboratory of isolation and evolution. Because the islands have escaped much of the historical human impact on coastal California, they provide an ideal place for a National Park.

Of all the Channel Islands, the smallest and closest to the mainland is Anacapa Island. Totaling 296 ha, Anacapa Island with its three islets (East, Middle, and West) is just over 1 square mile in area. One of the northern Channel Islands, it lies southwest of the City of Ventura, 9 miles across the Santa Barbara Channel from the nearest mainland point.

Geology

(Adapted from Gustafson, 1999) The Channel Islands are but exposed peaks in a topographically complex area of submarine basins and ridges known as the Continental Borderland. This has been a region of intense geological activity – including crustal deformation, volcanism, faulting, uplift, and erosion – caused by local tectonic processes.

The deep wrinkles of today's Boderland began to form in a previously broad continental shelf during the Oligocene epoch (30 million years ago) in response to stress at the boundary of the North American and oceanic plates. Widespread volcanic activity both on and off shore followed in the Miocene epoch (24 to 7 million years ago), as the Farallon Plate was subducted under the continental shelf.

Among the ranges created by this tectonic activity was the Santa Monica Mountains Range, which originally ran north and south. By the end of the Miocene, however, this range had rotated into its present east-to-west orientation, as had several other mountain chains now known collectively as the Transverse Ranges. The four northern Channel Islands, including Anacapa Island, constitute the seaward extension of the Santa Monica Mountains, which rise in downtown Los Angeles, plunge into the ocean at Point Mugu, and continue westward for many miles.

During the Pleistocene ice ages, sea levels dropped enough for the four northern islands to form a single, vast island now known as *Santarosae.* For decades, scientist assumed that a landbridge once connected Santarosae to the mainland range as well. But as bathymetric knowledge of the ocean floor improved, geologists concluded that even during periods of lowest sea levels (about 17 thousand years ago), the connection between the mainland and Santarosae remained submerged. As glaciers melted at the close of the Pleistocene, rising sea levels flooded lower elevations of Santarosae, leaving the higher regions exposed and separated.

Anacapa Island is mostly made up of volcanics, miocene basalts, andesites, and breccias formed largely by underwater eruptions 15-20 million years ago.

Geologic reconnaissance conducted by Johnson (1979) on Anacapa Island described the bedrock geology, quaternary marine terraces and sediments, and quaternary terrestrial sediments.

Bedrock Geology

The bedrock geology of Anacapa Island is comprised of dark colored Miocene Conejo volcanics with some modest to significant interbeds of lighter-colored San Onofre Breccia, also of Miocene age. Some of the basalt is of the pillow type indicating submarine eruptions. Various joints, faults, and fractures are seen in the sea cliffs about the island and where these intersect the sea, sea caves have formed. Scholl (1960) concluded that Anacapa has tilted to the northward as a unit in the Late Pleistocene or Holocene. This tilt is very apparent on each of the three islets.

Quaternary Marine Terraces and Sediments

Quaternary marine terraces and sediments occur at various elevations, the most conspicuous of which is the 250-ft. terrace which dominates the mesa-like form of Middle and East Islets. These have been described by several authors (Scholl 1960; Lipps 1964), and occur at 25 and 250 feet elevations. During the geological reconnaissance associated with the present study, beach deposits were found at 25, 250, 650, 800, and 840 ft.

Marine sediments occur on all three islets but have been preserved best on Middle and West Islets. On Middle Islet, however, fosssiliferous terrace deposits occur at 25-ft.

elevation, and a marine unit some 2.5 – 4.5 feet thick veneers at the 250-foot terrace.

Quaternary Terrestrial Sediment

Quaternary terrestrial sediments are thin on East Islet, ranging from 0 –8 ft. thick, but on Middle and West Islets range up to 15 – 50 feet thick respectively. At the boat landing at the east-end of West Islet a terrestrial unit occurs which has yielded many remains of birds, at least one of which is extinct.

Soils

Soil information on Anacapa Island is known from a reconnaissance survey conducted by Johnson (1979). From eight hand-dug pits and soil lab analysis it was determined that the Island has three major soil types.

<u>*Lithic Xerorthents*</u> – soils found on moderately steep to steep recent erosional slopes.

<u>*Typic Chromoxererts*</u> – clayey, poorly horizonated soils that shrink and crack during summers and swell when wetted during winters. Found on gentle to moderate slopes on all three islets.

<u>*Vertic Argixerolls*</u> – clayey, organic matter-rich soils that have shrink-swell characteristics such that it forms significant cracks in summer. Found on the gentlest and flattest portions on all three islets.

Status and Trend

Determination of the status or trend of soil resource conditions for Anacapa Island is difficult because of the lack of monitoring data. Generally, declines in soil quality and productivity are associated with intensive vegetation management activities, roading, and grazing. Prior to becoming a National Monument in 1938, all three islets had been grazed primarily by sheep. East Islet had sheep grazing between 1902-1912, and Middle and West Islets were grazed from 1902-1937 (Johnson 1979). It is estimated that soil resources were significantly affected during this period, but has since recovered. However, to varying extents the islets have been invaded by alien grass and forb species. The impacts to soil resources as a result of these invasive species are not known.

Cyanobacterial crusts

Cyanobacterial crusts are important for increased soil stability, water infiltration, and fertility of soils. Cyanobacterial crusts are common on the Channel Islands. Surveys done by Belnap (1994) indicate that cyanobacterial crusts should cover the soil surfaces in most of the vegetation types found in the Channel Islands.

These soil crusts are impacted by soil surface disturbance, including grazing, people and off-road vehicles. The only opportunity currently for these crusts to be disturbed on Anacapa Island is through trampling by people.

Although restricted to hiking trails on East Anacapa Islet, authorized activities such as iceplant removal and terrestrial animal monitoring, as well as unauthorized trampling by errant hikers may impact these crusts. Middle and West Islets receive minimal foot traffic.

Climate

Precipitation and Temperature

The Channel Islands enjoy the Mediterranean climate typical of the central

California coast. Rain pelts the islands off and on from November to March, but is scarce from late May to October, when a stable Pacific high-pressure system settles off the coast. A shallow coastal marine layer helps ameliorate summer drought conditions on the islands in all but the driest of years.

Northwesterly winds blow throughout the year, picking up speed most afternoons and dropping off at night. These winds drive fog against the islands' northwestern slopes, which provide very different climatic conditions than the south-facing coastal slopes of the mainland. Santa Ana winds occasionally disrupt this pattern, particularly in the fall and early winter. These hot dry winds blow from the east when high-pressure systems are present of the interior mainland.

Drought

Drought is an important process that affects ecosystems. Drought is defined as an absence of usual precipitation (less than 75 percent of normal), for a long enough period that there is decreased soil moisture and stream flow, thereby affecting ecological processes and human activities. Drought conditions occur frequently on Anacapa Island.

Air Quality *(Clean Air Act)*

Current Status and Trend

The history of air quality monitoring on the Channel Islands goes back to the period of 1988-1992 when a air quality station was located on East Anacapa Island. This station monitored ozone, sulfur dioxide, hydrocarbons, and nitrogen oxides. This station was removed when the Coast Guard converted the Anacapa lighthouse to solar power, and removed the power supply for the air quality station. In 1996, in cooperation with the Santa Barbara County Air Pollution Control District, an ozone monitoring station was built on Santa Rosa Island.

It is probable that the combination of prevailing wind patterns, a low natural fire history, and small human populations has

Table 4. Anacapa Island-Lighthouse 1992 Ozone Summary (Ventura County Air Pollution Control District)

Year	% of Days Moni-tored	Number of Days Standard Exceeded			1-hr Ozone Concentrations ppm					8-hr Ozone Concentrations ppm		
		State 1-hour	Federal 1-hour	Federal 8-hour**	1st High	2nd High	3rd High	4th High	EPDC*	1st High	2nd High	3rd High
1992	67%	4	0	2	0.100	0.100	0.100	0.100	0.102	0.094	0.090	0.081

*The Expected Peak Day Concentration (EPDC) is calculated based on data for 3 successive years, listed by the last year of the three year period. The EPDC represents the ozone concentration expected to occur once per year.
**Proposed Federal Standard

allowed for generally good air quality on the island. Following the population and development boom along coastal southern California, however, poor air quality is widespread, and smog often mars the visibility from and around the islands.

The phenomenon of "Santa Ana" winds that come from a northeasterly, inland direction can greatly affect air quality at Anacapa Island. These winds usually occur during fall and winter and are characteristically warm and dry and may be of very high velocity near the mainland shore. They primarily affect those islands close to the mainland by carrying out to sea the air pollution usually found onshore. Satellite images show that Santa Ana winds can carry pollutants several hundred miles offshore and have the potential to negatively affect all of the park islands. A bigger concern relative to air pollutants in the Channel Islands is a "Catalina eddy" that can bring pollutants up the coast from the Los Angeles basin and a post-Santa Ana event where the air pollutants that were pushed offshore come slowly back to the coast. Another type of pattern that would bring moderate levels of air pollutants to the Channel Islands is an eastern Pacific high pressure system that causes light winds and poorly dispersed air. Normally, the sea breeze pushes the air pollutants to the coast and keeps low levels of air pollutants in the Channel Islands.

Terrestrial Environment

Introduction

This section provides a description of the terrestrial component of Anacapa Island that is directly related to conditions addressed in the alternatives. As such, it is not a complete description of the entire terrestrial environment. This chapter is organized to focus on the sub-issues identified for the terrestrial environment using the best information available. This chapter will also include descriptions of the significant conditions and trends of the resources that may be affected by the proposed project or its alternatives. Listed below are the four terrestrial components that will be described in this section:

- Invertebrates
- Herpetofauna
- Avian
- Mammals

Invertebrates

Current Status

A natural resources study completed by the Santa Barbara Museum of Natural History (Miller and Hochberg 1979) generally described the dominant insects on Anacapa Island. The survey focused on insects that would have been of special interest to the Park such as, endemics and pests. Since that time, several studies have added to the knowledge base of invertebrate species for Anacapa Island. In the Parks *Terrestrial Invertebrate Monitoring Handbook* (Fellers 1991), the Park provided an update of invertebrate fauna that was known to exist on Anacapa Island. Table 5 shows a comparison of the species identified in 1979 by Hochberg and Miller (1979) and the current state of knowledge. Table 6 describes the number and proportion of endemic terrestrial invertebrate taxa on Anacapa Island.

The Parks report (1989) states that despite the increasing knowledge of the composition of the terrestrial invertebrate fauna, there is still an almost complete lack of data on the ecology, distribution and abundance of invertebrates on the park islands.

Table 5. Terrestrial Invertebrates known from Anacapa in 1979 (Hochberg 1979; Miller 1979) and 1989.

Taxa	1979	1989
Snails	2	2
Insects	94	130
Other Arthropods	3	7
Total	**99**	**139**

Trend

Channel Islands National Park developed a Terrestrial Invertebrate Monitoring Handbook (Fellers and Drost 1991) for the purpose of detecting significant changes in the diversity, abundance and distribution of terrestrial invertebrates. Because of the isolation of the Islands, the Park is especially interested in expansion of non-native invertebrates into native plant communities. Unfortunately, due to budgetary and personnel constraints the monitoring program has not been implemented. As a result, trend estimates for the invertebrate population's "health" on Anacapa Island is not known.

Table 6. Number and proportion of endemic taxa on Anacapa Island (Fellers and Drost 1991).

Taxa	No. of Species	Total Endemic (percent)
Snails	2	1(50)
Arthropods	137	18(13)

Herpetofauna

Current Status

Herpetofauna for this discussion includes native amphibians and reptiles on Anacapa Island. Only one native amphibian, the Pacific Slender Salamander (*Batrachoseps pacificus pacificus)* and two native lizards, the Side-blotched Lizard (*Uta stansburiana*) and the Southern Alligator Lizard (*Elgaria multicarinatus),* occur on Anacapa Island.

In 1988 the Park published a protocol (Fellers et. al. 1988) for monitoring terrestrial vertebrates within the Park. A significant portion of the monitoring protocol was directed at monitoring the Park's amphibians and reptiles. The purpose of monitoring was to determine population status. Population status was reported using two parameters; 1) an uncalibrated index of population size and, 2) weight-length regression. The population index allows the park to track changes in population size and thus detect both long-term trends and sudden, short-term changes. The weight-length regression provides a measure of the general health of the population.

Trend:

Data collection on the reptiles and amphibian monitoring began in 1993. Figure 2 shows the population index for both species.

Normal year-to-year changes can be expected for the salamander because their activities are strongly moderated by rainfall. As shown in Figure 2 the population index for the pacific salamander increased dramatically during the wet winter season of 1997-98.

Avian

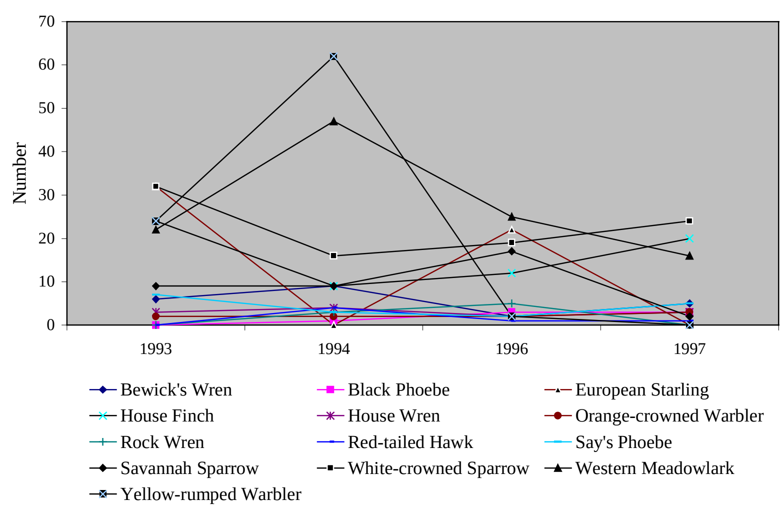
Landbirds

Current Status

Twenty-two species of landbirds are known to breed on Anacapa Island (Diamond and Jones 1980). Seven of these taxa are recognized as endemic subspecies, occurring only on Anacapa and one or more of the other Channel Islands (Johnson 1972). These endemic species include the Allen's Hummingbird (*Selasphorus sasin sedentarius*), Pacific-slope Flycatcher (*Empidonax difficilis insulicola*), Horned Lark (*Eremophila alpestris insularis*), Bewick's Wren (*Thryomanes bewickii newophilus*), Loggerhead Shrike (*Lanius ludovicianus anthonyi*), Orange-crowned Warbler (*Vermivora celata sordida*), House Finch (*Carpodacus mexicanus frontalis*) and Rufous-crowned Sparrow (*Aimophila ruficeps obscura*).

Not all of the species that are known to breed on Anacapa Island were observed during the 1995-1997 National Park Service surveys. Middle and West Anacapa Island were not included in the transects and could have contained breeding landbirds (Austin and Coonan 1998). West Anacapa Islet provides the best landbird habitat out of the three Anacapa islets, due to its greater topography and more extensive stands of native shrub vegetation, including coastal sage scrub and coreopsis scrub. A complete list of landbirds found on Anacapa Island can be found in the Appendix.

Figure 3. East Anacapa Island Fall Landbird Counts



Trend:

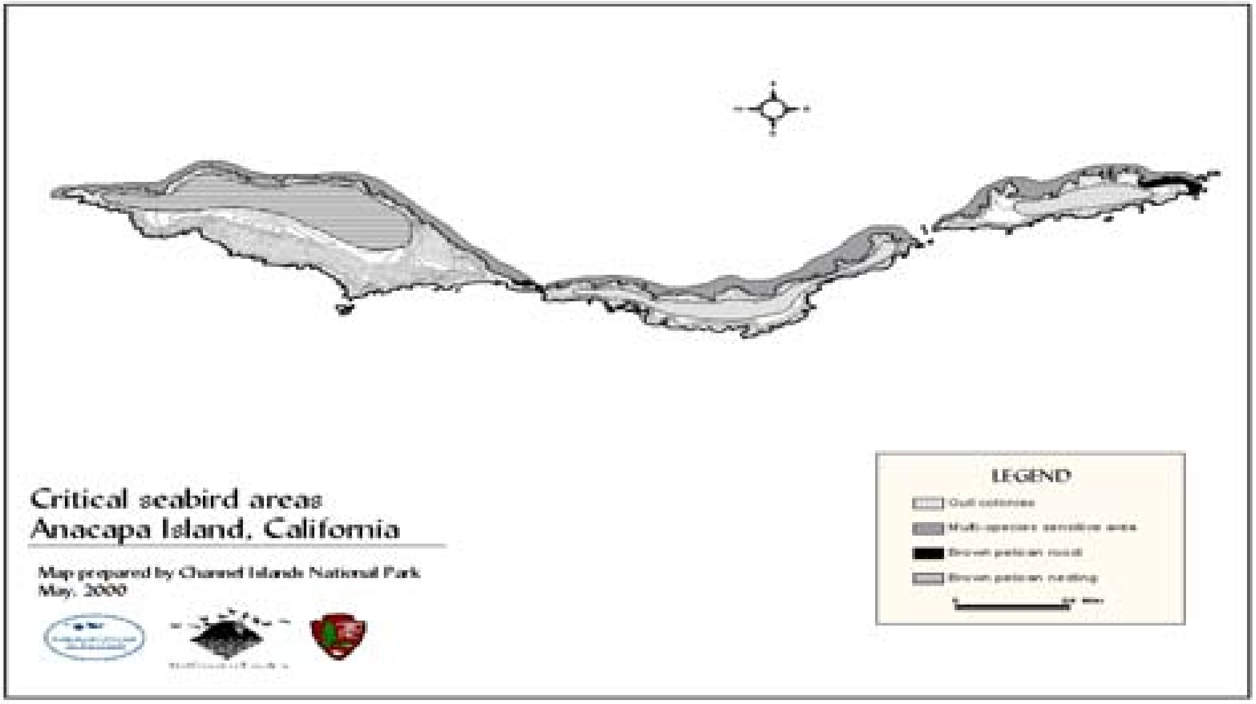
Part of the terrestrial monitoring program at Channel Islands is focused on monitoring landbirds. The objective of the monitoring program is to provide, on an annual basis, species and numbers of breeding land birds on Park Islands. Counts are made to provide information on relative abundance of all breeding birds on each island during breeding and non-breeding periods each year.

Seabirds

Current Status

Currently there are eight species of nesting seabirds on Anacapa Island. Of the eight species, three are classified as being Species of Special Concern in California. These Species of Special Concern include

Figure 4. Critical Seabird Areas.



the Ashy Storm-Petrel (*Oceanodroma homochroa*), Double-crested Cormorant (*Phalacrocorax auritus*), and the Xantus' Murrelet (*Synthilboramphus hypoleuca*) (California Department of Fish and Game 1992). The Xantus' Murrelet is also listed as a Federal Species of Concern (U.S. Fish and Wildlife Service 1998). The Channel Islands National Park also provides one hundred percent of the state's population of nesting Xantus' Murrelet. Figure 4 shows the critical seabird areas on Anacapa Island.

One of the breeding seabirds on Anacapa Island is the California Brown Pelican (*Pelecanus occidentalis californicus*), which is listed as a federal Endangered species. One hundred percent of the state's population of nesting California Brown Pelican occurs on Anacapa and Santa Barbara Island. Because of its significance as a listed species under the Endangered Species Act, the Park will be consulting with the U.S. Fish and Wildlife Service on this project.

Factors that threaten nesting seabirds on Anacapa Island include predation by introduced Black Rats (*Rattus rattus*), oil pollution, organochlorines, and gill nets (Drost and Lewis 1995). The introduction of non-native plant species may play a role in loss of habitat, but the numbers of nesting seabirds on Anacapa Island are still relatively low compared to the available habitat.

Trend

Brown Pelican

In the 1950's the pesticide DDT heavily impacted Brown Pelicans. The pesticide was concentrated as it moved up the food chain and in Pelicans and other predatory birds caused the eggshells to be so thin that the incubating adult crushed the eggs. By

1968 the population was so low that only 100 pairs bred on Anacapa Island and only four chicks fledged. For this reason, Brown Pelicans were listed as a Federally Endangered Species. DDT was banned in the U.S. in 1972 and since then Brown Pelican numbers have increased. Today they are close to, or above historical population sizes, making the Brown Pelican a conservation success story.

Today Brown Pelicans are susceptible to pollution (especially oil spills and fishing gear entanglement), disturbance, and predation of eggs and young chicks by introduced species.

Brown Pelicans are particularly susceptible to disturbance in the early part of the breeding season; during incubation and the first three weeks of chick rearing. During this period, if adults are disturbed they will fly off the nest leaving the eggs or young chicks exposed to heat, cold, or gull and raven predation. For this reason, breeding colonies such as Anacapa Island must be strictly protected during the breeding season. Even a single group of visitors during the breeding season can result in complete breeding failure over large parts of the colony.

During the non-breeding season Brown Pelicans are much less susceptible to disturbance. They will fly off if approached closely, but the only impact this has on individuals is the energetic cost of flying away and the time lost flying that could be used for preening or resting. In addition, adults are much less likely to be energetically stressed during the non-breeding season when they are non-involved in courtship or chick rearing. Consequently, during the non-breeding season, single disturbance events will have little impact on Brown Pelican populations. However, repeated disturbance of non-breeding Brown Pelicans could have a cumulative impact if it caused a significant energetic drain or significantly reduced time available for preening.

Species of Special Concern

Two of the species of concern are sea cave/crevice nesting seabirds that are susceptible to disturbance. These species Ashy Storm-Petrel (*Oceandodroma homochroa)* and Xantus' Murrelet (*Synthliboramphus hypoleucus)* nest in similar habitats on Anacapa Island. Population decline in both species has been documented by Sydeman et al. (1998).

The executive committee of the Pacific Seabird Group has authorized a committee to draft a petition to list the Xantus' Murrelet for protection under the Endangered Species Act. The Pacific Seabird Group, however, has yet to render an opinion on the merits or reasons for listing Xantus' Murrelet.

In addition to rat impacts on the murrelet, other disturbance factors such as oil pollution and the associated impacts (increased predation, disorientation, disruption) from bright lights from squid boats who fish adjacent to Anacapa Island may be contributing factors to the decline of the Xantus' Murrelet population.

An assessment of nesting habitat confirmed the impacts of introduced predators on the Xantus' Murrelet on Anacapa Island. Of the estimated 505 potential nesting sites accessible to rats, only two sites, or 0.4%, had evidence of nesting murrelets (McChesney et al. 2000). Both eggs showed evidence of mammalian predation and were in areas where rats appeared to be common. In contrast, on rat-free Santa Barbara Island similar surveys in 1991 found murrelet eggshells in 29.4% of potential sites. Murrelets on Anacapa Island are mostly limited to nesting in areas inaccessible to rats or where rats occur infrequently.

Mammals

Current Status

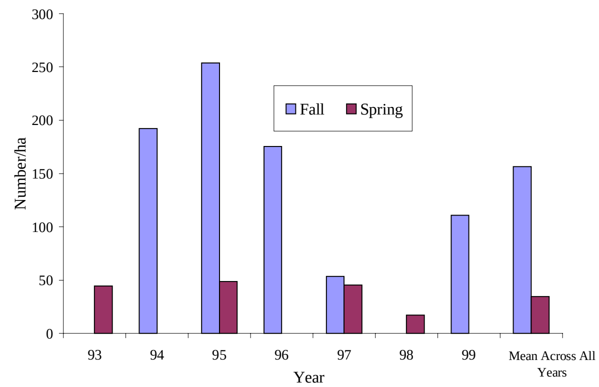
The Deer Mice on Anacapa (*Peromyscus maniculatus anacapae)* and Santa Barbara Islands (*Peromyscus maniculatus elusus)* are the largest native land mammal. Both subspecies are endemic and restricted to their respective island. As abundant generalist granivores/predators, they undoubtedly have significant influence on the plants and terrestrial invertebrates on the islands, as prey species, they largely determine the numbers of some of the resident hawks and owls (Fellers et al. 1988).

As part of its vertebrate monitoring program, the Park has been monitoring mouse populations on Anacapa since the spring of 1993. Monitoring of Deer Mice employs mark-recapture grids (Fellers et al. 1988). There are currently 3 grids set up on Anacapa Island, one on each islet. The grids are monitored in the spring and late summer/fall of each year.

Trend

Mouse trapping has been conducted on Santa Barbara Island since the early 1980's. One of the most significant findings from this data is that there are large fluctuations in population levels that are related to annual rainfall, predation pressure, and season (Fellers et al. 1988). C. Drost and others, have hypothesized that breeding suppression is the ultimate factor limiting the Deer Mouse population on Santa Barbara Island. (This fluctuation has resulted in densities from less than 10 mice/ha to over 450 mice/ha. Summarized in Figure 5 are the mouse densities from Anacapa Island since 1993.

Figure 5: Mean Deer Mice Densities (No/ha) Anacapa Island.



Rare, Threatened and Endangered Plants

Current Status

There is only one federally endangered plant on Anacapa Island: Island Malacothrix (*Malacothrix squalida*). It occurs only on Santa Cruz Island and Middle Anacapa. On Middle Anacapa it is found in two locations: near the Knife's Edge and on an east facing slope near the west end of the island.

It is an annual herb from the aster family. It ocurs on rocky coastal bluffs in coastal scrub.

Trend

Island Malacothrix has been documented from Middle Anacapa Island on two occasions: when it was first collected in 1963 and again by Steve Junak in 1998. Local populations of Island Malacothrix on Anacapa Island are impacted by soil, habitat alteration, and localized impacts from seabird nesting. Its limited occurrence makes it highly susceptible to stochastic events which could lead to extirpation from Anacapa Island.

Marine Environment

Marine Mammals

Two species of marine mammals utilize habitat areas on or around the shores of Anacapa Island. These species, the California Sea Lion (*Zalophus californianus*) and the Harbor Seal (*Phoca vitulina*), are year round residents. Both species are abundant and widely distributed throughout the area.

California Sea Lion

Current Status

California Sea Lions are the most conspicuous and abundant pinnipeds in the coastal waters of southern California. The principal breeding rookeries in the Channel Islands are on the western end of San Miguel Island, including Castle Rock, the offshore sides of San Clemente and San Nicolas Islands, and around Santa Barbara Island. They haul out on all of the southern California Islands (Bartholomew et al 1970).

On Anacapa Island California Sea Lions are known to haul out, in varying numbers, at two locations. These locations are both on south shore of the East Islet. Although pupping has been observed in these two areas, overall habitat quality is limited due to the marginal beaches on Anacapa (narrow and rocky and can be completely submerged during high tide), and heavy visitation (on-shore and off-shore).

California Sea Lions are opportunistic feeders, and feed in large groups when schooling fish or squid are available and probably disband when the food source is scattered (Bonnel et al. 1979). Feces analysis of California Sea Lions from San Miguel Island showed squid, Pacific Hake, rockfish, and a variety of other schooling pelagic and demersal fishes (benthic fishes) to be utilized (Antonelis et al. 1978).

Incidental set and drift gillnet fishing continues to be the leading human caused mortality factor. However, for the first three-quarters of 1994, when compared to the years 1991-93, incidental gillnet kills showed a large reduction (Barlow et al. 1995).

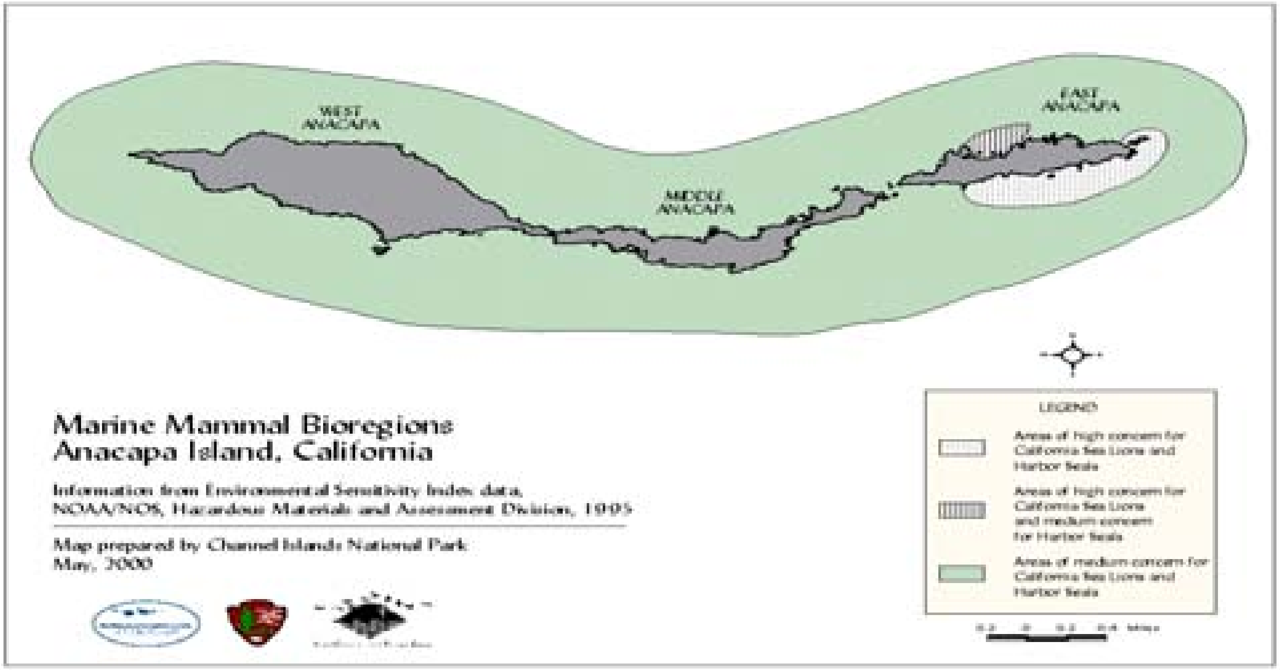
Trend

Specific population trends for Anacapa Island is not known. However, population trends for four southern California rookeries, which includes rookeries from the Channel Islands, were estimated by Barlow et al. (1995). With the exception of the El Nino events of 1983 and 1992, pup counts increased at an annual rate of 5.2% between 1975 and 1994. Pup counts between the El Nino events increased at 8.8% between 1976 and 1982 and at 8.2 % between 1983 and 1994 (Barlow et al. 1995).

Harbor Seal

Current Status

Figure 6. Marine Mammal Bioregions



Harbor seals are occasionally seen in and around harbors, such as the Ventura Marina, breakwaters and jetty. Traditionally they seek to avoid the disturbance that usually accompanies the activities of humans. They are much more wary than any other pinnipeds of the Channel Islands area and can only be approached closely with great caution (Bartholmew et al. 1970). Generally they haul out and breed only on the most secluded beaches, rocks, and mud flats available, usually avoiding areas inhabited by other species of pinnipeds (Bigg 1969).

Harbor seals occur on inaccessible areas of the south shores of all three islets. While pups have been observed on southern West Islet the role of Anacapa as a hauling and breeding ground is unclear. Harbor seal movement is usually confined to less than 500 km from their pupping sites. The gillnet fishery is the leading human caused mortality factor for the Harbor Seal. Barlow (1995) notes that gillnet mortality may reach as high as 5-10% of the California Harbor Seal population.

Trend

Population size for California Harbor Seals is estimated by counting the number of seals ashore during the peak haul-out period (May/June) and multiplied by a correction factor that estimates the number of seals on land to those in the water. Harbor seal counts have continue to increase each year except during El Nino events of 1983 and 1993. Annual population has been estimated for the islands, and show a stable population between 1983 through 1995 (Barlow et al. 1995).

Marine Invertebrates

Current Status

Intertidal invertebrates have been monitored by the Park since 1982 with the following goals: 1) monitor trends in population dynamics; 2) determine normal limits of variation; 3) discover abnormal conditions; 4) provide remedies for management problems; and 5) measure the effects of management actions. Fifteen sites on four park islands are monitored each spring and fall.

Trend

For the species that were monitored as part of the intertidal monitoring surveys percent cover did not vary more than 10% (See Figure 7). The biggest decline detected by the monitoring program is for black abalone. Since 1985 when over 900 black abalone were counted across all Anacapa monitoring zones, the population declined significantly with no individuals being counted the last two years (See Figure 8)

Figure 7. Average Percent Cover of Intertidal Zone, Anacapa Island (Across all Zones)

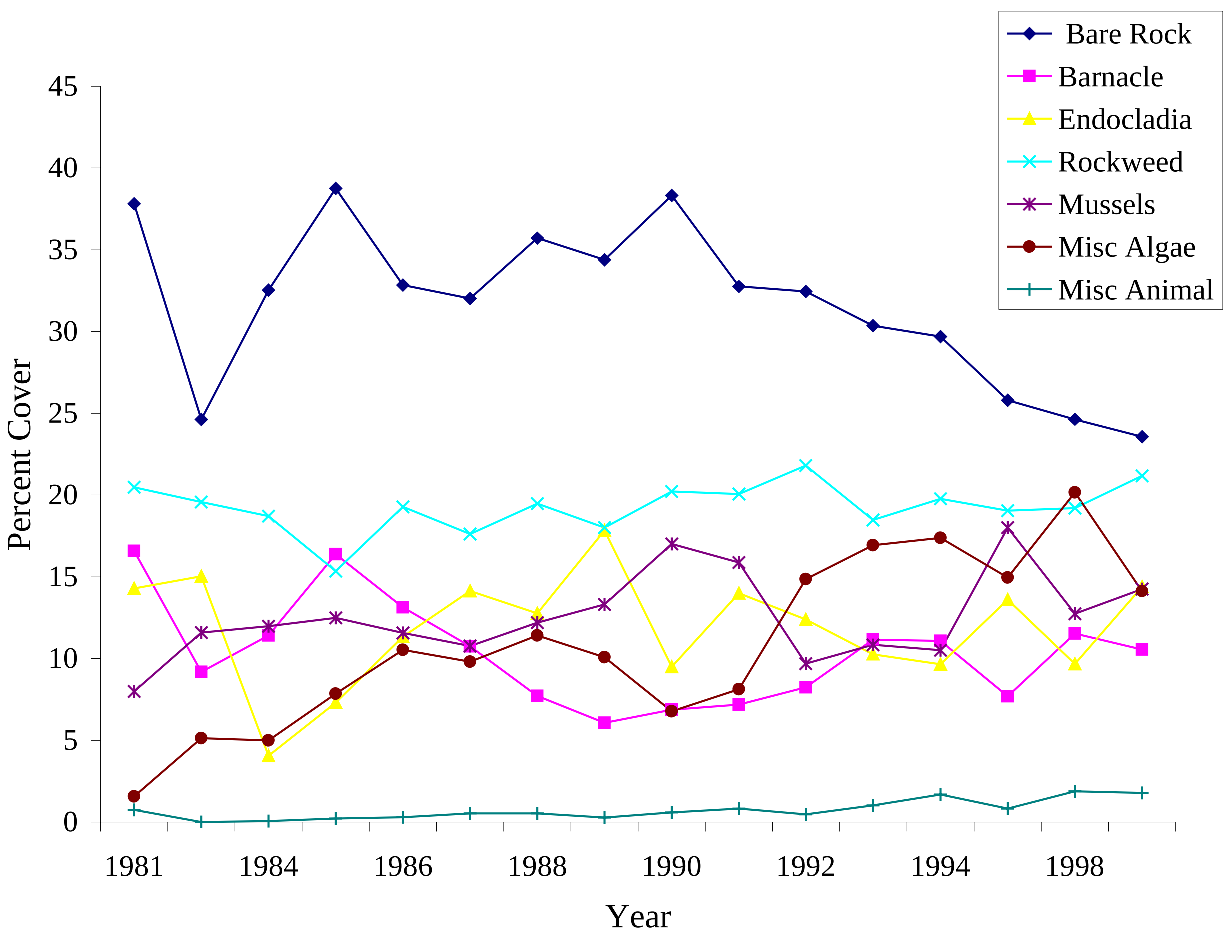
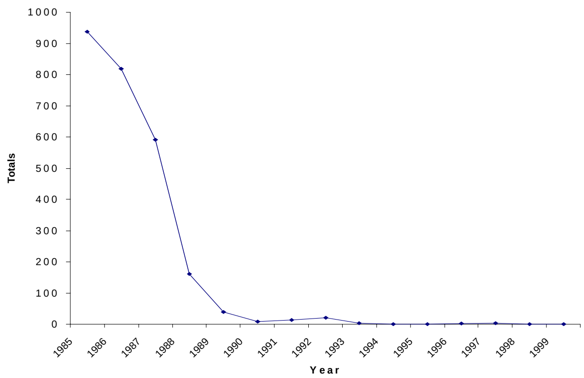


Figure 8. Anacapa Black Abalone Counts



Human Uses and Values

Channel Islands National Park, and specifically Anacapa Island are recognized locally, nationally, and internationally as an area of exceptional scientific value with irreplaceable cultural resources, notable geological and paleontological features and plant and animal communities that have evolved in a unique manner because of their isolation from the mainland. The waters surrounding the islands contain one of the most diverse and productive marine ecosystems in the world.

Anacapa Island and its surrounding waters have status as both a state of California ecological reserve (surrounding waters to 1 nautical mile) and a federal research natural area. As an ecological reserve boating activities close to shore are prohibited along parts of West Islet for the protection of nesting pelicans. West and Middle Islet have status as a research natural area and are closed for from public use with the exception of Frenchy's Cove.

As an area of such diverse and important resources, the Park attracts a wide array of people to the islands. In addition to the 16,000 annual visitors to the island, various scientists, and Park personnel frequent the island as well. Not included in this statistic is the number of people who recreate with private boats, or who conduct commercial fishing operations around the waters of Anacapa Island. Figure 9 shows the monthly average for the years 1996-99 of campers and visitors who come ashore.

Park concessionaires provide most of the public transportation to Anacapa Island. Trips to Anacapa are scheduled almost daily throughout the summer and at least on weekends throughout the rest of the year. The trips can last all day or half day. Visitors are only allowed on East Anacapa Island or Frenchy's Cove when conditions permit.

Figure 9. Campers and Visitors Ashore

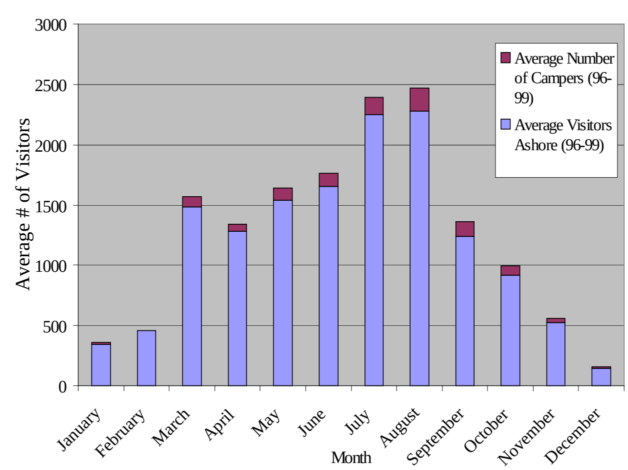
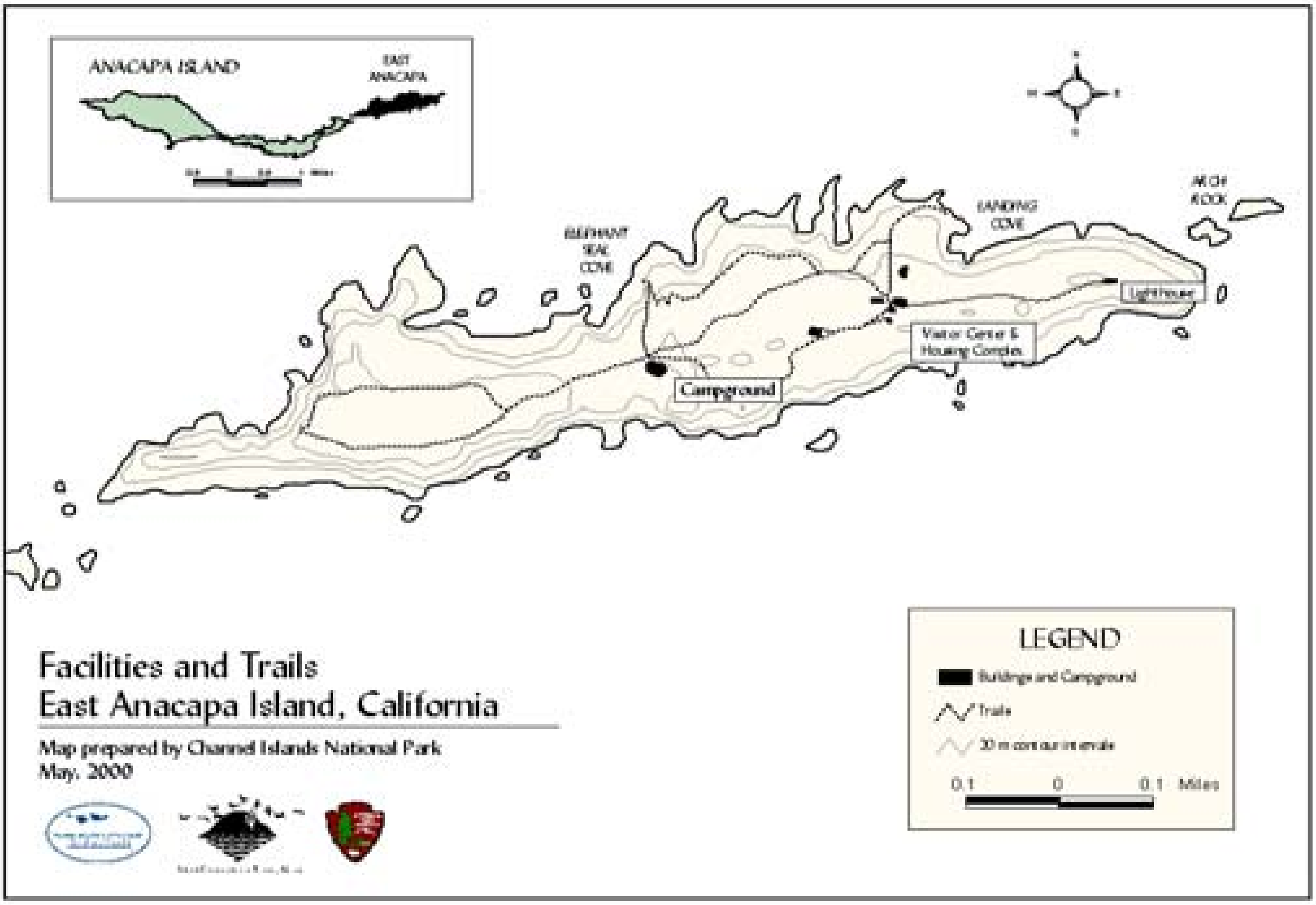


Figure 10. Facilities and Trails.



ANACAPA ISLAND RESTORATION PROJECT

CHAPTER FOUR
ENVIRONMENTAL CONSEQUENCES

Chapter Contents

Introduction

This chapter discloses the environmental consequences of implementing each alternative described in Chapter Two. The environmental consequences, or environmental effects will be categorized in three broad areas. The three categories of effects are direct, indirect, and cumulative. These "effect" categories will form the basis of the effects analysis in this chapter.

Direct effects, as defined by the Council on Environmental Quality, are those which are caused by the action and occur at the same time and place. Indirect effects are those which are caused by the action and are later in time or farther removed in distance. Cumulative effects are those that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The cumulative impacts analysis has been narrowed down to two main issues, the potential repeated exposures of non-target species to the rodenticide and the cumulative impacts to seabirds that utilize Anacapa Island for breeding. This chapter forms the scientific and analytical basis for the relative comparison of effects presented towards the end of Chapter 3.

Issue 1: Efficacy

Introduction

This section of the analysis compares the different alternatives and how well they meet the purpose and need. The objective of this project is to remove 100% of the rat population from Anacapa Island. Therefore, the rodenticide of choice, and its delivery into the ecosystem, must offer the greatest probability of achieving success. The success of the eradication is dependent on the rodenticide chosen, the bait composition and its delivery into the ecosystem and awareness of the local conditions that could be exploited to maximize success. These factors will be analyzed for each alternative.

The Rodenticide and Toxicological Properties

There are three rodenticides outlined in the alternatives. They are brodifacoum, bromadiolone (second generation anticoagulant) and diphacinone (first generation anticoagulant). All of these chemicals are anticoagulant rodenticides, which cause mortality to the target species through hemorrhaging (See Biochemistry below for further discussion). In general, the difference between the first and second generation anticoagulants is their acute toxicity to rats, the amount required to kill rats, and their ability to control a population of rats.

The acute toxicity of the rodenticides are presented in Table 7. Acute toxicity (LD_{50}) is defined as the amount of active ingredient (mg) per kg body weight, required in a single oral dose to kill 50% of a test population. Only the acute toxicity of brodifacoum is known to the target species, *Rattus rattus*. The other LD_{50} data presented are based on Norway rat (laboratory rat) data that may not be representative for *Rattus rattus*. Following the pattern of toxicity for the lab rat across all three anticoagulants, brodifacoum is approximately twice as toxic as bromadiolone, and orders of magnitude more toxic than diphacinone. Although all the rodenticides are toxic to the target rat species, in practice, the rodenticides differ in their ability to kill the target species.

The rodenticides presented are classed as either "single feeding" or "multi-feeding" rodenticides. The first generation anticoagulant diphacinone is a "multi-feeding" rodenticide in

Table 7. Amount of bait required (g) for rats to reach one LD_{50}.

	Active Ingredient (Rodenticide)		
	Brodificoum 25 ppm Alternative 2,3 and 6	**Bromadiolone 50ppm Alternatives 4,5**	**Diphacinone 50 ppm Alternative 6**
LD_{50} (mg/kg; range)	0.26-0.56 [a]	0.56-0.84	2.3 – 7.0
Rat Weight (g)[b]	150	150	150
mg Active Ingredient	0.039 - 0.084	0.084 – 0.13	0.35 – 1.05
Amount of Bait (g)	1.56 – 3.36	1.68 – 2.52	6.9 - 21
Number of Pellets	0.78 – 1.68	0.84 – 1.30	3.5 – 10.5
Number of Feeding Days[c]	0.16 – 0.34	0.17 – 0.25	0.69 – 2.1

a LD_{50} for black rat (R. rattus) is 0.65-0.73. All LD_{50} data is for Norway rat (Laboratory). Comparing laboratory rat data across the different rodenticides, bromadiolone is half as toxic as brodifacoum. If the LD_{50} differences between brodifacoum and bromadiolone for the lab rat follow a similar pattern for the black rat, the LD_{50} data presented may be too low. Conservatively, the feeding estimates should be considered an absolute minimum to one LD_{50}.

b from Erickson (1990)

c assumes approximately a 10g daily requirement of dry matter per day based on the allometric equation: Food Ingestion Rate (g/day) = $0.621(\text{Weight})^{0.564}$. Assumes bait is 100% Dry matter and satisfies daily requirements.

that rats are required to feed on the bait over a period of days (estimated around 7 days) to cause death. This is due to the ability of rats to metabolize and excrete the chemical in a relatively short period of time negating the toxic effect of the initial dose. However, if the rats feed on the bait exclusively for a period of days, the toxic effect will take hold and cause death. Brodifacoum and bromadiolone are somewhat insensitive to metabolism, relative to diphacinone. These compounds can cause death after a "single feeding" if enough of the rodenticide is consumed. In other words, rats on the island would have to only consume a small amount of bait to cause death if brodifacoum or bromadiolone were used in sufficient concentrations (which would still be less amount of active ingredient than if a first generation compound were used). From an eradication standpoint it is necessary that every individual exposed to the rodenticide succumbs. Therefore, a bait, able to kill after ingestion a single mouthful would be most efficient for eradication purposes (Eason 1991 as cited in Taylor 1993).

Variation exists within every rat population to the susceptibility of the rodenticides. Of most interest in an eradication program are those individuals which require more and more bait to induce mortality, or show bait avoidance behavior. It is those individuals that may cause failure and form the founding population in the future, making it that much harder to remove rats from the island because of the inherited lower susceptibility. Diphacinone, with its multi-feeding requirement to induce mortality, increases the probability of rats surviving post application due to bait avoidance, inadequate bait consumption or other mechanisms. The use of brodifacoum is proposed to "clean up" those remaining individuals that were not lethally exposed to the diphacinone bait. However, under alternative 6, the repeated use of diphacinone bait would select for individuals that require more and more rodenticide to be killed or show higher bait avoidance behavior due to previous exposure to diphacinone. If rats that survive show bait avoidance behavior, they may avoid the brodifacoum bait when presented. Thus, there is lesser confidence in achieving eradication under alternative 6. Bromadiolone, (alternatives 4 and 5) would increase the probability of killing all target animals because of its greater toxicity and its "single-feeding" label. However, bromadiolone has been shown to be unable to control 100% of *Rattus rattus* after two day's of feeding on 50 ppm bait (Buckle 1994). After the presentation of equal concentration of brodifacoum and bromadiolone to a study population of black rats, only brodifacoum killed 100% of the rats after 1 day and 2 days of presentation. Bromadiolone was only effective in killing 47% and 90% after one and two days of feeding (Buckle 1994).

Only brodifacoum offers the highest probability of achieving the 100% kill of rats, thus, meeting the purpose and need of the Anacapa Island Restoration Project. Brodifacoum has been the most extensively used rodenticide in island restoration practices worldwide (Appendix C).

Composition of Bait and how it is Applied

This section investigates how the composition of the bait and its application method would affect the outcome of the restoration project. The composition of the bait would be commercial manufactured baits, either in pellet or block form. The application technique, either bait stations and/or aerial broadcast, would differ in probability of eradication, primarily based on the movement of rats on the island. To successfully eradicate rats, bait must be delivered into each rat's territory across the island (Appendix C).

Each of the alternatives outlines the use of different rodenticides and/or methods of delivery. In each case, the aerial broadcast would utilize a commercially manufactured compressed grain pellet. Bait stations would be armed with commercial grade blocks of approximately 20 g or the 2 g compressed grain pellets. The baits would be formulated for high palatability and acceptance by rats and would be consumed readily by the target species.

Alternative 1: No Action Alternative

Under the no action alternative, there would be no use of rodenticides in the Anacapa environment, except for the localized baiting in buildings on east island. With no rodenticide application, the rat population would not be controlled, and the numbers of rats on the island would fluctuate within the annual cycle. Efficacy would effectively be 0% on Middle and West Islands, and very small (>0%), on East Island where control would take place in the few buildings.

Alternatives 3 and 5: Aerial- Bait Station Combination

The use of bait stations on top of the island as well as aerial broadcast of the rodenticides onto the cliffsides was developed to minimize the exposure of non-target species to the rodenticide through direct bait consumption. Although it minimizes the primary exposure risks to non-target species, may compromise the success of the eradication because some individuals possibly would not be exposed to the bait.

Habitat utilization by rats on Anacapa Island follows an annual cycle. Rats are most abundant along the shoreline during the late dry season, and in very low density on the slopes and top of the island (Erickson 1990; Howald et al. 1997; Collins 1979). General observations have suggested that during the wet season, the rat populations increase and subordinate individuals are pushed into marginal territories, such as up the slopes and on top of the island. As the dry season progresses and food availability on top declines, the abundance of rats on top declines. Rats have been found in very low density on top of the island during the late dry season, but not absent (Howald et al. 1997; ICEG 2000). With the use of bait stations, some rats may not enter the stations even though they are present in their territory. This neophobic behavior, common in rats (Greaves 1994), may prevent some individuals from gaining access to bait in the stations. Bait stations deployed only on top of the island may allow for rats to enter the rodenticide free cliffsides once the aerial application is complete. As most cliff/shore dwelling rats have died, the subordinate rats may move off the top of the island down to the shoreline into preferred habitat, where they would escape exposure to the rodenticide and meet no resistance from territorial rats. These individuals could form the founder population. To overcome this potential, stations would be left armed for over a year before any aerial broadcast activity. This could allow for neophobic rats to get used to the stations over time, enter, and consume the bait and die. Alternatively, if rats refuse to enter stations, they may continue their day to day activities and die naturally without exposure to the rodenticide. Their offspring, if any, would emerge from their dens with the armed stations present in their territory and may readily enter the stations and consume bait. Conversely, their offspring may have inherited the behavior of bait station avoidance and could escape exposure. There is no island rat eradication recorded that used a combination of broadcast and bait stations and thus, there is no precedent for this type of operation. Alternatives 3 and 5 offer the lowest probability of successfully eradicating rats.

Alternatives 2, 4 and 6: Aerial Broadcast

The aerial broadcast of the rodenticide across the entire island as laid out in alternatives 2, 4 and 6 increases the probability that 100% of the rats would be exposed to the bait. Rats would encounter pellets during their nightly foraging excursions and neophobic behavior, such as to bait stations, would be minimized.

Local Factors

Warfarin resistance

An attempt to control and/or eradicate rats from Anacapa Island was carried out over a number of years in the 1980s and early 1990s. Many control methods were attempted, including warfarin delivered from bait stations. The control of rats can be a strong selection agent, increasing the frequency of rats that cannot be killed via the control method used. Where populations of rats have been previously exposed to poison, some rats demonstrate bait avoidance behavior and others may be biochemically “resistant” to the anticoagulant used (Greaves 1994). It is unknown if the population of rats on Anacapa Island contain individuals that would demonstrate bait shyness or are resistant to warfarin. Thus, it is recommended to use an active ingredient that would be lethal to “warfarin-resistant” individuals and is able to provide a lethal dose in a “single-feeding” in case of bait shy individuals. Second-generation anticoagulants would kill warfarin-resistant rats and, if in sufficient concentration, would kill rats after a single feeding, thus, dramatically increasing the probability of successful eradication.

Timing

Rat eradication programs are most likely to be successful if they take place during the annual population cycle when no reproduction is taking place and when rat numbers are declining. This insures that new-born rats would not emerge from the dens after all bait has been consumed, and that most rats would be food stressed and therefore more likely to consume bait. Based on the population fluctuations and breeding season of black rats on Anacapa Islands, October through January is the best period for eradication (Collins 1979, Erickson & Halvorson 1990). Each of the alternatives would be initiated during the low point in the annual cycle.

Summary

This analysis has demonstrated that strictly from an efficacy standpoint, Alternative 2, the preferred and proposed action (the use of brodifacoum aerially and hand broadcast) would offer the highest probability of achieving eradication and meeting the purpose and need.

Issue 2: Non-Target Impacts

Introduction

Non-target species, are those species that may be negatively affected from the actions of the project, has been broken in to two components, the physical impacts and exposure to rodenticide residues.

Physical disturbance may occur from baiting activities, and crews walking around the island. Rodenticide exposure, for the purpose of this analysis, can occur through direct bait consumption (primary exposure) and secondarily (via carcasses containing rodenticide residues).

Physical Impacts

Introduction

This section will analyze the impacts from both baiting and crews walking around the island conducting research and monitoring on the project. The analysis is broken down by baiting technique within alternative - aerial or bait station. Within each category, the direct and indirect impact to each sub-issue will be analyzed.

Alternative 1: No Action Alternative

The physical impacts of this alternative would be negligible. Physical impacts would be restricted to normal Park activities as well as intermittent Navy and Coast Guard aerial activity around the island.

Under this alternative, no baiting would take place and therefore, risk of rodenticide exposure would be restricted to non-target species in an and around buildings where rat control with rodenticides would take place.

Rats would continue to be a major perturbation in the Anacapa ecosystem, continuing to have detrimental impacts on small crevice nesting seabirds, the deer mouse, invertebrates, and plants.

The rats would continue to prevent the smaller pelagic seabirds, such as Xantus' murrelet and ashy-storm petrel, from nesting outside of the sea caves. Murrelets would continue to be restricted to nesting in areas inaccessible to rats, although abundant nesting habitat is found elsewhere. Murrelets utilize only 0.4% of available habitat on Anacapa Island compared with 30% on rat-free Santa Barbara Island (G. McChesney, unp. data.). Rats would continue to predate nesting seabirds and their eggs, further leading to declining population levels of the Xantus' murrelet. The declining population may lead towards protection under the Endangered Species Act.

The endemic mouse on Anacapa Island would continue to be at risk of extirpation. Rats have been implicated in the 20 year extirpation of deer mice from East Anacapa Island, rediscovered in 1997. Rats had likely preyed and outcompeted the mice which resulted in extirpation. The extirpation of mice from the islets could re-occur, and could have serious implications for birds of prey which rely on the mice as their primary prey base.

The intertidal zone would continue to be an important foraging area for rats. The invertebrates would continue to be impacted, especially the lined shore crab. The terrestrial invertebrates would continue to be an important part of the rat diet. The population of terrestrial mollusks on Anacapa Island, which are very rare, would unlikely recover.

The flora of Anacapa Island would continue to be detrimentally impacted. The rats would continue to be an important vector for dispersing seeds of iceplant, a highly invasive non-native species which "chokes out " native species. The island oaks and cherry trees on West Island would continue to have low regeneration which could result in complete failure of regeneration of the species. There is a possible severe economic impact to the National Park Service with trying to constantly restore native habitat due to rodent activities.

Effects Common to Alternatives 2, 3, 4, 5, and 6: Aerial Broadcast

Under each of the alternatives, a helicopter would aerially spread a rodenticide from an underslung hopper. The helicopter would fly 25-50 m above ground at an airspeed of approximately 50 knots. Under each of the alternatives, bait would be aerially broadcast on the cliffsides and all of West Island would be treated. Alternatives 2, 4 and 6 propose broadcast of the top of Middle and East Islands as well. Alternatives 3 and 5 would use bait stations on top of the island and the impact associated with that will be covered in a separate section below. The total treated area varies between the alternatives; however, the flight operations may have a net impact to some species. To ensure even and adequate coverage of the island, a crew would circumnavigate the island by boat spreading bait by hand in key locations.

The project's efforts in eradication and subsequent potential impacts to non-target species and the environment would be monitored. Crews of varying sizes would regularly visit study sites and collect appropriate data.

Sub-issue 1 – Marine Mammals

Direct - Resting California Sea Lions and Harbor Seals would likely be disturbed by the helicopter activity and boat traffic to hand broadcast bait. It is likely that these species would retreat from their resting areas to the ocean. The disturbance to this group is likely to be short, restricted to three passes of the helicopter. The seals and sea lions would likely return to the haulouts shortly after the disturbance. This type of activity is somewhat common with functions performed by boat traffic around the islands daily.

Monitoring activities by research crews would not take place in the vicinity of the haulouts and would not result in disturbance or other effects.

Indirect - The seals and sea lions would not be subject to any indirect effects as a result of disturbance. The disturbance would be of short duration, and there would be plenty of alternate haul out areas around the islands individuals could retreat to.

Sub-issue 2 - Invertebrates

No impact to this group is expected from helicopter or any other physical activities.

Monitoring on study plots and traversing along trails would not have a significant impact on this group of animals.

Sub-issue 3 – Fishes

Direct - No impact is anticipated other than minor disturbance from intermittent inflatable boat traffic. The extent of boat traffic at any one point along the shoreline would be very intermittent. This would result in only minor disturbance. The fish would return to normal activities soon after departure. Boat traffic around the Anacapa shoreline is common and frequent. The additional inflatable boat traffic would not be expected to increase disturbance outside regular Park traffic.

Indirect - No indirect impacts would be anticipated.

Sub-Issue 4 – Herpetofauna

Direct - The impacts to the herpetofauna would be disturbance associated with foot traffic from researchers. The salamander would be dormant or deep within thick vegetation during the proposed application period and would be at low risk of disturbance. There would likely be disturbance to the Side-blotched and Alligator Lizards which would be active on most regions of the island at the time of baiting. The visiting public walking along trails regularly disturb sunning Side-blotched Lizards, that quickly return to their spots after the disturbance has passed.

Indirect - There would be no indirect impacts to this group.

Sub-Issue 5 – Seabirds

Pelagic Seabirds

Direct - There would be no impact to the pelagic seabirds during the baiting operation, these species would be foraging offshore. During the breeding season, these species would be susceptible to disturbance from research crews walking around the island, causing flushing from nesting areas. Few, if any, pelagic seabirds would be expected to nest on top of the island due to predation pressure from rats.

Indirect - There would likely be no indirect effects from short duration disturbance. If disturbance was of long duration or chronic, there could be nest abandonment or susceptibility to predation. However, disturbance is expected to be of short duration, thus likely having no indirect effect.

Roosting Seabirds

Direct - The effect on the seabirds would be in the form of disturbance. Seabirds that roost on the island would likely be flushed as the helicopter approaches. The main species of concern is the endangered brown pelican. Boat activity along the shoreline to dispense bait would likely flush roosting seabirds. Disturbance to roosting pelicans by boat traffic around the island has been observed on Anacapa Island (B. Keitt, pers. comm.). Most pelicans return to the same roosting location 10-30 minutes after disturbance (B. Keitt, pers. comm.), or would likely roost elsewhere. Coast Guard and Navy helicopter activities occur periodically on and around East Anacapa Island with no detrimental impact to roosting Brown Pelicans (F. Gress, pers. comm.)

Monitoring activities of research crews may disturb roosting seabirds. However, study protocols have been designed such that only minimal activity would take place around known roosting areas, and therefore, disturbance would be minimal. Monitoring would occur during the breeding season but no monitoring would take place in the vicinity of the pelican colony on West Island. Monitoring would be conducted around breeding Western Gulls. Disturbance is the only direct effect expected; however, it would be of minor significance as gulls are routinely disturbed by visitors on East Island and nest successfully.

Indirect Effects - Disturbance to roosting seabirds would have a low probability of indirect effect. The disturbance from both aerial and hand-baiting would be short and there is plenty of alternative roosting areas available on the island.

Repeated or chronic disturbance would not be expected under any alternative.

Sub – Issue 6 - Landbirds

Direct - The immediate effects on avian species of helicopter use above Anacapa Island and the bait drop would involve disturbance of roosting species. This immediate effect would be minimal as the normal response of the land birds would be to take cover in surrounding vegetation. The stress associated with this activity is unlikely to be greater than that caused by certain visitor activities on the island or by helicopter use associated with other Park operations made in the past or future. The helicopter would likely cause birds of prey to flush from roosting areas. Flushing of species is a common occurrence with visitors to East Island, and individuals usually return to their roost after 10 to 30 minutes. These effects are unlikely to exceed those incurred during normal Park operations.

Falling bait pellets would unlikely have a significant effect. The approaching helicopter would likely cause landbirds to either leave the area or move into areas that offer protection such as thick vegetation, which in turn would offer protection from falling pellets.

Indirect - During the baiting operation, indirect effects would not be expected and are insignificant. Nesting landbirds could be disturbed during research and monitoring. No chronic activity would be expected.

Sub - Issue 7 - Terrestrial Mammals

Direct - No impact to the deer mouse is expected. The deer mouse is primarily nocturnal and would be in their burrows during the aerial application of the bait in the daylight hours. Minor disturbance to mice may occur while monitoring nocturnal species. However, this disturbance would be restricted to trail and building areas and would not have any long term consequences.

Indirect - No indirect effects are anticipated from helicopter activity or monitoring activities.

Sub - Issue 8 - Flora

Direct – The Island Malacothrix is an annual species that would not be growing or in bloom during the application window. It would not be susceptible to the rodenticide and would not absorb any residues. It may be susceptible to trampling damage during the monitoring period after the bait has been applied and the growing season has started.

Indirect - Soil compaction from repeated foot traffic over the growing areas of the Island Malacothrix could result in increase water runoff, leading to increased erosion during the rainy season, resulting in degraded habitat impairing productivity of this species.

Mitigation – To mitigate against any damage to this species, NPS botanists will identify and mark known locations of the malacothrix. Personnel working on Middle Anacapa Island will be advised of the presence of the plant and will be briefed thoroughly on techniques to minimize trampling of the area surrounding malacothrix locations.

Effects Common To Alternatives 3 and 5: Bait Stations

The use of bait stations on top of East and Middle Islands is common to both alternatives 3 and 5. In these alternatives, bait stations would be placed at equal distances on a grid pattern around the island. The stations would be checked daily until the activity (bait removal) ceases or declines precipitously. Then the stations would be checked monthly throughout the year until the following year when they would be re-armed and checked during the aerial broadcast operations.

Sub-issue 1 – Marine Mammals

No direct and indirect effects because bait stations are on top of island, well away from flushing distances to the haul-outs.

Sub-issue 2 - Invertebrates

No impact to this group is expected from placing and checking stations.

Sub-issue 3 – Fishes

No direct or indirect impacts, bait stations are in the terrestrial environment.

Sub-Issue 4 – Herpetofauna

Direct - There would likely be disturbance to those individuals that are along the trail network used to gain access to bait stations.

Indirect - There would be no indirect impacts to this group.

Sub-Issue 5 – Seabirds

Pelagic Seabirds

Direct - There would be no impact to the pelagic seabirds, these species would be foraging offshore during the initial baiting period. The monthly checks of the bait stations would likely overlap with the breeding season. If the pelagic birds are nesting on top of the island, crews moving between stations may disturb birds, and cause them to flush.

Indirect - The birds would likely return to their nests once the disturbance is passed.

Roosting Seabirds

Direct - There would be minor disturbance to nesting Western Gulls on Middle and East Anacapa Island during the bait station checks. The impact of the disturbance would be flushing from territories, however, this is believed not to have a great impact because gulls are routinely disturbed by visitors to East Anacapa Island with no detrimental impact.

Roosting Brown Pelicans would be flushed from roosting locations. The use of bait stations would require frequent checks and would result in frequent disturbances to pelicans.

Indirect Effects – Daily checks of bait stations would occur over the winter into the early spring when nesting by Western Gulls has been initiated. Regular station checks could potentially lead to nest abandonment or for opportunistic predation by other species as a result of disturbance.

The chronic disturbance to roosting pelicans could result in roost abandonment. Roost abandonment would be insignificant as there are alternative roosting areas around Anacapa Island such as on West Island which would not be disturbed from bait station use.

Sub – Issue 6 - Landbirds

Direct - Repeated disturbance to birds nesting or establishing nesting territories may cause nest or territory abandonment. However, it is believed that there would be no significant disturbance to any of the species to cause nest or territory abandonment. During the breeding season, the checks of the bait stations would be intermittent.

Indirect - There would be no indirect effects expected because of the low direct impacts.

Sub - Issue 7 - Terrestrial Mammals

Direct - No impacts to the deer mouse is expected. This species is nocturnal, all checks would be conducted during daylight hours. The mice would be in their burrows.

Indirect - No indirect effects are anticipated from repeated checking of bait stations.

Sub - Issue 8 - Flora

Direct – The Island Malacothrix is an annual species that would not be growing or in bloom during the application window. It may be susceptible to trampling damage during the monitoring period after the bait has been applied and the growing season has started.

Indirect - Soil compaction from repeated foot traffic over the growing areas of the Island Malacothrix could result in increase water runoff, leading to increased erosion during the rainy season, resulting in degraded habitat impairing productivity of this species.

Mitigation

To mitigate against any damage to this species, NPS botanists will identify and mark known locations of the malacothrix. Personnel working on Middle Anacapa Island will be advised of the presence of the plant and will be briefed thoroughly on techniques to minimize trampling of the area surrounding malacothrix locations.

Toxicological Impacts

Introduction

The main toxicological issue associated with the Anacapa Island Restoration Project is the potential impact to other wildlife species from rodenticide exposure. For the purpose of this analysis, incidental wildlife species potentially at risk of exposure to the rodenticide are defined as non-target species. To fully and effectively present the potential toxicological impacts to non-target species, this section is organized to give background into the biochemistry of the rodenticides, followed by a relative comparison of toxicological impacts by alternative. Within the relative comparison of toxicological impacts section, the potential direct (primary) and indirect (secondary) exposure to the rodenticides is analyzed by alternative. In the last section, the analysis would focus on the direct and indirect toxicological impacts presented by the respective sub-issue.

Biochemistry

The proposed action and alternatives have outlined the use of second generation and first generation anticoagulant rodenticides. The anticoagulants act by blocking the vitamin K oxidation-reduction cycle in the liver microsomes, preventing the production of activated clotting factors (Thijssen and Baars 1989). Death results not from the active ingredient itself, but the uncontrolled bleeding after tissue damage (Brown et al. 1988). For a non-target species to be at risk of hemorrhaging, it would have to consume a minimum amount of the anticoagulant. Before any symptoms of anticoagulant poisoning are measured, a threshold level (concentration in the liver) must be reached. Symptoms include, but are not limited to, increased time to clotting (prothrombin times (PT)) leading to hemorrhaging. A minimum amount of active ingredient needs to be consumed, absorbed and bound in the liver, and significantly decrease the production of active clotting factors resulting in an increased prothrombin time, before an individual is considered at risk of hemorrhaging. Thus, organisms are able to tolerate sub-lethal levels of anticoagulants without displaying any symptoms of poisoning. Above that threshold, the risk of hemorrhaging is high and measurable (eg. increased clotting time). Once at risk of hemorrhaging, activity is required to induce hemorrhaging and subsequently mortality (spontaneous hemorrhaging is possible, i.e., although low activity, hemorrhaging still occurs). Without the presence of enough anticoagulant the induction of hemorrhaging, and subsequently mortality would not occur. Thus, all animals are able to tolerate some level of anticoagulant rodenticide exposure without risk of hemorrhaging. The level of risk is determined by the toxicity of the chemical and that individual’s exposure. This analysis will focus on the potential primary and secondary poisoning risks to the wildlife resources.

The relative risk of non-target species poisoning on Anacapa Island is determined by a number of variables including the toxicity and exposure to the rodenticide. Exposure is determined by the availability of the active ingredient in both space and time. Primary poisoning occurs when species feed directly on the bait. Secondary poisoning occurs when animals feed on primarily poisoned organisms that have rodenticide residues in their tissue. The potential of tertiary and quaternary poisoning exists (eg. birds or mice that consume carrion insects, containing residue of active ingredient after digesting a primarily poisoned mouse, would be tertiarily poisoned) but has not been thoroughly documented. For the purpose of this analysis, the risks of primary and secondary exposure to the rodenticides will be investigated as per Record and Marsh (1988). Primary exposure to the rodenticides is determined in part by:

- Toxicological properties of the rodenticide
- Bait composition and delivery into the ecosystem
- Non-target species behavior and foraging strategy
- Local environmental factors;

Secondary exposure to the rodenticides is driven by any one species primary exposure to the rodenticides. In addition to the above factors, the behavior and location of death of the target species will influence secondary poisoning.

Relative Comparison of Toxicological Impacts by Alternative

This section will compare the potential toxicological impacts by alternative. Under the features common to alternatives 2 – 6, each section will evaluate the variables (toxicology, bait composition, behavior of species and local factors) that contribute to risks of non-target species exposure to the rodenticide. This section will follow with a breakdown of toxicological impacts by sub-issue. Where possible, an acute risk of exposure to the rodenticides was evaluated for each sub-issue and rodenticide.

Alternative 1 – No Action

Under this alternative, there would be no application of rodenticides, therefore there would be no toxicological impacts.

Features Common to Alternatives 2, 3, 4, 5 and 6

Primary Exposure

Toxicology

The rodenticides are vertebrate toxicants. All the rodenticides presented in the alternatives are toxic to all the vertebrates, provided they are exposed to the rodenticide in sufficient quantities. The toxicity to both the target and non-target species will determine the relative primary and secondary exposure risks. The risks of exposure to the anticoagulants is determined by how well the non-target species is able to metabolize and excrete the compound, which is

Table 8. Primary exposure index for each alternative

	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Ranking (Low to Highest)	1	4	2	6	5	3

a function of its acute toxicity. Further analysis will be presented by sub-issue (see below).

Bait Composition and Delivery into the Ecosystem

The bait composition and method of delivery into the ecosystem would influence how and if species are primarily exposed. The bait formulation (inert products, size of pellet) and method of dispersal into the Anacapa ecosystem would determine the relative primary exposure risks. For example, granivorous species would be more interested in rodent bait composed of a compressed grain pellet vs a high protein "meat" bait. The insectivorous, or carnivorous, species may "avoid" a bait that is composed of compressed grain. Similarly, size of the bait itself plays an important role in determining if a species may be exposed to the bait itself. The smaller species may not be physically able to consume the bait due to its size, in contrast, the larger species may not be interested in small pelleted bait if available. Thus, some species are " protected" from feeding on the bait because of its size. Under all alternatives, the bait would consist of a compressed grain pellet and could be attractive to most granivorous/omnivorous species capable of ingesting that size pellet. Alternatives 3 and 5 would see the use of a block that is larger than the pellets and would limit further species from consuming the bait.

How bait is delivered into the Anacapa Island ecosystem would determine the scale of potential rodenticide exposure. The alternatives outline the use of aerial/hand broadcast and bait stations for delivery of the rodenticide onto Anacapa Island. The aerial broadcast of the rodenticides has been demonstrated to represent a risk of non-target exposures to the rodenticides (Edward et al. 1988).

A risk index (Edward et al. 1988) to provide a measure of primary exposure risk when evaluating rodenticides was utilized to qualify the relative primary exposure risks among the alternatives. The risk index takes into account bait concealment (C - scored 1 to 3, high to low), quantity of bait placed (Q), and numbers of animals present (N). Using these factors, the equation:

$$\sqrt[3]{(C \times Q \times N)}$$

can be utilized to evaluate the relative primary exposure risks. For the purpose of this analysis, the primary poisoning risk index was calculated for each alternative using: 3 for low concealment (aerial) 1 for high concealment (bait stations), bait quantity per hectare applied, and assumes that only one non-target animal is present. For the alternatives with both bait stations and aerial application (alternatives 3 and 5), and alternative 6 (two different rodenticides), the risk index was calculated for each application technique and/or rodenticide, and averaged. The scores were ranked from lowest primary exposure risk to highest for comparative purposes (Table 8).

The risk of primary exposure is highest under alternative 4 and lowest under alternative 3. The highest risks of primary exposure occurs when the rodenticide is broadcast, and lowest when presented in bait stations. Presenting bait in tamper proof bait stations limits access of the bait to rats and species smaller than rats (such as deer mice and invertebrates). The use of bait stations would lower the scale of rodenticide exposure, but it would not reduce the risk of exposure to zero. Although the relative exposure risks between the alternatives vary, it would be impossible to preclude the possibility of exposure. The Risk Index is useful as a tool to evaluate the primary exposure risks, alone it does not provide an adequate measure of the relative risks.

Behavior of Non-Target Species

The behavior of the non-target species and their associated foraging strategy is an important determinant in risk evaluation. The hazard of the rodenticide is a function of toxicity and exposure (Record and Marsh 1988). Although the toxicity of a rodenticide is high in some cases, the non-target species needs to be exposed to the rodenticide to be considered at risk. Exposure may not occur if the species is not present during the baiting operation, or does not feed on the bait or a primarily exposed organism, thus avoiding both primary and/or secondary exposure.

Local Environmental Factors

Exposure to the rodenticide, primary or secondary, is determined by the availability of the rodenticide in space and time. The conditions of the local environment will influence the availability of the rodenticide by enhancing the degradation of any residual bait (or not). The application rate was determined by consumption rates of rats and mice over a 4 day period. The majority of the bait will be consumed by rats and mice, leaving few pellets in the environment. The combination of rainfall, fog and invertebrates will degrade the remaining bait pellets. The application will take place prior to the rainy season such that any remaining bait will absorb moisture and break up. The presence of moisture would encourage mold and microbial degradation of the rodenticide to its base components of water and carbon dioxide. Bait will not likely be present on Anacapa by the end of the rainy season.

Similarly, the timing of the operation will influence the scale of potential primary and secondary exposure risks. For example, migratory species may not be present during the aerial application window and therefore would not be exposed. Conversely, the use of bait stations over time would potentially put those species at higher risk.

Consequence of Primary Exposure

Many variables must be taken into consideration when evaluating the primary exposure to the rodenticides. The consequence of primary exposure to the rodenticides may be an anticoagulated state leading to hemorrhaging and mortality. To characterize the consequence of primary exposure to the rodenticides, the toxicology data and exposure data (based on allometric equations (EPA 1993) were used to model the number of LD_{50}s individuals would be exposed to if they fed exclusively on the rodenticide bait for one day.

Risk quotients (RQs) were calculated by dividing the exposure estimates with ecotoxicity values:

RQ= Exposure/Toxicity

For the purpose of this discussion, an estimate of the primary poisoning risk to the birds and mice were estimated by calculating the number of LD_{50}s/day a bird would likely be exposed to if it fed exclusively on the bait, using the following formula:

LD_{50}s/day = mg rodenticide consumed/day ÷ [LD_{50} x weight (kg)]

Where mg rodenticide consumed/day = amount of bait eaten x % active ingredient in the bait. Allometric equations were used to estimate amount of bait consumed daily (EPA 1993). If no LD_{50} data existed for that species, the LD_{50} from the species in closest taxonomic relationship was used consistently for each rodenticide (eg. Laboratory rat LD_{50} data used for brodifacoum, bromadiolone and Diphacinone). However, caution must be used when interpreting this data because phylogenetic relationships cannot be used to predict sensitivity to the rodenticides (Hill 1994; Mineau, 1991). To more precisely present the relative risks of poisoning to non-target bird species, the LD50 data was statistically “corrected” following Mineau et al. (2000).

Table 9. Properties of the rodenticides affecting their potential for secondary poisoning.

	Active Ingredient (Rodenticide)		
	Brodifacoum [a] Alternative 2, 3 and 6	Bromadiolone Alternative 4, 5	Diphacinone Alternative 6
Sensitivity to Metabolism	Low	Low	High
Tissue Retention	High	High	Low
Biological Half-Life	Long	Long	Short
Estimated time	150-200 days (RED 1998)	318 days (RED 1998).	15-20 days (WHO 1995)

For regulatory purposes, the EPA evaluates the Risk Quotients and compares them to the Office of Pesticide Programs Level of Concerns (LOCs). LOCs are evaluated as: Acute High Risk (LOC >0.5), Acute Restricted Use (LOC >0.2), and Acute Endangered Species (LOC >0.1). It is on this evaluation that the EPA restricts certain pesticides from certain use patterns or availability to public or professional pest control uses. For the purposes of this discussion, any rodenticide with a RQ >0.5 is presumed to put that group of species at risk of lethal poisoning.

Secondary Exposure

Toxicology

Brodifacoum and bromadiolone are second generation anticoagulants while diphacinone is a first generation anticoagulant. In general, the difference between the two categories is the toxicity and the sensitivity to metabolism which is reflective in the toxicity. Upon ingestion and absorption, the anticoagulants bind to a “warfarin binding” protein in the liver microsomes where they act to prevent the production of active clotting factors. The first and second generation anticoagulants both bind at this site and the difference between the chemicals is their binding affinity at this site. Brodifacoum has a greater affinity than bromadiolone and both have a much higher affinity than diphacinone. Diagrammatically:

Brodifacoum>Bromadiolone>>>>Diphacinone.

This binding affinity may be the reason that the second generation anticoagulants are significantly more toxic. In general, the stronger the binding affinity, the higher the toxicity. The binding affinity is also related to the ability of the organism to metabolize and excrete the compound. The stronger the binding affinity, the greater the resistance to metabolism once bound. Thus, the ability to metabolize

Diphacinone>>>>Bromadiolone>Brodifacoum.

The implications of the sensitivity of metabolism is that relative risks of secondary poisoning vary between the rodenticides. For example, mortality was found in barn owls fed brodifacoum (5/6) and bromadiolone (1/6) dosed rats but no mortality was detected in barn owls (0/2) fed diphacinone dosed rats (Mendenhall

Table 10. Potential for accumulation of the rodenticides for the different sub-issues.

Sub-Issue	Active Ingredient (Rodenticide)		
	Brodifacoum Alternative 2, 3 and 6	Bromadiolone Alternative 4, 5	Diphacinone Alternative 6
Marine Mammals	High	High	Low
Invertebrates	Low	Low	Low
Fishes[a]	High	High	Low
Herpetofauna[a]	High	High	Low
Birds	High	High	Low
Mammals	High	High	Low

a No literature data available, however, estimated to follow similar pattern as for mammals and birds.

and Pank 1980). This is suggestive also of the potential secondary poisoning impact of single versus multiple exposures to the rodenticides. Brodifacoum would have a higher potential for secondary exposure impact after a single exposure, while diphacinone may require multiple exposures to illicit the toxic effect. With brodifacoum and bromadiolone, because death is delayed between 3-10 days (for rodents and birds), they would continue to feed on the bait long after a lethal dose has been ingested, allowing for accumulation of the rodenticide in the carcass and liver. With diphacinone, the high rate of excretion and metabolism does not allow for significant levels of residues to accumulate in the carcass, although residues would be present and would present a secondary poisoning hazard. Diphacinone bait requires rats to feed on the bait over a period of up to 7days to illicit the toxic response. During that period, the rats are rapidly metabolizing the compound. Because ingestion is believed to be faster than metabolism, rats will eventually reach the threshold and a toxic response is measurable, potentially negating the secondary poisoning "protection". In comparison, brodifacoum and bromadiolone are "single-feeding" anticoagulants and are capable of illiciting a toxic response to the target species after a single feed. Table 9 summarizes the factors affecting the secondary toxicity of the rodenticides in the alternatives.

The low sensitivity to metabolism, high retention of residues in tissue and long biological half life of the second generation anticoagulants present a secondary exposure hazard to species preying on primarily exposed organisms. Godfrey (1985) demonstrated that most of brodifacoum administered to rats that survived the dosing was retained up to 10 days after administration. Sheep dosed with brodifacoum at 2 mg/kg showed liver concentrations of 2 mg/kg four months later (Rammell et al. 1984). However, the biological half life must be qualified. For a sub-lethally exposed organism, the decline of the anticoagulants have been demonstrated to be biphasic – a rapid phase (in which the majority of toxicant is excreted) followed by a very slow phase (lower toxicant loading in the tissue) (RED 1998). Diphacinone, with its high sensitivity to metabolism, low tissue retention and short biological half-life, would not accumulate in predators as brodifacoum or bromadiolone. In other words, diphacinone offers greater secondary exposure protection than do either bromadiolone and brodifacoum. Thus, the second generation anticoagulants present a short term and long term non-target secondary poisoning potential and have the potential to present a poisoning hazard to non-target species especially through cumulative exposures.

The potential for accumulation and retention of the rodenticides for each of the species in the sub-issues is outlined in Table 10. The invertebrates are expected to accumulate minimal if any residue (Pain et al. 2000, Howald 1997). The residues available in the invertebrates are believed to be restricted to the presence of the chemical in the gut of the organism. Thus, digestion time of the bait is the critical period as a secondary exposure hazard.

Composition of Bait and how it is Applied

The above analysis demonstrates that the anticoagulant rodenticides represent a potential secondary poisoning risk to non-target species. However, the levels of residues found within carcasses can be mitigated through alteration of concentration of active ingredient and its application technique. From a secondary poisoning perspective, by decreasing the concentration of active ingredient applied, the residue body burden found in target species carcasses is lessened. For example, Kaukeinen (1982), fed voles 10 ppm and 50 ppm brodifacoum bait. The brodifacoum concentrations were 4-10 fold more in those voles that fed on the 50 ppm brodifacoum bait.

Table 11. The relative secondary poisoning potential over time.

	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Temporal	NA	Short	Long	Short	Long	Short

Thus, the concentration of the active ingredient has a secondary poisoning consequence.

The delivery of the bait onto Anacapa Island would occur by one of two methods: aerial broadcast and/or in combination with bait stations. Eradication of rats using the bait station approach would be a saturation baiting strategy where an "unlimited" supply of bait is offered until activity ceases or slows, then the frequency of checking and re-arming of bait stations is reduced. This allows for the possibility of "overkill" where rats are able to consume as much bait as they desire. Recently, Howald et al. (2000) evaluated the brodifacoum residue levels within Norway rat carcasses after an eradication effort from a large seabird colony using bait stations. The residue concentration levels within the carcass were partitioned equally in the liver (site of activity) and gastro-intestinal tract (primarily from unassimilated bait). Unassimilated bait found in the gut of rats found dead above ground, represented 30-50% of the total brodifacoum residue load, and reflected the saturation baiting strategy employed. The aerial application of the rodenticide may potentially limit the consumption of bait by rats with less chance of overkill and thus limit the residue loading in any one carcass (Record and Marsh 1988). The levels of the rodenticides that may be found in rats and mice cannot be readily predicted for each of the alternatives.

On Anacapa, rats may consume all the bait before mice have access to it, versus in a bait station where bait would be available in stations for mice long after rats have been eradicated. The presence of bait in stations in the long term would present a long term secondary poisoning potential, possibly outweighing the short term secondary poisoning potential (Table 11). In other words, the window of secondary poisoning from toxic rats and mice would be shorter with a single aerial broadcast, and longer with bait stations. For a successful eradication using bait stations, stations must be armed for well over a year, perhaps two (Kaiser et al. 1997, D. Veitch, pers. comm., R. Taylor, pers.comm.). Once rats have been eradicated, and mice begin to use stations and die, other mice would fill those territories, enter the stations, and consume bait. On Anacapa, the secondary poisoning potential from bait station delivery is determined by the length of time stations are left armed.

Behavior of Target Species on Intoxication and at Death

The risk of secondary poisoning to predators/scavengers of rats and mice is limited by the availability of these prey in space and time. For the aerial predators on Anacapa, their search image is for live prey and thus risk of poisoning is during the latent period (after rats and mice have consumed the bait, but have not yet died) (estimated at 2 weeks). Anticoagulated rats demonstrate altered behavior which potentially makes them more susceptible to predation and scavenging. For example, Norway rats exposed to a lethal dose of brodifacoum spent significantly more time in open areas, sitting motionless or staggering about (Cox and Smith 1992, Gemmeke 1990). Most Norway rats radio-tagged in the field before baiting died underground in their burrows (87 – 100%) (Howald 1997, Taylor 1993). However, laboratory studies have demonstrated up to 50% die in the open (Cox and Smith 1992; Gemmeke 1990). Thus, anticoagulant poisoned rats and mice would be available to both diurnal and nocturnal predators and scavengers. On Anacapa, islet wide treatment would yield numerous dying rats and mice displaying erratic behavior and likely would be a significant prey base because of the ease of catching them. Optimal foraging theory indicates that an individual would use an area for foraging that would provide the greatest yield. Similarly, a number of rats and mice would die above ground and available for diurnal scavengers.

Local Environmental Factors

The above analysis has demonstrated a risk of secondary exposure to the rodenticides, however, it does not consider the local conditions at the time of the application window. The late fall period corresponds to the late dry season, which is a time when conditions for most species can be difficult. Both the rat and mouse population would be at the lowest point in their annual cycle which would limit the numbers of poisoned rats and mice available to avian hunters and scavengers on the island. The onset of the rainy season soon after the bait has been applied will degrade the bait thus limiting the potential primary and secondary exposure.

Toxicological Impacts by Sub-Issue

The analysis is broken down into the sub-issues, and within each sub-issue, broken down into primary and secondary exposure. The consequence of rodenticide exposure for each sub-issue, where possible, was calculated and is representative of a "worst-case" scenario. Where the Level of Concerns (LOC) exceed 0.5, suggested mitigation measures are presented.

Sub-Issue 1: Marine Mammals

Primary Exposure (Direct)

The risk of primary exposure to the pinnipeds is the same across all alternatives because of the aerial broadcast of the rodenticides onto the cliffsides. Alternative 6 is a higher risk for exposure because of the multiple treatments with both diphacinone and brodifacoum.

Toxicology - No data exists on the toxicity of the rodenticides to marine mammals. If consumed in sufficient quantities, the rodenticides are likely toxic to the seals and sea, impairing hemostasis as in the other vertebrates.

Bait Composition and Delivery - The aerial application of the rodenticides onto the cliffsides and shoreline of the islands present a risk that bait may drift into the ocean or land on the beach areas where marine mammals feed and haul out. Therefore, this group is at risk of primary exposure if they were to be attracted to the bait.

Behavior and Foraging Strategy - The pinnipeds feed exclusively in the marine environment, and only haul out to rest and breed.

The diet of the California Sea Lions and Harbor Seals is primarily composed of fish and other animal species, however, it is unknown if they would be interested in bait pellets falling through the water column if they were to drift into the marine environment. The bait is a grain based pellet, that would unlikely be attractive to the seals and sea lions. The primary exposure of the seals and sea lions to bait while hauled out on shore is believed to be very low. The seals and sea lions would be utilizing the haul-outs around Anacapa Island during the proposed period of baiting.

Figure 11. Risk Quotients for Harbor Seals

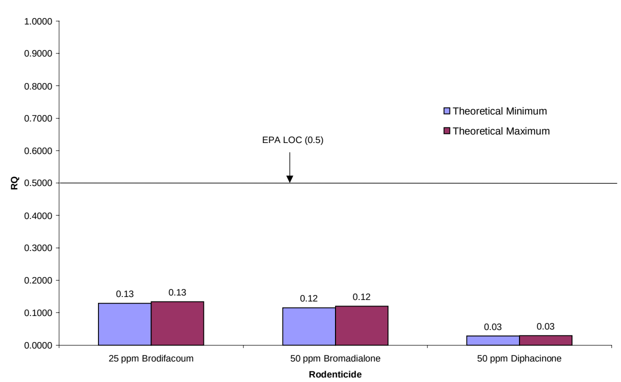


Table 12. The 48 hour LC_{50}/EC_{50} (ppm) for freshwater invertebrates (from RED 1998).

Species	Active Ingredient		
	Brodifacoum	**Bromadiolone**	**Diphacinone**
Water Flea (*Daphnia magna*)	0.98	0.24-2	1.8

Rodenticide Exposure Risk - The sea lions and seals are at low risk of primary exposure because of their foraging strategy. Calculating their risk quotient assuming a "worst case scenario" where they would feed exclusively on the pellets revealed that their exposure falls below the EPA LOC of 0.5 for all rodenticides (Figure 11).

Secondary Exposure (Indirect)

The diet of the California Sea Lions and Harbor Seals is primarily composed of fish and other animal species. Sea lions and seals are abundant around Anacapa Island during the proposed application window. If fish, predominantly sheephead, were to be primarily exposed to the rodenticide, the seals and/or sea lions may feed on the fish and be secondarily exposed to the rodenticide. This scenario is believed to be an extremely low probability because of the low probability of fish primary exposure – see above.

Sub-Issue 2 – Invertebrates

Primary Exposure (Direct)

Toxicology - Limited data exists on the acute toxicity of the rodenticides to the invertebrates. The EPA released data outlining the acute toxicity of the rodenticides to the water flea, a freshwater invertebrate (Table 12). No other invertebrate toxicology data is available.

The anticoagulant rodenticides are not known to affect the terrestrial and intertidal invertebrates because of their different blood clotting systems (Shirer 1992). Extensive field and lab trials have shown that beetles (Morgan et al. 1996; Eason and Spurr 1995; Stejskal et al. 1994; Tershy et al. 1992), cockroaches (Godfrey 1985), wetas (Morgan et al. 1996), land crabs (Pain et al. 2000; D. Veitch pers. comm.), snails, slugs, orthopterans, millipedes (Howald 1997), and ants (Godfrey 1985; Tershy unpubl. data) are attracted to rodent baits and can survive on a diet of 20-50 ppm brodifacoum.

Bait Composition, Delivery and Behavior - This sub-issue combines both the marine and terrestrial invertebrates. The terrestrial invertebrates would play a significant role in the removal of residual bait that is not consumed by rats and mice. A wide range of invertebrate species would consume bait and may transport the rodenticide into the ecosystem (see Secondary Poisoning). Limited studies on Anacapa Island in 1999 showed that sowbugs are attracted to placebo bait (ICEG 2000). The invertebrates on Anacapa Island would play a significant role in removal of residual bait that is not consumed by rats and mice.

There is a risk that some bait may enter into the intertidal zone and ocean around the Anacapa Island. If bait were to enter, the marine fauna would likely be a significant factor in consuming any bait pellets. There would likely be no direct impacts to individual species as their blood clotting mechanisms are comparable to the terrestrial species (Shirer 1992).

The consequence of rodenticide ingestion appears to be insignificant to the invertebrates. However, the consumption of the bait by invertebrates may have significant consequences for species that prey on those species, potentially moving the rodenticide into the ecosystem.

No RQs were calculated because of lack of acute toxicity data and the apparent low susceptibility to the anticoagulant rodenticides.

Secondary Exposure (Indirect)

The invertebrates would play a significant role in the removal of carcasses containing residues of the rodenticides, thus would be secondarily exposed. The invertebrates would ingest the rodenticide, however, they would not carry significant levels of residues outside the resident time in the gut of the organism (Pain et al. 2000; Morgan et al. 1996). They would present a risk of movement of the rodenticide into the ecosystem.

Sub-Issue 3 – Fishes

Primary Exposure (Direct)

Toxicology - No data is available on the toxicity of the rodenticides to marine fishes, however, data is available for freshwater species (Table 13).

Bait Composition, Delivery and Behavior - The drift of bait pellets into the marine environment from aerial broadcast is possible. The fish in the nearshore waters off of Anacapa Island are at risk of primary exposure through consumption of bait pellets that may fall through the water column. A small study was initiated in 1999 to identify those fish species that may consume bait (Table 14; ICEG 2000). Placebo baits were hand broadcast in small areas, the species present tallied along with their reaction

Table 13. The 96 hour LC_{50} (ppm) for freshwater fishes (from RED 1998).

Species	Active Ingredient		
	Brodifacoum	Bromadiolone	Diphacinone
Rainbow Trout	0.015	0.24	2.6
Bluegill Sunfish	0.025	3.0	7.5

to the bait pellets. The majority of the pellets that were falling through the water column illicited no response from marine fishes (62%). However, baits falling through the water column illicited an "inspection" response 20% of the time (inspection defined as approaching or following the pellet and/or "kissing" the pellet). Only sheephead was noted to actually take in and break up the pellet, but did not apparently consume the bait. Based on these results, sheephead is the only species to be considered at primary exposure risk if bait enters the marine environment. However, it is recognized that other species, or larger individuals of the species could be interested in bait pellets. Fish may also be at risk of exposure through the absorption of rodenticide residue across their gills if a high enough concentration is found within the water column. All the rodenticides in the alternatives are slightly to highly lipophilic and would therefore not be found in significant concentration in the water column. Any bait falling into the ocean would rapidly absorb moisture and begin to breakdown. Studies with placebo baits has shown that a compressed pellet lasts up to a "few hours" in calm conditions on the ocean floor (B. Keitt, pers.comm.). The incessant wave action and persistent swells on Anacapa Island would expedite the degradation process. On breakup of the bait pellets, the rodenticides, are not water soluble and would not readily stay in the water column, rather, begin to bind to available organic matter – such as marine animals and in the benthic layer. Therefore, the probability of a high enough concentration of rodenticide to enter into the sea and be of high enough concentration to be absorbed across the gills or skin of fish is low.

Secondary Exposure (Indirect)

Predatory fish may consume any primary exposed fish and/or other prey and are secondarily exposed to the rodenticide. However, this event is not likely to be extensive and would not likely adversely affect any local populations.

Sub-Issue 4 – Herpetofauna

Primary Exposure (Direct)

Toxicology - No LD_{50} data exists for the herpetofauna, however, studies have demonstrated equivocal results. In New Zealand, skinks found dead after an application of brodifacoum, tested positive for brodifacoum and showed symptoms of anticoagulant poisoning (see Eason 1995). This is in contrast to Tershy (pers. comm.) in which lizards were force fed 50 ppm brodifacoum bait. After two weeks, the lizards showed no symptoms of poisoning. No lab data is available to evaluate potential primary exposure.

Bait Composition, Delivery and Behavior - The three species of herps on Anacapa Island are primarily insectivorous and are at a low risk of primary exposure to the rodenticide. However, during an eradication campaign in New Zealand, Telfair's Skinks (*Leiolopisma telfairii*) reportedly consumed rain softened bait and succumbed to brodifacoum (Merton 1987 in Eason and Spurr 1995). The most significant pathway for rodenticide exposure is likely secondarily via their invertebrate prey base.

Table 14. Attraction of marine fishes to placebo baits, Anacapa Island, Spring 2000

Common Name [a]	Species Name	Event					Grand Total [b]
		No action	Inspected Bait	Touched Bait	Chewed Bait	Consumed Bait	
Blacksmith (391)	*Chromis punctipinnis*	22%	0%	0%	0%	0%	22% (11)
Garibaldi (19)	*Hypsypops rubicundus*	6%	6%	6%	0%	0%	18% (9)
Kelp bass (11)	*Paralabrax clathratus*	6%	2%	2%	0%	0%	10% (5)
Opaleye (100)	*Girella nigricans*	16%	4%	4%	0%	0%	24% (12)
Senorita (7)	*Oxyjulis californica*	2%	2%	2%	0%	0%	6% (3)
Sheephead (7)	*Pimelometopon pulchrum*	6%	0%	2%	2%	0%	10% (5)
Unidentified (14)	*Unidentified*	2%	2%	2%	0%	0%	6% (3)
Zebra perch (1)	*Hermosilla azurea*	0%	0%	2%	0%	0%	2% (1)
None (1)	*none*	2%	0%	0%	0%	0%	2% (1)
Grand Total		62% (31)	16% (8)	20% (10)	2% (1)	0% (0)	100% (50)

a Total number of individuals of a species during study in brackets.
b Number of events in brackets.

If the bait would be attractive to any of the lizards or salamander, the aerial broadcast of the rodenticide would increase the probability that greater numbers would be exposed. The use of bait stations on top of the island would spatially exclude most individuals from exposure, limiting exposure only to those individuals that have a bait station within their territory. If an individual was poisoned, that territory would become vacant and could be filled with another individual. That individual would then be at high risk of primary exposure. With an aerial broadcast laid out in the alternatives, the scale of impact would be a short window in time since the bait would be removed from the environment. Bait stations would have the potential for long term exposure to individuals.

No RQs were calculated due to lack of acute toxicity data.

Secondary Exposure (Indirect)

The lizards and salamander are at risk of secondary exposure through consumption of primarily exposed invertebrates. It is unknown if the diet of the herpetofauna is similar or contains species that would degrade residual bait in the Anacapa environment.

Sub-Issue 5 and 6 – Seabirds and Landbirds

Primary Exposure (Direct)

Toxicology - Toxicity data exists for both groups of birds (seabirds and landbirds) (Table 15). Brodifacoum is the most toxic rodenticide to birds.

Bait Composition, Delivery and Behavior - *(Pelagic Seabirds)* The pelagic seabirds are considered to be at low risk of primary poisoning because of their foraging strategy which is almost exclusively offshore. They are almost exclusively carnivorous, preferring live prey. If during the aerial operations, bait was to fall into the water, and a pelagic seabird was in the vicinity, it may mistake a pellet for an injured fish and perhaps pursue and consume.

Most of the pelagic seabirds winter offshore from Anacapa Island and are at a very low risk of exposure.

(*Roosting Seabirds)* - The roosting seabirds, those that utilize Anacapa Island for roosting and tend to primarily feed offshore, are at greater risk of exposure to the rodenticide than pelagic seabirds. Recent studies documented Western Gulls exploring piles of placebo bait deliberately placed near roost sites (ICEG 2000). Similarly, placebo baits that were deliberately hand broadcast into the marine environment caught the attention of Western Gulls which subsequently investigated the bait. The attraction of gulls to the bait falling into the water drew more gulls into the area. However, the bait pellets fell through the water column quickly and no gulls were observed to successfully “fish” out any pellets.

The timing of the operation is late fall and early winter when gull numbers are at their lowest.

Brown Pelicans

There would be no direct effect of the rodenticide bait on the pelicans since they are fish eaters. There is no likelihood that they would ingest any bait directly, or secondarily from contaminated prey. The bait would be in a pellet form and is not expected to adhere to bird feet or feathers, therefore, it is unlikely that pelicans will inadvertently ingest the pellets during preening activities. Pelicans are not scavengers and will not eat dead and poisoned rodents. (It is expected that most (87-100%) of rodents will die underground after consuming the bait.) Pelican prey species are schooling fish such as anchovies and sardines, species which would not come into contact with the bait.

(*Landbirds)* - As a conservative estimate of primary exposure risks, the granivorous and omnivorous species are presumed to be at a primary exposure risk during the operations. Over 47% of the landbirds are either granivorous or omnivorous and may be subject to primary exposure risks on Anacapa Island (Table 16).

However, this is based upon year round occurrence of these species on the islands. During the proposed application period, many of the landbird species would have moved off the islands to their wintering grounds. On Anacapa Island, this reduces the number of species at risk from 59 granivorous/omnivorous species to 26. Further, recent surveys in November/December 1999 on Anacapa Island detected only 14 species, including carnivorous and insectivorous birds (ICEG 2000). The most abundant species were the House Finch, Bewick's Wren and Says Phoebe.

The interest in the bait by non-target species was investigated in the Fall of 1999 as part of the pre-eradication research. Placebo bait pellets were placed in exposed locations around Anacapa Island and observed from a distance. After 62 hours of observation time, only one pile was investigated by a Western Gull, which apparently did not ingest any of the pellets (ICEG 2000). However, during spring trials, placebo baits were investigated by Western Gulls and at least one was noted to consume pellets. No landbird species were noted around the pellets during the observation period. This data suggests that the relative risk of primary exposure to the landbirds would be lower than suggested by the above table.

Table 15. Acute Oral and Dietary Toxicity of Rodenticides to Birds (LD_{50} mg/kg) (A dash indicates that no data is available) (RED 1998).

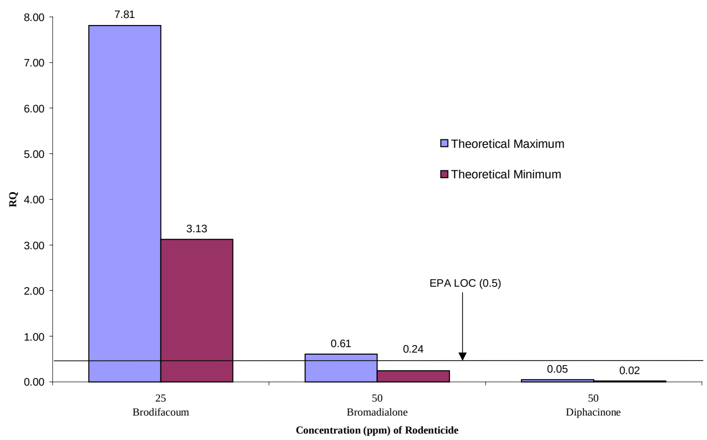
Species	Active Ingredient (Rodenticide)					
	Brodifacoum [a] Alternative 2, 3 and 6		Bromadiolone Alternative 4 and 5		Diphacinone Alternative 6	
	LD_{50}	LC_{50}	LD_{50}	LC_{50}	LD_{50}	LC_{50}
Mallard	0.26	2.0	-	158	3158	906
Northern Bobwhite	-	0.8	138	37	>400 - <2000	>5000
Canada Goose	<0.75	-	-	-	-	-
Black-backed Gull	<0.75	-	-	-	-	-
Laughing Gull	0.7	-	-	-	-	-
California Quail	3.3	-	-	-	-	-
Ring-necked Pheasant	10	-	-	-	-	-
Harrier Hawk	10	-	-	-	-	-
House Sparrow	>6	-	-	-	-	-

a The LD_{50} for an unknown bird species has been estimated to be above 0.56 mg/kg (see Howald et al. 2000)

The RQs for birds are presented in Figures 12, 13, and 14. The bird RQs exceed the EPA LOC of 0.5 for brodifacoum, and bromadiolone, falling below for diphacinone. This suggests that under the proposed alternative, if a bird was to be primarily exposed to the rodenticide, there is a risk of hemorrhaging and mortality.

The lack of interest in the placebo baits on Anacapa Island does not preclude the possibility of primary poisoning to landbirds. Field studies have shown that landbirds have been exposed to rodenticides that have been dispensed in both bait stations and by broadcast. Common Ravens, wekas and keas have been observed reaching into, or breaking into bait stations to gain access to the brodifacoum bait (Howald et al. 2000, Eason and Spurr 1995, Taylor and Thomas 1993). The primary exposure in combination with secondary exposure to brodifacoum had a significant

Figure 12. Risk quotients (RQ) for 20-50 g birds



impact on the local populations. These species are large, aggressive and share an omnivorous diet which contributed to their decline. Primary exposure and some mortality of birds of varying sizes, foraging strategies and classifications including: Kiwi, South Island Robins, weka, North Island Saddlebacks, blackbirds, chaffinches,House Sparrows,H Sparrows, Australian Magpie, Paradise Shelducks, and Pukeko have been reported (Empson and Miskelly 1999; Dowding et al. 1999; Eason and Spurr 1995; Morgan et al. 1996). All were suspected or confirmed exposed to brodifacoum, applied both aerially and in bait stations, and used for rat eradications from islands. Although the above studies have documented exposures and some mortality of these species from rodenticide exposure, the significance of the extent of poisoning was varied ranging from significant mortality (Howald et al. 2000; Eason and Spurr 1995; Empson and Miskelly 1999), to minor and insignificant (Robertson et al. 1993; Robertson et al. 1999; Dowding et al. 1999; and Empson and Miskelly 1999). Although there were incidences of poisoning in most island eradications, some impacted species recovered to population densities which were higher than densities before rodenticide application. (Empson and Miskelly 1999; Robertson et al. 1999; B. Simmons, pers. comm.)

In summary, landbirds will be exposed to the rodenticides on Anacapa Island. The consequence of such exposure would depend on the rodenticide. Brodifacoum and bromadiolone would result in mortality to some individuals, through single and cumulative exposures. The risk of primary poisoning would be significantly less with the use of diphacinone.

Secondary Exposure (Indirect)

(*Pelagic Seabirds*) - The risk of secondary exposure to the pelagic seabirds is through consumption of primarily exposed fish. The

Figure 13. Risk Quotients (RQ) for 100-200g birds

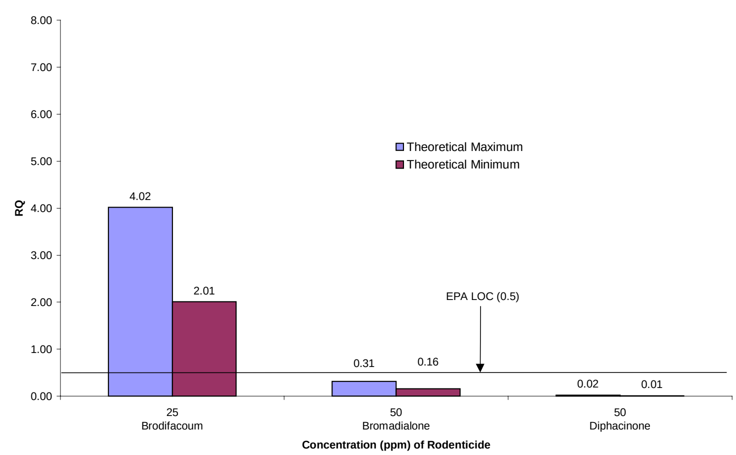


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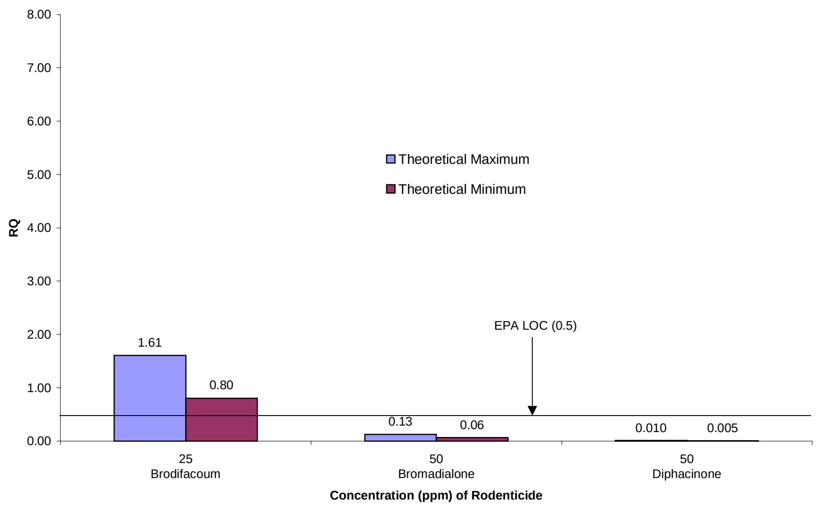
Figure 14. Risk quotients (RQ) for 500-1000 g birds



foraging grounds and the size of the prey would limit the potential for exposure. Most of the smaller seabirds take small prey such as sardines which would not be able to consume the bait pellets. The risk of secondary exposure to these species is very low.

(*Roosting Seabirds)* - Western Gull is the only species believed to be at risk of secondary exposure in the terrestrial environment via consumption of primarily exposed mice. No gulls were observed to consume any snap-trapped mice placed out in open areas, however, one was noted to pick up and drop a mouse carcass (ICEG 2000).

In the marine environment, if fish were to be extensively primarily exposed and were to float on the surface of the ocean, gulls would likely be an important scavenger that would consume the fish.

(Landbirds)- The birds of prey and scavengers are at risk of secondary exposure through predation/scavenging of live/dead mice and rats containing rodenticide residues (Table 17). Smaller landbirds such as the insectivores are at risk of secondary exposure through consumption of invertebrates that would have rodenticide residues in their digestive tract, however, the extent of this is believed to be relatively insignificant.

During the pre-eradication research, 11mice and 14 rat carcasses were observed for 165 hours to identify scavengers. The Common Raven and American Kestrel were the only landbird species observed to scavenge rats and mice (ICEG 2000). On Anacapa, only one pair of Common Ravens were observed, and American Kestrels were in low abundance, not even showing up in the bird surveys conducted in November/December 1999 (ICEG 2000). The birds of prey also were in low abundance, a maximum of 3 Burrowing Owls, 2 Short-eared Owls, and a pair of Barn Owls were observed on East Anacapa Island; Red-tailed Hawks and Northern Harriers were also in low abundance during fall surveys. This indicates that although there is a risk of secondary exposure to these species, the relative number of species present on the island during the proposed application period is low.

It seems reasonable to expect a significant impact on any species that preys primarily on rats and/or mice on Anacapa Island if brodifacoum is used. The relative risk would be less, although not absent with bromadiolone. The eradication of rats from East Island with a follow up on Middle and West Island may limit secondary poisoning because only a limited part of the island would be treated at any one point in time.

Table 16. Occurrence of landbirds in the Channel Islands National Park and their foraging strategies.

Island	Granivore	Omnivore	Insectivore	Carnivore	Total
AI		3			3
SBI	1	13	5	4	23
AI and SBI	3	53	14	8	78
Other Islands		9	2	3	14
Total	4	78	21	15	118

The risk of secondary poisoning to predators/scavengers of rats and mice is limited by the availability of these prey in space and time. For the aerial predators on Anacapa, their search image is for live prey and thus risk of poisoning is during the latent period (after rats and mice have consumed the bait, but have not yet died) (estimated at 2 weeks). Anticoagulated poisoned rats and mice could be available to both diurnal and nocturnal predators and scavengers. On Anacapa, islet wide treatment would yield numerous dying rats and mice displaying erratic behavior and likely would be a significant prey base because of the ease of catching them. Similarly, a number of rats and mice would die above ground and available for diurnal scavengers. There would be extensive secondary poisoning of the birds of prey with the use of brodifacoum or bromadiolone. The risk of secondary poisoning would be significantly less, although present with the use of diphacinone.

Mitigation

It is recognized that the landbirds are at risk of primary and secondary poisoning. To minimize visual attractiveness to birds, and thus primary exposure, the bait would be dyed blue or green; colors known to be less preferred by the Passerines. Suggested mitigation measures to minimize or prevent exposure to the rodenticides could include: Live trap and release owls and diurnal birds of prey on the mainland, or live trap, hold in captivity until the risk period passes, and release birds of prey back on to island.

This mitigation would be difficult to implement because live trapping of specific individual birds can be difficult if not impossible (B. Walton, pers. comm., G. Howald, pers. obs.). If required to implement, efforts would be made, but no guarantees that all individuals would be removed. Similarly, removal of birds of prey from Anacapa, could result in more birds filling the empty territories potentially presenting a greater secondary poisoning risk because more birds would be present (B. Walton, pers. comm.).

An alternative approach may be to provide

Table 17. The birds of prey and scavengers of Anacapa Island at risk of secondary exposure

Birds of Prey	Scavengers
Barn Owls	Common Raven
Burrowing Owls	American Kestrel
Short-eared Owls	
American Kestrel	
Northern Harrier	
Red-tailed Hawk	

the landbirds with supplemental food which would be more attractive than the bait pellets and/or rodent carcasses. Supplemental feeding stations would have to be established and regularly maintained before, during and after the baiting period.

For those carnivorous species that would scavenge dead rodents, carcass searching could be carried out to find, collect and dispose of any dead rodents. Thus, secondary exposure via carcasses is minimized.

Sub-Issue 7 – Terrestrial Mammals

Primary Exposure (Direct)

Toxicology - Acute oral toxicity data exists for mammals (Table 18). Brodifacoum is the most toxic rodenticide proposed under the alternatives.

Bait Composition, Delivery and Behavior - The presence of the deer mouse on Anacapa Island presents difficulties for eradication.

The baits are optimized for rodent control, and subsequently mice would be attracted to and would consume the bait. The impact on the mouse population would be heavy. The aerial broadcast of bait into the ecosystem increases the probability that any one individual mouse would be exposed to the bait, however, the exposure would be limited to a short window in time as bait would be removed from territories. However, it may not result in 100% mortality because rats have larger home ranges than mice (Howald et al. 1997) and are competitively dominant. Consequently, it can be difficult to simultaneously eradicate both species because the rats consume all the bait before the mice have access to it. If all the bait is consumed within the home range of an individual mouse, that mouse would then escape contact with bait (D. Veitch, pers. comm.). If on Anacapa, rats consume all the bait within an area larger than the home ranges of male deer mice on Anacapa Island (Howald et al. 1997), then the mice living in those areas would likely survive for some time without contacting bait.

The RQ indicates that brodifacoum and bromadiolone exceed the EPA Level of Concern of 0.5 (Figure 15). Diphacinone offers some protection to deer mice, assuming that the LD_{50} for house mice is representative of the sensitivity of deer mice. Deer mice are at a high risk of poisoning after a single days feed on bait containing either brodifacoum or bromadiolone.

There would be a high impact to the mouse population.

Secondary Exposure (Indirect)

The risk of secondary exposure to mice is believed to be small. The only route of exposure would be through the ingestion of an invertebrate containing rodenticide residues, or through consumption of poisoned carrion. The low retention time of the rodenticides in invertebrates limits this exposure window. Alternatives 2, 4, and 6 would limit the temporal risk. Bait stations in the remaining alternatives would increase the probability of secondary exposure over time.

Mitigation

The endemic subspecies of the deer mouse on Anacapa represents a logistical challenge to eradication of rats. The proposed mitigation for mice is outlined in Chapter 2.

Cumulative Effects

This section will analyze how each of the alternatives could have a cumulative impact to predators and scavengers through repeated exposures to the rodenticides, and the potential (non-toxicological) cumulative impacts to seabirds. Included is a summary of rodenticide toxicology issues from the Mainland of Southern California which could contribute to non-target impacts.

Table 18. Acute Oral Toxicity of Rodenticides to Mammals (LD50 mg/kg) (A dash indicates that no data is available) (adapted from Erickson 1999)

Species	Active Ingredient (Rodenticide)		
	Brodifacoum Alternative 2, 3 and 6 LD_{50}	Bromadiolone Alternative 4 and 5 LD_{50}	Diphacinone Alternative 6 LD_{50}
Norway Rat	0.26-0.56	0.56-0.84	2.3-7.0
Black Rat	0.65 [a]	-	-
Laboratory Mouse	0.4	1.75	50-300
Vole	0.2	-	-
Dog	0.25-1.0	10-15	0.88-7.5
Coyote	-	-	0.6
Rabbit	0.29	1.0	35
Guinea Pig	2.78	2.8	-
Mink	9.2	-	-
Mongoose	-	-	0.2
Cat	25	-	14.7

a from Taylor 1993

Alternative 1 – No Action

This alternative would utilize no rodenticides and therefore would have no potential for cumulative exposures.

Effects Common to Alternatives 2, 3, 4, 5 and 6

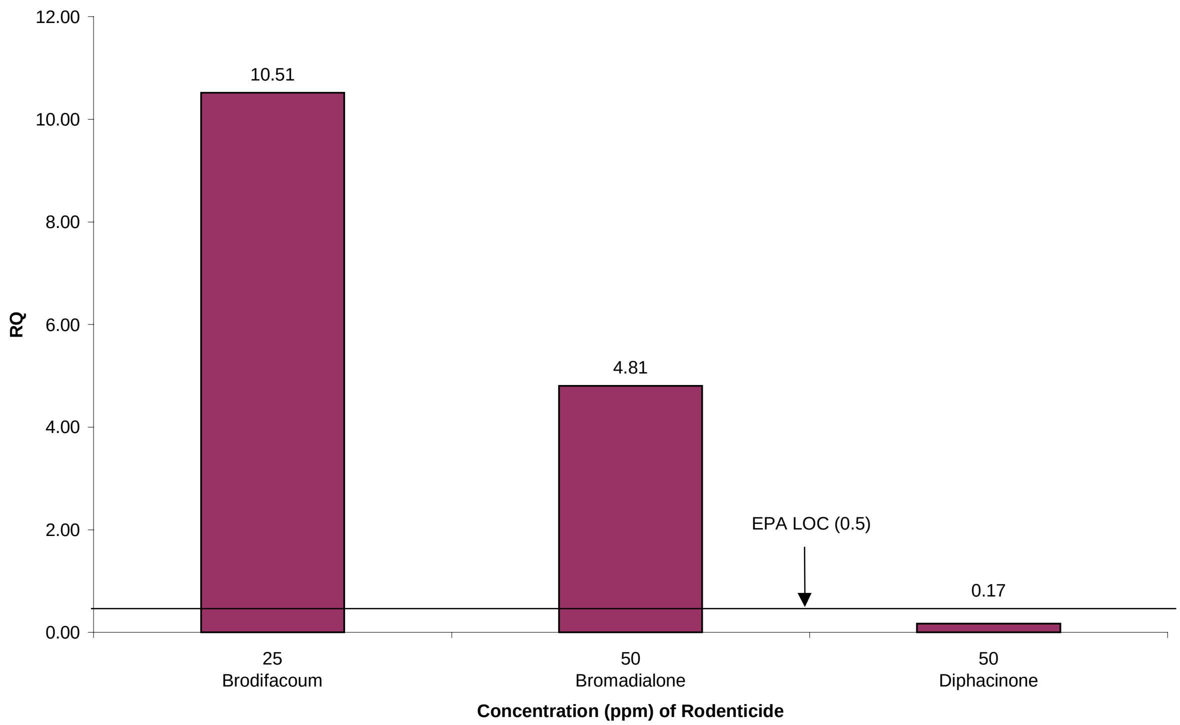
The use of brodifacoum or bromadiolone could result in predators and scavengers being exposed to the rodenticides through cumulative exposures. The properties of these chemicals (outlined above) are such that they are relatively insensitive to metabolism in vertebrate tissue which could result in accumulation of residues in time. The consequence of re-exposure is determined by how long after the initial application the bait is re-applied, the amount of area re-treated and the rodenticide in the bait. The 20 ha headland of Middle Island is not anticipated to be re-treated for up to a year after initial application. However, there may be a requirement for the re-treatment to protect East Island intermittently through the year. Any other areas treated initially would not be re-treated between one and two years after the initial application. This analysis is divided into primary and secondary exposure.

Middle Island Headland Re-Treatment

Primary Exposure

Between each treatment, there will be enough time elapsed for degradation of any residual bait that may not have been consumed by the rats or mice, thus reducing primary risks between treatments to very low or negligible. This negligible period is expected to carry through the landbird breeding season, thus allowing birds to successfully breed before re-treatment may be

Figure 15. Risk Quotient (RQ) for a 20 g deer mouse.



necessary. As the rat population grows, and if they re-invade the headland, and the risk of re-invading East Island is deemed to be high, the treatment of the headland may be required. Thus, after treatment the primary poisoning risk would again be high, but not as high during the initial application because fewer rats would likely be occupying the territory and thus would not require as high a sowing rate to kill them all. The application period may cross over into the Western Gull breeding season and may result in primary exposure of gulls to the rodenticide. During the spring 2000 field trials, placebo bait, was not found to be attractive to gulls occupying nesting territories. This data suggests that although some gulls may be attracted to and consume bait, there will likely not be extensive primary exposure of gulls.

Secondary Exposure

The risk of secondary exposure would be greatest during the initial application, and less with the subsequent re-applications because fewer rats and mice would be available as prey and there would be less bait placed into the environment. Similarly, if baiting of the headland occurs during the gull breeding season, there would be less overall risks to birds of prey on the islands because gulls harass the raptors generally excluding them from the island. During the spring and summer periods, very few, if any, birds of prey were observed and they were not detected during bird surveys. Some species, such as the Burrowing Owl and Short-eared Owl only overwinter on Anacapa Island, thus, they would not be present during the intervening months when the headland on Middle Island would be treated, thus escaping re-exposure. However, upon return to the islands, they may be at a greater risk of being lethally exposed to the rodenticide if they already contain sub-lethal levels of rodenticide residue in their tissues from exposure on the mainland. In other words, individuals could succumb to smaller and smaller amounts of rodenticides because of the sub-lethal levels in their tissues. This situation would be dependent on the availability of the rodenticide residues in time on the island. Re-application of an area could result in rodenticide residue being available in time which could lead to cumulative exposure.

Kaukeinen (1982) reported that no significant wildlife mortalities have been documented after 30 years of anticoagulant usage. Thus, the consequence of baiting would be restricted to non-target species that would be found on Anacapa Island. Migratory species that overwinter on Anacapa Island could potentially be exposed to the rodenticides on Anacapa, survive, and on return to breeding grounds on Mainland California, be exposed to the rodenticide and could succumb to the rodenticide exposure. The anticoagulant rodenticides have been detected in wildlife losses on Mainland California (B. Hosea, pers. comm.) and recently in golden eagles trapped on Santa Cruz Island (T. Coonan, pers. comm.). The detection of brodifacoum in golden eagles on the islands indicates that species with sub-lethal levels of rodenticide are transporting the chemical into the Channel Islands National Park from the mainland since no vertebrate pest control has taken place. With residues in their tissues they could be re-exposed to the anticoagulants on Anacapa Island, and succumb. The golden eagles are non-native species to the islands and are currently being removed from the islands (3-5 total remain). Only one golden eagle has been observed around East Anacapa Island (ICEG 2000). As time passes, the relative exposure risk would decline because limited bait would be applied in a relatively small area of land, at one point in time. On the mainland, the rodenticides are used for control and follow a chronic use pattern extensively around the state in both agricultural and urban settings.

Alternative 6

The use of diphacinone under alternative 6 could represent a risk of poisoning to non-target species via the mechanism outlined above. The relative risk would be less than brodifacoum or bromadiolone because of the significantly lower residence time in vertebrate tissue.

Seabirds

This project objective is to restore the island and as a consequence, free up seabird nesting habitat. Pressures on the seabird populations that utilize or could utilize Anacapa Island for breeding include oil spills and the squid fishery. The squid boats fish at night with high powered lights to draw in the squid for harvesting. The light boats cause increased predation to the adults and juvenile seabirds, and are known to negatively influence normal breeding activities (B. McIver, pers. comm.). Oil spills cause oiling of feathers which negates the insulatory properties of the feathers and leads to hypothermia and death. This section of the analysis will evaluate the cumulative effects to seabirds for each alternative.

Alternative 1 – No Action

Under this alternative, the negative impacts of oil spills and light boat activities would continue. Together with the presence of the rats on Anacapa Island, the reproductive potential of the seabird population would be seriously hindered.

Effects Common to Alternatives 2-6

Under these alternatives, rats would be removed from the island. The removal of the rats from the island should result in an increase in seabirds, particularly the Xantus' murrelet. The increased population could help offset some of the negative impacts from both oil spills and squid fishing. For example, if during the breeding season and the Xantus' murrelets were breeding in large numbers on both Anacapa and Santa Barbara, and a large oil spill occurred around either island, only one of the two populations of birds may be at risk of oiling (under the broad assumption that each population has a distinct foraging range away from each other). Compare with the occurrence of an oil spill around Santa Barbara Island, where a significant portion of the breeding population is at risk of oiling if rats were not removed from Anacapa. Similarly, the increased population of birds could help offset the potential impacts from predation due to light boats around the island. However, the presence of the light boats may also have a detrimental impact on the seabirds such that the seabird population could not grow even with the rats removed.

Issue 3: Public Safety and Visitation

Introduction

This section in the analysis will analyze the potential exposure of the general public to the rodenticides and how the proposed action would potentially impact visitors enjoyment to the park during the baiting operations. Within the exposure to the rodenticide section, the analysis will discuss how each method of delivery of the rodenticide may expose the visiting public to the rodenticide and associated health risks of exposure. Within visitor impacts, the effects discussion will focus on how the alternatives could potentially impact enjoyment of the park during operations.

Exposure to the rodenticide

The different application methods of the rodenticides could potentially expose the visiting public to the rodenticide through primary exposure. However, it should be noted that this would need to be an intentional exposure on the part of the visitor, i.e., a person would have to seek out the bait and deliberately consume it. Anacapa Island is open to the visiting public year round. Visitors are allowed access to East Island and with permission, to West Island in Frenchy's Cove. Thus, primary exposure to the rodenticide is limited to these areas of the island. There is a small possibility that fisherman may catch fish that could contain trace amounts of rodenticide residue, thus, being secondarily exposed. This analysis is organized by application technique (aerial vs. bait station). A summary analysis outlining the health concerns associated with exposure is presented.

Aerial Broadcast (Alternatives 2, 3, 4, 5, and 6)

Each of the alternatives would use aerial broadcast either on the cliffsides or both the cliffsides and top of Middle and East Islands. The aerial broadcast of a rodenticide bait increases the probability that a bait is found in any one location on the treated area. However, the probability of finding a bait pellet would be small. Bait pellets are about 2 g in size, and would fall to the ground with enough force to be covered by vegetation and out of general sight.

The alternatives would restrict public access to the island 2-3 days during treatment. This closure period would allow for the rats and mice to consume the majority of the bait within 72 hours (ICEG 2000). The buffer areas around the buildings and campground on East Island would not be aerially treated, thus reducing the probability of finding the bait pellets even further because these areas attract the greatest number of visitors. Signs posted at the landing areas indicating that the island has been treated would

Table 19. Number of bait pellets for one LD_{50} exposure to humans for each rodenticide [a]

Age	Weight (kg)	Brodifacoum	Bromadiolone	Diphacinone
Adult	70	364	392	1610
Child	10	52	56	230

a LD_{50} defined as amount of pellets required for a 50% chance of lethal hemorrhaging . LD_{50} assumed to be 0.26 mg/kg for brodifacoum, 0.56 mg/kg for bromadiolone and 2.3 mg/kg for diphacinone, based on LD_{50} data for the Norway rat.

provide information about the program to visitors and warnings about the bait and to avoid it if encountered.

There is a risk of bait pellets drifting into the marine environment from aerial activity. The bait pellets may be consumed by fish and potentially representing a secondary poisoning hazard to fisherman consuming the catch. The likelihood of exposure is small, and significant exposure via this pathway is believed to be even smaller. The fish population studied did not consume any bait pellets, although sheephead was noted to chew and spit out the bait. The amount of residues found within the consumable flesh of fish would likely be of inconsequence relative to the amount required for measurable effects (Table 19). Only fish around Anacapa could be exposed to the bait, and of those only in the nearshore waters. There is a fishing restriction to 60 ft depth around the north shore of Anacapa, lowering the probability of rodenticide exposure to fisherman even further.

Bait Stations (Alternatives 3 and 5)

In these alternatives, the use of bait stations around the buildings and campground on East Island would limit the potential for exposure to the rodenticides. The rodent bait would be encased within a lockable station that would be appropriately labeled "Rat Poison- Do Not Disturb". Pesticide labels attached to the stations would provide information as to the bait in the stations and emergency contact numbers would be provided as well as treatment for exposure. The stations would limit access to the bait to all but the most persistent visitors, such as those that may vandalize stations.

Consequence of Exposure

The exposure to small amounts of the bait is considered to present a very low risk to humans. Warfarin, a relative of brodifacoum and bromadiolone, is a common antithrombin medication, administered to human patients as a drug to "thin" the blood preventing heart attacks and strokes. If sufficient amounts are consumed, exposure to either of the rodenticides would have the same effect as warfarin. In effect, "thinning" the blood. If too much was consumed, an antidote would be available. Treatment is through dietary or daily injections of Vitamin K1, a common and readily available vitamin. Studies have shown that workers handling brodifacoum, the most potent of the three rodenticides presented, over a 9 month period did not show any effects suggestive of significant exposure (ICI, in Taylor 1993).

To demonstrate the relative risks of exposure, the number of 2 g bait pellets required to consume one LD_{50} for an adult and child is presented (Table 19).

Summary

The probability of visitors exposed to the bait is extremely small. The probability of exposure would be limited by closing the island for 2 –3 days, allowing for the vast majority of the bait to be cleaned up by rats and mice. Posters would warn visitors of the application, and bait stations around buildings with pesticide warning labels. Additionally, it would be rather difficult for one to find and consume enough bait to be of any consequence. Effective medical treatment would be available because of the slow onset of toxicosis and availability of an antidote (Vitamin K1).

Mitigation

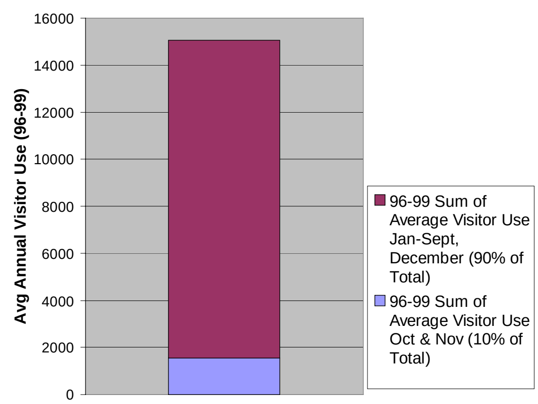
The bait could contain a bittering agent (bitrex) at a concentration known to deter human consumption, yet still be highly attractive to rats. However, there are data which suggest that bitrex could have a detrimental impact on eradications because some rats may be sensitive to the bittering agent (D. Veitch, B. Simmons, pers. comm.). The bait would be dyed a blue or green color that may be diluted out of the bait when exposed to water such as saliva and /or sweat making it a good indicator for someone who may have incidentally eaten or picked up the bait. Hospitals would be notified prior to the operation that anticoagulants have been used, and to not overlook symptoms of anticoagulant exposure.

Public areas on East Anacapa Island – trails, picnic areas and campgrounds would be inspected for any exposed bait, which would be removed before the island is open to the public. All employees and other park staff would be instructed about any hazards concerning the rodenticide before they are allowed on the island after application.

Impacts to Visitor Enjoyment

Visitation to Anacapa Island is highest in the summer and lowest in the fall and winter periods. November and December are the slowest months with relatively minor numbers of visitors to the islands as compared to the peak season (Figure 16). The project plan would be to divide the islands into two sections, treating East Anacapa Island in year one and then Middle and West Island in year 2, thus always leaving one of the two public areas open to visitors at any one point in time. Similarly, the other Park islands would be open to visitors throughout the project period. Therefore, closure of the island for 2-3 day period post application would have no significant impact to visitor enjoyment.

Figure 16. Visitor use during proposed treatment period.



Sustainability and Long Term Management

This section of the analysis will focus in on the relationship between local short-term uses of the environment and the maintenance and enhancement of long term productivity, irreversible and irretrievable commitments of resources, and adverse impacts that cannot be avoided. The analysis is divided into the no action alternative and rats eradicated (Alternatives 2-6) since the impacts across all alternatives will be similar. The difference between the alternatives would be the scale of impact to the resources.

Relationship between Local Short-term uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Alternative 1 – No Action

Under this alternative, no short term uses of the Anacapa environment would take place. The Island would continue with normal Park operations as it has in the past. As a result, there would be no new existing short-term uses that would affect long term productivity.

Alternatives 2-6 – Rats Eradicated

Under these alternatives, rats would be removed from the islands with the use of a rodenticide. The alternatives differ by rodenticide choice, intensity, and duration of application, however, the end result – rats eradicated - remains the same. The use of the rodenticides in the Anacapa ecosystem represents a risk of non-target poisoning to birds and mice causing reductions in population sizes. However, the actions would be of short duration which would result in short term declines of some species but those species would recover. Mitigation measures to minimize those impacts have been developed for landbirds. Deer mice have been appropriately protected from extirpation or extinction as outlined in Chapter 2. The benefit of rat eradication would be the recovery of the nesting seabirds, increased mouse populations, increased populations of intertidal invertebrates and terrestrial invertebrates. This increase in native species populations could potentially support greater numbers of those species that were incidentally poisoned with the rodenticide. In other words, the benefits outweigh the costs.

Irreversible and Irretrievable Commitments of Resources

The irreversible commitments are those which cannot be reversed, except perhaps in the extreme long term . An example, extinction of a species is an irreversible loss. Irretrievable commitments are those that are lost for a period of time, e.g., restriction of visitor use while an area is temporarily closed would be an ongoing irretrievable loss. The following describes irreversible and irretrievable commitments of resources resulting from affirmative actions identified in the various alternatives.

Alternative 1 – No Action

Under this alternative, continued rat predation of seabirds would represent an irretrievable loss. An irreversible loss could be the lack of regeneration of the island oaks and cherries on West Island. Similarly, the financial commitment of the American Trader Trust Council would be an irreversible loss since the funds are dedicated towards seabird habitat restoration.

Alternatives 2-6 – Rats Eradicated

Under each of the alternatives there would be no irreversible loss of resources. There would be irretrievable loss of resources, in particular, mice and landbirds. However, these resources are proposed for mitigation and protection before the operations would begin.

Unavoidable Adverse Impacts

The impacts identified below for each alternative are those for which there are no mitigating measures or which could not be mitigated to a level of insignificance.

Alternative 1 – No Action

The No Action alternative, by definition, contains no measures to mitigate impacts to resources. The presence of rats in the Anacapa ecosystem will continue to result in significant, unmitigated, adverse impacts to seabirds, landbirds, mice, invertebrates, and plants.

Alternative 2-6 – Rats Eradicated

Under each of the alternatives, the level of mitigation should be sufficient for a level of insignificance.

ANACAPA ISLAND RESTORATION PROJECT

CHAPTER FIVE
CONSULTATION AND COORDINATION

Chapter Contents

Coordination

Although Channel Islands National Park has identified Anacapa Island rat eradication as a priority for management with its inclusion in the 1985 GMP, it was not until the Island Conservation and Ecology Group (ICEG) submitted a rat eradication proposal (Tershey et. al 1997) to the Park that a specific action was developed.

Because the primary benefactors of rat eradication on Anacapa Island are seabirds, the Park found support for the planning of the project through the American Traders Trustee Council (ATTC). The ATTC was formed as a result of an oil spill off of the Huntington Beach shore from the single-hull tanker *American Trader* in 1990. The ATTC is responsible for the dissemination of settlement monies paid by the oil carrier.

The ATTC was able to support the restoration planning for this project because the proposed activity primarily benefits seabirds and seabird habitat. Monetary support of the planning of this project was disseminated through a cooperative agreement between ATTC, NPS, and ICEG. The cooperative agreement outlined responsibilities of each party during the planning phase of this project. The Park will seek funding through ATTC to implement the decision that results from this analysis.

Public Involvement

The NEPA "scoping" process [40CFR 1501.7] was used to determine the scope of the analysis and to identify potential issues and opportunities related to the Proposed Action. A summary of the scoping and public involvement process for the proposed project is as follows:

Internal Scoping

The Park has an extensive record of controlling rats on EAI. Through these efforts, the Park has collectively gained knowledge about the issues surrounding the presence of rats on the island. In addition, the Park has funded scientific studies that focus on the ecology and control of rats within the Park.

External Scoping

Island Conservation and Ecology Group(ICEG)

ICEG is a non-profit conservation group made up of American and Mexican conservation biologists, educators, and public officials working to protect biological communities on the over 250 islands in northwest Mexico and California. Since 1996, ICEG biologists have been studying the rat infestation on Anacapa Island and have advised the Park on ecological issues associated with rats on the island.

Vertebrate Pest Experts

As part of the Vertebrate Pest Conference held in San Diego, CA (3/6-9, 2000) vertebrate pest experts made a site visit to Anacapa Island to discuss the rat eradication project. Their comments and concerns were recorded and have been considered in this analysis.

General Public and Government Regulatory Agencies

The Park has made extensive efforts to inform and seek input from the general public and government regulatory agencies regarding the need to eradicate rats from Anacapa Island. These efforts include the following:

- 11/18/99 - Scoping letter sent to all interested publics who expressed an interest in Channel Islands National Park. This included all government regulatory agencies that may have oversight authority regarding the proposed action.

- 11/19/1999 – Park press release sent to all local media outlets. This resulted in stories regarding the proposed project in three local newspapers (Ventura Co. Star, Santa Barbara Newspress, and LA Times). Several out of area newspapers printed the article when the Associated Press distributed it on its AP wire. A Santa Barbara local TV station (Channel 6 KSBY) aired a story regarding the proposed project.

- 11/20/1999 – Park posted information on its World Wide Web (www) site. This included a Frequently Asked Question (FAQ) summary regarding this project.

- 11/26/1999 – Notice of Intent (NOI) to prepare and Environmental Impact Statement for this project was published in the Federal Register.

- 12/8/1999 – Public meeting held at the Park. Paid for ads and public notices announcing the meeting were published in three local newspapers (Santa Barbara Free Press, Ventura County Star, and the Los Angeles Times). A local radio station (KVEN 1520) covered the meeting and aired its story the following day.

- 7/7/2000 - Notice of Availability for the Draft EIS appeared in the Federal Register. Combined, the Park widely distributed paper copies or CD-ROM disks to over 100 government agencies, organizations, and individuals. In addition, the DEIS was made available on the Park's website. The Park also issued a press release to 50 local media outlets announcing the release of the DEIS. This resulted in at least two articles about the project and the release of DEIS for comments (Santa Barbara Free Press and the LA Times).

- 9/5/2000 – This date ended the review period for the DEIS. At the end of this chapter is the Park's response to the substantive comments that were sent regarding the DEIS. Included is a full reprint of the letters the Park received on the DEIS.

List of Preparers

FEIS Preparation

Steve Ortega	Restoration Specialist	Channel Islands National Park
Gregg Howald	Wildlife Biologist [Ecotoxicology]	Island Conservation and Ecology Group

FEIS Review

Kate Faulkner	Natural Resources Division Chief	Channel Islands National Park
Tim Coonan	Branch Chief for Terrestrial Monitoring and Restoration	Channel Islands National Park
Allen Schmierer	Environmental Compliance Specialist	Pacific West Region – National Park Service

FEIS Technical Assistance

Cathy Schwemm	GIS Specialist	Channel Islands National Park

List of Recipients

Below is a list of all agencies, organizations, and individuals that will receive a copy of the FEIS.

In addition, the Park will notify the general public that the FEIS is available for comment by:

- Issuing a press release to the 50+ local media outlets that are part of the Park's Public Relations mailing list
- Placement of a legal notice in both the Santa Barbara News Press and the Ventura County Star
- Post the FEIS on the Park's website in PDF format

Government

- California Department of Fish & Game
- U.S. Fish and Wildlife Service (Ventura Office)
- Environmental Protection Agency (Washington Office)
- California Environmental Protection Agency
- Central Coast Regional Water Quality Control Board
- California Coastal Commission
- National Marine Fisheries Service
- Channel Islands National Marine Sanctuary
- U.S. Army Corps of Engineers
- U.S. Geological Survey
- Canadian Wildlife Service
- U.S. Coast Guard
- National Wildlife Research Center, U.S. Department of Agriculture
- Honorable Lois Capps
- Honorable Elton Gallegly
- City of Ventura

Organizations and Businesses

- Santa Barbara Museum of Natural History
- National Wildlife Research Center
- Institute for Wildlife Studies
- The Nature Conservancy
- Santa Barbara Botanic Garden
- Catalina Island Conservancy
- Environmental Defense Center
- National Parks and Conservation Association
- California Native Plant Society
- National Fish and Wildlife Federation
- Pacific Seabird Group
- American Trader Trustee Council
- Island Packers
- National Audubon Society, Seabird Restoration Program
- Ventura Audubon Society
- Santa Cruz Island Foundation

Individuals

- Peter Triem
- Bruce Colvin
- Gillian Keys
- Deborah Jaques
- Charles Drost
- Desley Whisson
- Frank Gress
- Dan Anderson
- Lyndal Laughrin
- William Everett
- Dick Veitch
- Buck Hull
- Ole Barre
- Jack Gillooly
- Eiji Imamaura
- Steve Junak
- Cristina Bren
- John Cloud
- Scott Cooper
- Jack Engle
- John Gherini
- Tom Gherini

- Michael A. Glassow
- Jeff Howarth
- Julie Tumamait-Stensile
- Adrian M. Wenner

The Park maintains a mailing list of individuals and organizations interested in the activities of Channel Islands National Park. A notice will be sent to this mailing list that notifies them of the availability of the FEIS. The notice will give instructions on how to request a copy of the FEIS or view it at the Park's website.

Response to Scoping Comments

At the public meeting comments were given regarding the project. In addition, the Park received five written comments on the proposal. The comments received on the proposal were either asking the Park to consider a certain alternative, or to consider certain impacts which may occur as a result of implementing the proposed action.

Alternatives

Three alternatives were recommended during the scoping period:

- Introduce predatory snakes
- Introduce neutered/spayed cats from animal shelters
- Use less toxic rodenticides

Each of these alternatives are discussed in Chapter II. The use of less toxic rodenticides was an alternative put forth to address the issue of non-target species poisoning. The issue of non-target species poisoning is discussed in Chapter IV Environmental Consequences.

Impacts

The comments the Park received on potential impacts to wildlife species asked that the analysis include impact analysis for the following species:

- Raptors
- Anacapa Deer Mouse
- Pinnipeds

The Environmental Consequences section in Chapter Four address impacts to these species and others.

DEIS Comments and Responses

The following are letters that were received on the DEIS and the Park's response to the comments.

VENTURA AUDUBON SOCIETY
INCORPORATED
P.O. Box 24198
Ventura, CA 93002

September 5, 2000

Channel Islands National Park
Attn. Superintendent
1901 Spinnaker Dr.
Ventura, CA 93001

Dear Mr. Setnicka:

The Ventura Audubon Society has reviewed the DEIS for the Anacapa Island Restoration Project. We agree with the objective of this program, eradicating rats from Anacapa to help restore seabird populations, but we have some questions, concerns and comments regarding the techniques and rodenticides employed. Our responses are listed categorically here.

Preferred Alternative (#2). Presented as the most effective alternative, it also has the highest potential for negative environmental effects, because of the broadcast method and toxicity of poison. Of most concern is the "heavy impact" to the endemic deer mouse population as described, and unknown impacts to various landbirds and invertebrates, some of which may be considered transitional (to full species status). Further, as islands are very sensitive to population changes, even temporary disruptions could produce long-term effects on other members of limited food chains—and/or make a reduced population even more subject to other changes (disease, climate, etc.). Without much (or any?) research on the effects of brodifacoum on associated endemic and other species, it may not be prudent to experiment to this extent on Anacapa Island.

Toxicity of poisons. While the half-lives of the proposed rodenticides are given in a chart, there is little discussion of "persistence." How long will each poison be toxic? Will the poisons break down to toxic or non-toxic byproducts? Will this occur at a constant rate or differential, when exposed to rain, seawater, or dry conditions? If the pellets fall in places not exposed to rain, how long could they persist? (Our concern, of course, is the continued poisoning of non-target species subsequent to the initial die-off.)

Unknown variables and issues of concern:
-- With invertebrate poison consumption causing transport into narrow food chains, secondary and tertiary poisonings and their persistence may be untraceable and/or unable to be mitigated.
-- Little or no research is given charting effects of poisons on herpetofauna.
-- An assumption presented, that rats would consume most or all of the bait present, out-competing the mice, appears overly optimistic and is not backed by hard data. Especially if brodifacoum is used, rats may ingest very little compared to non-target species.

A1: The impacts to invertebrates has been adequately described (p. 66) for various species. Invertebrates do not have a Vitamin K dependent blood clotting system and therefore are not believed to be negatively impacted by the anticoagulant rodenticides.

Landbirds: The risk analysis for landbirds evaluated the potential for primary and secondary exposure (p. 69). The risk analysis grouped landbirds primarily by foraging strategy which is the primary risk evaluation tool as it determines risk of primary or secondary hazards. Included was a summary of studies completed that documented no landbirds were interested in placebo bait pellets presented. There are no landbirds endemic to Anacapa Island, however, there are endemic subspecies that exist on Anacapa and the other much larger and diverse Park islands (San Miguel, Santa Rosa, and Santa Cruz Islands) and the other Channel Islands (Diamond and Jones 1980, Johnson 1972). Of the eight endemic avifauna found on Anacapa, all are also found on at least one or all of the Channel Islands. Adequate mitigation, such as timing of operation, color of bait pellets, size of bait pellets and formulation of bait pellets will be adopted to minimize risk of rodenticide exposure.

A2: All acute toxicity data is presented in the EIS. No toxicity data exists for many species found on Anacapa Island. For risk evaluation, it is common practice by the US EPA to utilize data from species representative of specific groups eg., Passerines, upland gamebird, and waterfowl. It is impossible to predict the response of any species to a pesticide without data from that species. It is logistically and financially infeasible to collect laboratory toxicology data on every individual species. The data presented allows an evaluation of the relative risks. Wherever possible, we utilized statistical data from the literature that more accurately estimated the acute toxicity of the rodenticides to birds. The data presented then allows for inferences to be drawn about the relative risks and response that could be expected.

A3: The AIRP focuses on restoring seabird nesting habitat. The benefits extend not only to seabirds, but also to landbirds, the Deer Mouse, invertebrates (terrestrial and marine), and plants through relief from predation pressure from rats. Rats on Anacapa Island have altered the ecosystem and are responsible for extirpating seabirds and other species from the island (eg. the 20 year absence of the Deer Mouse from East Anacapa Island). Worldwide, introduced rats appear to be responsible for about 50% of all bird and reptile extinctions. Anacapa Island may be a "sink" to many species because of the presence of rats. Some species are likely kept at a chronically low level, presenting a risk of susceptibility to environmental changes. The removal of rats will greatly benefit these groups of species. There are no endemic species, except for the Deer Mouse, on Anacapa Island that are at risk of rodenticide exposure. All impacted species will likely recover to pre-eradication levels or greater. For those species that are being heavily impacted by rats (seabirds, landbirds, invertebrates), their numbers will increase rapidly post eradication, and likely will exceed the pre-eradication levels. *(continued next page)*

Aerial broadcast. This method as described did not address various issues. Will
A8 *roosting* pelicans be exposed to the bait or the effects of low-flying helicopters? If most
rats live on the cliffs, and bait placement is proposed as "trickling from above and hand-
A9 placed from below," then couldn't the baiting be accomplished completely by hand or in
bait-stations (so as to further minimize marine and non-target effects)? Are rats living on
A10 offshore rocks? (If undetermined, study should substantiate rat presence so as to
minimize unnecessary broadcast and resultant disruption to roosting/nesting seabirds and
marine ecosystem.)

If brodifacoum is used, Appendix C appears to indicate it has been effectively applied
most often with ground applications. Because aerial application has apparently not been
A11 tested much (with actual attempts for either method not listed), and Anacapa's
ecosystems highly sensitive due to the small size of the island, ground application with
A12 bait stations would preserve more non-target species.

Migrations. There appears to be no proposal for aggressively controlling possible rat
migration from Middle and West Anacapa to East Anacapa, during the year after the
initial broadcast/baiting on East Anacapa. Has the placement of traps or bait stations
A13 along migration points been considered? (Monitoring alone doesn't seem the best
solution if no plan for containment is in place.)

Emergency Response Plan. As outlined in various sections and Appendix A, the park's
A14 response to new rat introductions should be fully developed and implemented prior to any
eradication efforts, including guaranteed funding and personnel to prevent future
infestations. Prevention standards and strategies (outlined on pg. 4) are recommended for
all islands irregardless of the outcome of this project.

Conclusion. A safer alternative than preferred #2 should be strongly considered,
A15 utilizing less-toxic poisons and methods of application. Aerial broadcasting of
brodifacoum presents the highest risk of widespread and persistent contamination of
Anacapa ecosystems, with many effects and variables unknown from the research cited.
Bait stations present the least-risky method even though they require more maintenance
and present other possible impacts, including logistical. Whichever methods and baits
A16 are chosen, all mitigations proposed in the DEIS, especially those to protect the deer
mice, should be enacted prior to application.

Please respond to the above address, and thank-you for considering these comments.

Sincerely,

Neil Ziegler, President
Ventura Audubon Society

A3 continued: The susceptibility to the rodenticide, followed by a recovery to levels higher than measured pre-eradication has been documented in New Zealand and elsewhere after rat eradication. The benefit of the eradication clearly outweighs the risk of rodenticide exposure.

A4: A discussion of persistence requires an analysis of the temporal and spatial availability of the rodenticide. The temporal availability of the rodenticides has been discussed on pages 61 and 64. The spatial availability of the rodenticide is only relevant if it is available to be consumed/absorbed by a biological organism susceptible to the chemical. Any residual bait that is not degraded due to rainfall, or heavy moisture will be susceptible to microbial degradation. There are no toxic metabolites. The rodenticide itself will bind strongly to organic matter in the soil where microbial degradation will expedite the detoxification process reducing the rodenticide to its base components of carbon dioxide and water. The binding to soil will lock the rodenticide, making it biologically unavailable to birds and mice. In the very extreme case of bait entering and residing unconsumed in a dry location on the island, the bait will still be susceptible to microbial degradation. There will not be any bait available in dry locations to be of biological significance to any population. These dry habitats, such as caves, are also good habitat for rat and mouse burrows and any bait found in these areas will likely be the first pellets to be consumed.

A5: The analysis focussed on primary and secondary poisoning. Tertiary poisoning is possible; however, very little study has been reported in the scientific literature. Studies have documented that invertebrates consuming the bait will test positive for the rodenticide so long as the bait is present in the gut of the organism. No rodenticide residue will likely be bound within invertebrates once the bait is excreted, thus, presenting a very low risk of moving the rodenticide into the food chain over the long term. The rodenticides appear to not persist in invertebrate tissue(Pain et al. 2000).

A6: The known ecotoxicology data for herpetofauna was presented in the EIS (pg. 67). There are plans to monitor the herpetofauna population to evaluate the potential toxicological effects. Although there may be some impacts to herpetofauna, there is evidence to suggest that removal of rats will cause increase in the herp population to levels higher than pre-eradication (Merton 1987). Rats are known to prey on the herpetofauna of Anacapa Island and the population may be chronically suppressed because of the rats. In other words, it is expected that the herpetofauna population will rebound and increase to levels higher than currently found on Anacapa Island.

(*Continued next page)*

A7: Rats prey on the Anacapa Deer Mouse and were believed to be responsible for the 20 year extirpation of the Deer Mouse from East Anacapa Island. Rats preyed on and out competed the mice for resources on the island. The bait, formulated for rodents, will be highly palatable to both the rats and mice. Rats will be competitively dominant for the resource. Sowing rates have been optimized such that very little if any bait will be remaining after application and once rats and mice have removed the bait.

A8: Although pelicans may be roosting on the island during the non-breeding season, it is anticipated that the pelicans may temporarily use alternate roost sites on other islands during the period of helicopter activity. There will be no direct effect of the rodenticide bait on the pelicans since they are fish eaters. There is no likelihood that they will ingest any bait directly, or secondarily from contaminated prey. The bait will be in a pellet form and is not expected to adhere to bird feet or feathers, therefore, it is unlikely that pelicans will inadvertently ingest the pellets during preening activities. Pelicans are not scavengers and will not eat dead and poisoned rodents. (It is expected that most (87-100%) of rodents will die underground after consuming the bait.) Pelican prey species are schooling fish such as anchovies and sardines, species which will not come into contact with the bait.

A9: The reasons for the methodology have been outlined in Chapter Two. The reasons for not pursuing placement of bait stations across the whole island are described on page 26.

The hand placement of baits from above and below, alone would not accomplish the purpose and need. Hand distribution of bait would not meet the basic requirement that bait be delivered in every rat's territory. Personnel would be required to stand precipitously close to the edge of the cliff. The cliff edges are extremely unstable and present a significant hazard to personnel. Daily orientation visits for visitors to Anacapa include a discussion of the necessity of avoidance of cliff edges because of the danger. Similarly, all cliff faces are not accessible. The cliffs rise 60 m to almost 300 m on West Island. There is no guarantee that by hand baiting, enough bait could be placed in high enough concentration on the cliff side to meet the purpose and need.

A10: Rats do exist on the offshore rocks (G. Howald, pers. obs.). The offshore rocks are close enough to the Anacapa Islands that rats could easily swim the distance to the island. Thus, if the offshore rocks are not treated, there would be an unacceptably high risk of rats re-invading the island negating the investment in eradicating the rats.

Al1:Aerial application of rodenticides for rodent control to protect endemic and native birds is a tool being pursued in Hawaii. Island rat eradications using the aerial broadcast of rodenticides have been carried out over many islands including in New Zealand and elsewhere in the world. The aerial broadcast of pesticides is common on agricultural lands on the mainland in Southern California. The preferred aerial applicator is an experienced agricultural aerial pesticide applicator, certified by the State of California.

A12: The reason for not pursuing bait stations on Anacapa Island has been outlined on page 26. The relative risk of non-target exposure to the rodenticides would be less with bait stations, however, it is technologically infeasible to place bait stations on the cliffsides. Baiting the cliffsides is necessary to meet the purpose and need of the project.

A13: In May 2000, studies were initiated to evaluate if rats would cross the channel between East and Middle Island. Rats from Middle and East Island were live trapped, fitted with a radio collar, and released in the channel, on the opposite island from which they were captured. After 3 months, no rat has been detected to cross the channel. Nonetheless, we recognize that rats re-invading East Island is a possibility. Re-invasion prevention is outlined in response D3.

A14: The Park fully understands the ecological implications of introductions of non-native plants and animals to Park islands. It is further understood that eradication should not be pursued without a prevention program in place to keep re-introductions from occurring. The Park is committed to fully implementing all aspects of the prevention plan (as described on pages 17) prior to the completion of rat eradication on Anacapa Island. Many aspects of the prevention plan, including public education and rodent proofing the Park's departure points will be implemented prior to Fall, 2001.

A15: The purpose and need require that rats be eradicated from Anacapa Island. The preferred alternative offers the highest probability of successfully meeting the stated objective. The use of a lesser toxic compound would result in a lower probability of achieving eradication. These lesser toxic compounds are valuable for control purposes, where they could be used chronically. However, control would require long term use of the rodenticides, which could result in greater impacts to non-target species than if the preferred action were adopted in the first place. This project is proposing a one time use of the rodenticide, and would not require re-treating. There will be no long term deleterious effects from the use of the rodenticide. Many species impacted by the rodenticide will rebound to pre-eradication levels and in some cases, exceed the levels found before eradication due to release from rat predation.

A16: As written in the FEIS, ensuring the viability of the Anacapa Deer Mouse is a necessary action.

ENDANGERED SPECIES RECOVERY COUNCIL

RECEIVED
CHANNEL ISLAND NAT'L PK

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A NON-PROFIT CORPORATION

Supt.
Admin.
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Protection
Marine Sci.
NBS - Terr.
NBS - Mar.

5 September 2000

Mr. Tim Setnicka, Superintendent
Channel Islands National Park
1901 Spinnaker Drive
Ventura, California 93001

Re: Draft Environmental Impact Statement, Anacapa Island Restoration Project

Dear Mr. Setnicka,

Thank you for the opportunity to comment on this important conservation undertaking. At the outset, I would like to note that our organization, the Endangered Species Recovery Council (ESRC), is 100% in favor of the complete removal of rats from Anacapa Island and the prevention of rat introduction to any other of the CINP islands.

We have long been aware of this plan, and we believe that aerial dispersal of rodenticide is the only practical means to accomplish rat eradication. Indeed, it was the ESRC that initially provided input from New Zealand experts who have successfully removed rats and many other non-native predators at many locations around the world.

Without going into line-by-line commentary on the DEIS, we would like to submit the following summary comments that we believe are most critical to evaluation of the proposed project and its impacts:

B1 1) It is our understanding that the precise rodenticide to be used has yet to be determined - neither the toxicant, the concentration, or the bait matrix. Until these issues have been resolved (and approved by the EPA), we find it impossible to adequately respond to the options as set forth in the DEIS.

2) We are gravely concerned that there has not been sufficient public outreach and education on the issue of aerial application of rodenticide. We anticipate, in light of the minimal public awareness of the health "risks" of such operations, that there could well be a backlash that could

B1: Chapter Two (Alternatives Considered in Detail pgs 16) of the EIS describes six alternative that are being considered for implementation. Each alternative describes the toxicant and concentration, including the delivery mechanism. The inerts of the bait will be of a commercially manufactured product, optimized for maximum palatability and acceptance to rats.

B2: Chapter Five (Public Involvement pgs 84) describes the effort the Park has made to solicit public input on this project. Local newspapers (Ventura Co. Star, LA Times, and Santa Barbara Newspress) have published at least one feature article about the project, some have done two articles. The Park will continue to keep the public informed via press releases, website, and public notices on this project as the compliance process moves forward.

The environmental analysis has discussed the potential human health risk and has determined that exposure of visitors to the rodenticide is extremely low. This fact, along with the island closure and the information dissemination (as described on pg 78) reduces even further the human health risk.

B3: The interaction between Deer Mice and Xantus' Murrelets has been described elsewhere (see Murray et al. 1983, Sydeman et al. 1998). The Xantus' Murrelet has evolved and contended with native predators such as mice on Santa Barbara Island (south of Anacapa Island) for centuries and is the largest breeding colony in the USA. The Deer Mice prey only on eggs, while rats are capable of preying on eggs, chicks and adult murrelets severely impairing reproductive potential in the short term and long term. Anacapa and Santa Barbara Island share similar habitats and the Deer Mice are the only native mammals on the islands. Rats are only found on Anacapa Island, which does not have a significant murrelet breeding colony.

(Continued on next page)

Mr. Tim Setnicka, Page two
5 September 2000

B2 derail this important project and hinder a number of other similar efforts being planned at National Parks and other locations throughout the United States. Much, much more information needs to be proactively disseminated and public fears adequately addressed before the DEIS can be considered complete, and a reasonable assurance of public acceptance attained.

B3 3) It should be noted in the DEIS that native Deer Mice (*Peromyscus sp.*) are also significant predators on the eggs of Xantus' Murrelet, and that removal of rats will not ensure a reduction of losses of murrelets to mice. A "decline" in numbers of murrelets and perhaps even storm-petrels cannot be exclusively attributed to rats. Conversely, a "recovery" could be limited by the presence of native deer mice. Rats could, in fact, also be suppressing deer mouse populations. This dynamic needs to be discussed in detail.

B4 4) We believe that before rat eradication is attempted, that rodent exclusion standards and practices should be fully developed and implemented by the Park. This is not clearly stated in the DEIS.

B5 In summary, we applaud the Park's use of electronic media to distribute the DEIS, but note that both the web site and CD ROM are cumbersome to use. In terms of substance, the document is difficult to read and understand even for professionals who have been engaged in eradication efforts for years. We suspect the public will be highly wary of technical language. Although we understand that such information needs to be included, it should also be stated in terms that a layman can easily understand.

B6 Given the critical weaknesses in crucial elements of this otherwise comprehensive document, we feel that a Revised DEIS should be prepared, and that adequate time be allowed for other regulatory agencies to provide approvals and the public's inevitable concerns to be satisfactorily addressed.

Thank you again for the opportunity to provide comments, and we wish you well in ultimately being successful of ridding Anacapa Island of the rats that have no rightful place in this unique ecosystem.

Sincerely,

William T. Everett — Dick Veitch (ge)

William T. Everett
President

Dick Veitch
Senior Restoration Analyst

B3 Continued:

The abundance of available nesting habitat (McChesney et al. 2000), similarity to Santa Barbara Island, and presence of the Xantus' Murrelet attempting to utilize Anacapa Island for nesting, strongly suggests that the Xantus' Murrelet and other small, crevice nesting seabirds will benefit from the removal of rats. The removal of rats from Anacapa Island should aid in the recovery of the Xantus' Murrelet and other crevice nesting species susceptible to rat predation.

B4: See Comment A14.

B5: The Park's intent in distributing the DEIS through its website was to allow for wider distribution to the public. Distribution of the DEIS by CD-ROM is a less expensive way to disseminate the analysis. However, the Park distributed traditional "hard" copies to people who requested them, or to people who did not have computer access. The Final EIS will be distributed in the same manner, however, the Park will review its website dissemination procedure.

The Park attempted to make the document as readable and understandable as possible. Some of the technical language that is in the document is a product of the complex subject manner. Since most of the environmental impacts revolve around rodenticide toxicology, standard methods were used for displaying and discussing this subject. Where possible the analysis attempted to summarize this information.

B6: The environmental analysis that has been prepared for this project meets a very high standard of environmental analysis. Both the legal requirement and the spirit of NEPA have been fulfilled. A supplemental EIS is necessary when substantial new information is discovered or substantial changes with environmental ramifications are made to the proposed action or an alternative to the proposed action. Because substantial changes are not being made, a supplemental EIS is not necessary. The Final EIS adds an option for preparing a supplemental EIS should first year implementation monitoring results indicate that objectives are not being met, or environmental effects are different that what is described in the FEIS (see pg 16 "Effectiveness and Validation Monitoring").

FROM: PETER D. TRIEM
OJAI RAPTOR CENTER
190 GREENVIEW CIRCLE
VENTURA, CALIFORNIA 93003 Tel: 805 642-4210

TO: SUPERINTENDENT
CHANNEL ISLANDS NATIONAL PARK
1901 SPINNAKER DRIVE
VENTURA, CALIFORNIA 93001

DATE: 2 SEP 2000

SUBJ: DEIS FOR ANACAPA RESTORATION PROJECT (AIRP). GOAL OF AIRP: ERADICATION OF NONNATIVE RATS FROM SUBJECT ISLAND.

REF: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR ANACAPA ISLAND RESTORATION PROJECT

1. Thank you for letting me read and comment on this DEIS. Not surprisingly, it is thorough, literate, and accurate, mostly. It has the look and feel of a document prepared by contractors well versed in this art form.

2. My credentials in brief are BA UC Berkeley biological sciences general curriculum; many years of field experience and scientific writing and editing with the US Forest Service as well as 10 years recent experience in providing medical care to wildlife injured, orphaned, or poisoned as their environment has become restricted and degraded.

3. To cut directly to the chase, given your intention to eradicate exotic rodents from Anacapa and inferentially other Channel Islands, I will stipulate to your choice of brodifacoum for initial attack and aerial dispersal in combination with bait stations as the preferred means of poisoning the target species, black rats. But the devil, in this case, is in the unstated premise and assumptions.

C1 4. **Feasibility**. Have you established that it is feasible to eradicate *Rattus* spp. from Anacapa? I see no feasibility studies included or cited nor any statement of the *probability* of success in one year, two years, or n years. The sad history of eradication programs is that they do not achieve their initial objective and become self-perpetuating. Some years back the journal Science published a sidebar titled: Gypsy Moths - 50, USDA - 0 to celebrate 50 years of gypsy moth eradication. You may counter that yours is small island population with less reproductive potential than lepidoptera, and in Appendix C you list some 33 island rat eradication programs - with the *implication* they were all successful. Were they? And what were the cost - benefit and risk - benefit results, the time to completion data, collateral damage, etc? What is the similarity of Anacapa to each of the islands in terms of latitude, climate, size, and relief? Anacapa is larger than all but three of the cases cited, most of which had target species other than *Rattus rattus*. . Given the costs and risks, is it too much to expect you to be explicit about feasibility and compare identical cases or at least present persuasive argument for the similarity of cases? There are many islands with negligible relief that can be made free of rats, but Anacapa is not one of them.

C1: A feasibility study was conducted in 1996 and a report submitted to the Channel Islands National Park (see Tershy et al. 1997). The probability of complete removal, or eradication, of rats from Anacapa Island is high. Eradication of rats from islands has taken place on islands in the sub-Antarctic, to tropical atolls to the temperate Northern Pacific in Canada. The basic underlying principal that resulted in the successful eradication programs has been the delivery of a bait containing a rodenticide into every rat territory on the island. This principal has been applied on all islands in all types of climates and sizes from small offshore rocks to the largest island of over 3000 hectares (7,500 acres). The objective of the AIRP is eradication and not control, therefore, treatment of the entire island is necessary for meeting the purpose and need. The topography of Anacapa was taken into account when developing the alternatives. Aerial broadcast is the only method for ensuring bait is delivered into every territory.

Appendix C is a list of successful eradications.

***LETTER C: OJAI RAPTOR CENTER** CONT .*

C2 5. **Assumptions**. 1) *The rats will take the bait.* Professional pest controllers have learned how difficult it is get <u>all</u> the rats to take the bait. When they have time and funds they typically pre-bait and pre-trap with innocuous baits and unset traps until they hope they have the whole population trained to take the bait. Then they blitz the target population with a combined assault of baits, mechanical traps, and glue traps. If even one pregnant female rat escapes, the area is repopulated at a predictable geometric rate. A recent study revealed part of the problem: young rats tend to eat only what their mothers eat, and given the abundant food along the littoral adjacent to the peak concentrations of Anacapa rats, there is no reason <u>all</u> the target rats will C3 accept poison baits. If you miss a few founder rats, it will be gypsy moths all over again. And as you note, survivor populations tend to select for recalcitrance. 2) *The breeding season for rats is April to September.* How sure are you of this? Mainland populations of black rats breed all year around, with litter size being a function of food availability and the female's weight and particularly fat:lean ratio. Decrudescence/recrudescence of testes is also a function of optimum weight, not solar azimuth as it is in birds. Skinny and obese male rats tend not to contribute to the gene pool. Your "baddest rats," in terms of risk to birds, population concentrations, and hazards to bait applicators are the ones that have year around access to food near the beach. They are the Willy Suttons of the rat world: they hang out in the rocks because that is where the C4 food and shelter are. What could be better than all the birds, limpets, carrion, and addled eggs you can eat plus a secure retreat lined with bird feathers? 3) <u>Rats are territorial.</u> In what sense? Adult males with the most testosterone keep lower ranking males away from the females, but is there a well delineated territory? However, territoriality does not seem to be the linchpin of your eradication program. Rats <u>are</u> pioneering animals, and this will have the same C5 effect as territoriality. 4) *Salamanders are dormant during the proposed baiting period from October to January (page 44).* Mainland slender salamanders are <u>active</u> during the rainy C6 season. Are the Island populations different in this respect? 5) *Alligator and side-blotched lizards would be active during the application period.* This period corresponds to the time of <u>least</u> activity for *Uta* spp. on the mainland; alligator lizards are active year around at lower elevations. C7 Two other assumptions you might revisit, although they have no impact on your DEIS: 6) *Trapping raptors would result in even more occupying the vacated "territory" - B. Walton.* By your account, there are no raptor nesting territories on Anacapa (there once was an active peregrine falcon nesting site there). Fall and winter raptors <u>do not</u> defend hunting territories, and their occurrence on the Islands is intrusive and random. Unless you have species of special concern such as San Clemente shrikes (probably already doomed) or bald eagles in very small numbers, removal is probably out of the question. <u>Raptors will be fatally poisoned</u>, and this invites the question: If a raptor should fall in the Island scrub and no one sees it, has it really fallen? 7) Finally, there is the canard "*Golden eagles are non-native species to the Islands* . . . . This is a convenient fiction, justifying the removal of golden eagles to save the Island foxes, a sound if desperate measure. The confabulation contains in its rich warp and woof the notion that golden eagles never flew to the Islands until recently when they espied from a great distance the absence of bald eagles and the opportunity to kill foxes when the "good guys in white hats" were not there to protect the foxes. That is a tale any six-year old could enjoy. Golden eagles are "non-native birds" to Anacapa in the same sense that red tailed hawks are - or any other of the casual avian visitors. Bald eagles with <u>nesting territories</u> will defend a stretch of beach from conspecifics in particular and eagles in general; migrating adults and immatures do not defend territories - they do rob others and intimidate. And don't count on them not killing foxes: these sea eagles kill large birds, seal pups, and sea otter pups. Revegetating the Islands will do more to save the foxes than bald eagles - and in the interim you could create fox shelters out of some of the trash and structures left on the Islands. And vaccinate the foxes for parvo and canine distemper. And worm them. What's so hard about that?

Sincerely,

Peter D. Triem

C2: Rat baits are formulated to be highly palatable to the target species. A battery of tests are required by the EPA to ensure that rats will consume the bait and will have the desired effect on the target population. On Anacapa Island, we are delivering the bait to the rats at a time of year when the population is food stressed and are actively seeking out high quality food resources such as that found in the bait. The bait is formulated to be highly palatable and attractive to the rat population. Island eradications are most likely to be successful if they take place during the annual population cycle when no reproduction is taking place and when rat numbers are declining. This insures that new-born rats will not emerge from their dens after all bait has been consumed, and that most rats will be food stressed and therefore more likely to consume bait.

C3: Work conducted by Erickson (1990) documented the seasonal reproductive condition of rats on Anacapa Island. His work has been cited throughout the EIS.

C4: The basic premise for all successful rat eradications is the delivery of bait into all rat territories. Territory is used synonymously with range.

C5: The application period corresponds to the late dry season on Anacapa Island. Bait will not be applied during the rainy season. During the dry season salamanders would be deep within thick vegetation or deep cracks within the soil to avoid dessication.

C6: Alligator Lizards and Side-blotched Lizards are active year round on Anacapa Island. The herpetofauna will be monitored before, during and after the eradication for measuring impacts from the baiting and the predator release once rats are eradicated. See comments from A6.

C7: Secondary poisoning of birds of prey is of concern. Mortality of individual non-target birds will be mitigated where possible. However, from an ecological perspective such mortality is only significant if it causes a long term population decline. There are no endemic birds of prey on Anacapa Island. The birds of prey on the Channel Islands are habitat limited, i.e., there are more birds than there is available habitat. Data from a raptor control effort around a colony of endangered Least Terns indicates that population effects of such removal are temporary.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Superintendent
Channel Islands National Park
1901 Spinnaker Drive
Ventura, CA 93001

Dear Superintendent:

The U.S. Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for the **Anacapa Island Restoration Project**, Ventura County, California (CEQ #000228). Our review is pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508) and Section 309 of the Clean Air Act (CAA).

The goal of the proposed action is to eradicate the non-native Black Rat from Anacapa Island and to keep Anacapa Island, as well as Santa Barbara Island, Prince Island, and Sutil Island, rat-free. The proposed action involves the aerial application of the rodenticide Brodifacoum into all rat territories on Anacapa Island over a period of two years. The application of rodenticide would occur during the fall of the year to minimize disturbance and exposure to other affected resources on the island. One of the greatest environmental concerns of this project is the exposure of non-target species to the rodenticide. Six alternatives are presented in the DEIS, including a Preferred Alternative and a No Action Alternative.

The six alternatives differ primarily in terms of 1) the type(s) of rodenticide used and 2) the application method(s) employed. There are three types of rodenticide (active ingredients) under consideration: Brodifacoum, Bromadiolone, and Diphacinone, and there are two application methods under consideration: aerial application from a helicopter, or by hand in areas inaccessible by helicopter, and "bait stations." The Preferred Alternative, Alternative 2, employs the aerial application of Brodifacoum over the extent of Anacapa Island. The other four alternatives are designed to reduce the impact of the rodenticide on non-target species. However, these alternatives are less effective in meeting the objective of 100% rat eradication.

EPA applauds the National Park Service's collaborative work with the Island Conservation and Ecology Group and the American Traders Trustee Council, as well as the public outreach that has been incorporated in the development of this document. EPA is also highly supportive of the proposal to split the project into two years to provide the opportunity to monitor, modify and improve operational procedures for the second year and to monitor the impacts of the project on non-target species.

In general, in our review of the DEIS, we have not identified any environmental impacts requiring substantive changes to the proposal. In addition, we believe the analysis provided adequately sets forth the environmental impacts of the Preferred Alternative and the other alternatives considered. We have rated this document LO-1, *Lack of Objections-Adequate Information*.

Our rating of LO-1 reflects our overall view of the adequacy of the document. However, we recommend the inclusion of clarifying language and a commitment to both monitor the impacts of the project to non-target species and to implement mitigation measures laid out in Chapters 2 and 4. Specifically, EPA requests that the Record of Decision (ROD) outline NPS's commitment to project monitoring and mitigation. EPA also requests that the Final EIS include a discussion of the emergency response plan for accidental spill of rodenticide during bait application. Please see the attache Detailed Comments for further discussion of these issues.

We appreciate the opportunity to review this DEIS. When the Final EIS is completed, please send two copies to me at the address above. If you have any questions or comments, please feel free to contact me or Nova Blazej, the primary staff person working on this project. Nova Blazej can be reached at 415-744-2089 or *blazej.nova@epa.gov*.

Sincerely,

David J. Farrel, Chief
Federal Activities Office

Attachments: Summary of EPA Rating Definitions
Detailed Comments

U.S. EPA DETAILED COMMENTS
DRAFT EIS: ANACAPA ISLAND RESTORATION PROJECT

PROJECT MONITORING & MITIGATION MEASURES

The DEIS states that the project will be split into two years to 1) allow for monitoring of efficacy of the project and 2) to allow the Park to monitor impacts to non-target species and to identify further necessary mitigation measures (p.13). The DEIS also includes descriptions of specific mitigation measures designed to protect non-target species, particularly deer mice and landbirds, from non-target poisoning (pp. 13, 63). The island populations of both deer mice and landbirds are expected to decline during the project period.

D1 - *Recommendation:* We strongly recommend that the National Park Service 1) commit to monitor, modify and improve operational procedures for year 2, as necessary, and 2) to commit to specific mitigation measures to protect and restore the populations of deer mice and landbirds on Anacapa Island. Include this commitment in the Final EIS and in the Record of Decision (ROD).

EMERGENCY RESPONSE PLAN

The DEIS states that application of the rodenticide would be carried out by or under the supervision of licensed applicators. The document does not, however, state whether an emergency response plan is in place in the case of an accidental spill of rodenticide during the project application.

D2 - *Recommendation:* In the EIS include a discussion of the emergency response plan that will be implemented in the case of accidental spill of rodenticide during the project application.

TEXT CLARIFICATIONS

Timing

Chapter Two of the DEIS includes a discussion of the "timing" of bait application and states that application would be restricted to September through December of each year to minimize disturbance and ecotoxicological impacts to non-target species. For clarity, it would be helpful to reiterate this restricted period of application in the discussion of each alternative. In addition, the discussion of the Preferred Alternative states that the 20 ha Middle Islet may be treated D3 periodically to prevent re-invasion of East Islet (p.14). Clarify whether or not repeated treatment of Middle Islet would occur only during the restricted months of September through December or during other periods of the year when impacts to non-target species would be more significant.

U.S. EPA Comments on DEIS: Anacapa Island Restoration Project — *August, 2000* — *1 of 2*

D1: The Final EIS adds a monitoring element to all action alternatives. In summary, should first year implementation monitoring results indicate that objectives are not being met, or environmental effects are different from that what is described in the FEIS (see pg 16 "Effectiveness and Validation Monitoring") then a supplemental EIS would be prepared. The supplemental EIS would address potential modification of the project and their environmental effects.

D2: A Bait Spill Contingency Plan will be developed in case of an accidental release of bait into both the terrestrial or marine environment. The handling and storage of the bait, as well as the dispensing of bait (aerial or hand placement) will follow California Code of Regulations (Title 3. Food and Agriculture) Division 6. Pesticides and Pest Control Operations managed by the California Environmental Protection Agency, Department of Pesticide Regulation. These regulations outline the requirements of applicators and pesticide handling procedures. All of these regulations will be complied with to ensure that there is a low risk of bait spill into sensitive environments. In addition, consultation with the US Coast Guard and NPS IPM staff will take place to develop a plan to respond to any bait spills. Included will be an outline of procedures for clean up, monitoring, and reporting of any bait spill incidents. All staff will be trained to standards and thoroughly understand their responsibilities in an emergency.

D3: The re-treatment of the 20 ha headland on Middle Island may become necessary for protection of East Island from re-invasion of rats. The intention of treating the 20 ha headland is to open up territory for rats moving East on Middle Island, thus, as they move out of rat occupied territory into unoccupied territory, they would utilize open territory on Middle Island. The size of the headland is equivalent to about 20-40 average sized adult rat territories. Thus, the highest probability of re-invading East Island would be late in the rat breeding season as juveniles are dispersing and are seeking their own ranges to occupy. Thus, the re-treatment period would only be necessary if rats are utilizing the headland extensively. Monitoring for rat presence/absence will take place on the headland near the accessible points along the shoreline. The results of the monitoring will evaluate location of detection, number of detections and rate of re-occupancy of the headland to evaluate risk of re-invading East Island. If the risk of re-invasion is deemed high, the 20 ha headland on Middle Island will be re-treated. Similarly, monitoring stations will be placed on the East Island near the accessible shoreline to evaluate presence/absence of rats suggestive of re-invasion from Middle Island. Monitoring stations near the accessible shoreline may include the use of non-toxic indicator blocks and the use of bait containing the rodenticide brodifacoum. Thus, rats will likely have consumed a lethal dose after they have been detected, presenting a lower risk of re-invasion. However, bait stations alone would not adequately defend against re-invasion of East Island because, the cliffs are extremely steep and unstable and bait stations could not be placed on them. *(Continued on next page)*

D4
Island Rat Eradication Success Rate
Appendix C presents a table on "Island Rat Eradications Worldwide" to give an overview of the active bait ingredient(s) used in various rat eradication efforts on islands worldwide (p.104). This table would benefit greatly from the inclusion of statistics on the success rate of each of the rat eradication efforts. Information on the success rate of previous efforts would give the public and decision makers a clearer idea of the success rate they can expect for the proposed project.

D5
Likelihood of Rat Re-colonization
The DEIS includes some information on the behavior patterns of black rats on Anacapa Island (pp. 4, 5, 53). A more thorough discussion of the island rat population and individual behavior patterns, such as individual territory and foraging range, would be helpful. This information would help establish a better understanding of the potential for re-colonization of areas previously treated for rats and the overall probability of success of the project.

D3 Thus, only a few bait stations could be placed along the accessible areas along the shoreline, thus, leaving the potential for rats not encountering the stations before they cross the channel.

If the risk of re-invasion is deemed high, then the headland on Middle Island would be re-treated outside of the September-December window. However, the impacts to non-target species would not be significant because treatment would be on a limited section of the island (20 ha), the sowing rate would likely be lower because of fewer rats, reducing the relative risks further, and Brown Pelicans do not nest on Middle Island. Although there would likely be non-target mortality from re-treating the 20 ha headland of Middle Island, the impacts would not be significant.

U.S. EPA Comments on DEIS: Anacapa Island Restoration Project ***August, 2000***
2 of 2

D3 *Response Continued*

D4: Appendix C is a list of successful island rat eradications. Once the time and resources have been invested into an island eradication, it becomes necessary to sustain those resources until the eradication is complete. The economic resources have been devoted to this project and Anacapa Island falls within the size class of all successful island eradications. The project also has a 2-3 year follow up monitoring plan for detecting the presence/absence of rats on the island post eradication. If rats are detected after eradication, the detection response plan would be implemented as outlined in Appendix A.

D5: The rats on Anacapa Island have been a focus of a few studies (ICEG 2000, Howald 1997, Erickson 1990 and Collins 1979). The rats are distributed unevenly across the island. The highest density of rats can be found along the shoreline, where the intertidal zone is likely and important foraging area especially during the lean dry season, and the cliffsides provide good burrowing habitat. Rats utilize the rocky crevices of Anacapa Island and are found to overlap quite extensively with the high quality murrelet nesting habitat (McChesney et al. 2000). Erickson (1990) documented important rat habitats as those that provide adequate cover, either from dense brush or rock crevices. Dense brush on the islands include coreopsis, sagebrush, and wild cucumber. The wooded canyons also provide excellent rat habitat. Grassland habitats found on Middle and East Island do not provide good habitat for rats and thus, rats are found in low density. The presence of rocky crevices providing protection appears to be the most important feature for the distribution of rats on Anacapa Island (Erickson 1990). Rats can be found utilizing gullies and drainages on the islands as travel corridors, allowing freedom of movement between feeding and burrowing areas. Radio-telemetry studies conducted in 2000 and 1996 confirmed that movement of rats on Anacapa is primarily limited to drainages and gullies, and areas of dense shrubbery , very little movement of rats has been found on the grassland. In May 2000, studies were initiated to evaluate if rats would cross the channel between East and Middle Island. Rats from Middle and East Island were live trapped, fitted with a radio collar, and released in the channel, on the opposite island from which they were captured. After 3 months, no rat has been detected to cross the channel. Re-invasion prevention is outlined in response **D3**.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
VENTURA FIELD OFFICE
2151 ALESSANDRO DRIVE, SUITE 255
VENTURA, CALIFORNIA 93001

REPLY TO
ATTENTION OF:

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August 7, 2000

Office of the Chief
Regulatory Branch

National Park Service,Channel Islands National Park
Attention: Tim Setnicka
Channel Islands National Park
1901 Spinnaker Dr.
Ventura, California 93001-4354

Dear Mr. Setnicka:

We received the DEIS for the Anacapa Island Restoration Project (AIRP), dated June 2,000. The stated purpose of the AIRP is to eradicate non-native rats from Anacapa Island and keep other islands rat-free. It appears the proposed project would not result in any Corps-regulated activities. Consequently, we will not be providing comments on the DEIS.

Please be advised a Corps of Engineers permit is required for:

a) structures or work in or affecting "navigable waters of the United States" pursuant to Section 10 of the Rivers and Harbors Act of 1899. Examples include, but are not limited to,

1. constructing a pier, revetment, bulkhead, jetty, aid to navigation, artificial reef or island, and any structures to be placed under or over a navigable water;

2. dredging, dredge disposal, filling and excavation;

b) the discharge of dredged or fill material into, including any redeposit of dredged material within, "waters of the United States" and adjacent wetlands pursuant to Section 404 of the Clean Water Act of 1972. Examples include, but are not limited to,

1. creating fills for residential or commercial development, placing bank protection, temporary or permanent stockpiling of excavated material, building road crossings, backfilling for utility line crossings and constructing outfall structures, dams, levees, groins, weirs, or other structures;

2. mechanized landclearing, grading which involves filling low areas or land leveling, ditching, channelizing and other excavation activities that would have the effect of destroying or degrading waters of the United States;

3. allowing runoff or overflow from a contained land or water disposal area to re-enter a water of the United States;

-2-

4. placing pilings when such placement has or would have the effect of a discharge of fill material;

c) any combination of the above.

If you believe your project includes any of the above activities which require Corps authorization, or if you have any questions, please contact me at (805) 641-3753. Please refer to this letter and 200001629-LM in your reply.

Sincerely,

Lisa Mangione

Lisa Mangione
Project Manager

LETTER F: CALIFORNIA COASTAL COMMISSION.

STATE OF CALIFORNIA – THE RESOURCES AGENCY — GRAY DAVIS, Governor

CALIFORNIA COASTAL COMMISSION
45 FREMONT STREET, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200

August 3, 2000

Tim J. Setnicka
Superintendent
Channel Islands National Park
1901 Spinnaker Drive
Ventura, CA 93001

Re: Draft Environmental Impact Statement for Anacapa Island Restoration Project

Dear Mr. Setnicka:

Thank you for the opportunity to comment on the above-referenced draft environmental impact statement. The proposed project includes the use of poison to eradicate black rats on Anacapa Island. The purpose of this letter is to inform the National Park Service that the proposed project is an activity that affects resources of the coastal zone and requires a consistency determination pursuant to the requirements of the federal Coastal Zone Management Act (CZMA).[1] Specifically, the National Park Service proposes to use aerial application of the rodenticide brodifacoum into all rat territories on Anacapa Island. The Commission staff agrees that these non-native rats degrade nesting habitat for shore and sea birds, compete with other native species, and the eradication of this animal would benefit the habitat values of the Island. However, the use of rodenticide could adversely affect water quality and habitat resources of the coastal zone. The rodenticides could degrade marine water quality through accidental discharges into the ocean or through storm runoff contaminated with the rodenticides draining into the ocean. Additionally, the rodenticide may also adversely affect non-target species either through the direct consumption of the poison or by consumption of animals killed by the poison. Therefore, the Commission staff believes that the proposed project triggers a requirement for a consistency determination pursuant to the CZMA[2] and its implementing regulations.[3]

A consistency determination is an evaluation of the proposed activity's effects on coastal resources or uses and its consistency with the mandatory enforceable policies of the California Coastal Management Program and includes the necessary information to support the federal agency's conclusion.[4] A consistency determination must be submitted to the Commission 90 days prior to final federal approval of the

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[1] 16 USC § 1450 *et seq.*
[2] 16 USC § 1456(c)(1).
[3] 15 CFR § 930.34(a).
[4] See 15 CFR § 930.39 for a full listing of the information required for a complete consistency determination.

Page 2

F1 activity, unless the state and the federal agencies agree to an alternate schedule.[5] If the federal agency determines that this activity does not affect coastal uses or resources, it must submit a negative determination 90 days before final federal approval of the activity.[6]

If you have any questions or need assistance preparing a consistency determination, please contact me at (415) 904-5292. Thank you for your cooperation in this matter.

Sincerely,

James R. Raives
Federal Consistency Coordinator

cc: South Central District

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[5] 16 USC § 1456(c)(1) and 15 CFR §930.41(c).
[6] 15 CFR § 930.35(d).

F1: On September 7, the Park sent a "Negative Determination" to the California Coastal Commission. In the letter the Park provided documentation as to why a "Negative Determination" was appropriate for this project.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

September 6, 2000

Memorandum

To: Superintendent, Channel Islands National Park, National Park Service, Ventura, California

From: Field Supervisor, Ventura Fish and Wildlife Office, Ventura, California

Subject: Draft Environmental Impact Statement for the Anacapa Island Restoration Project, Ventura County, California (A1415-CHIS)

We have reviewed your letter, dated July 11, 2000 and received in our office on July 13, 2000, requesting our comments on the draft environmental impact statement (EIS) for the subject project. The National Park Service (NPS) proposes to eradicate non-native black rats (*Rattus rattus*) from Anacapa Island and keep other islands rat-free. NPS presented six alternatives to accomplish this goal.

We applaud NPS's proactive efforts to restore the Channel Islands to a more natural state. We strongly support Alternative Two, the preferred alternative for the project. In this alternative, the rodenticide brodifacoum would be aerially broadcasted over the islands in November and December of 2000 and 2001. We believe that this alternative will best meet the purpose of the project by quickly and effectively eradicating black rats. We offer the following recommendations prepared in accordance with the Endangered Species Act of 1973, as amended, the Migratory Bird Treaty Act of 1918 (MBTA), and other authorities mandating Department of the Interior concern for environmental values:

G1

1. The project has the potential to affect birds protected by the MBTA. This risk is highest for granivorous landbirds that could ingest poisoned bait and predators such as western gulls (*Larus occidentalis*) and barn owls (*Tyto alba*) that could scavenge poisoned rat carcasses. The MBTA prohibits the take of any migratory bird, or part, nest, or egg of any such bird (16 U.S.C. 703). A list of species that are protected by the MBTA can be found at 50 Code of Federal Regulations 10.13. We recommend that you take all reasonable steps to prevent impacts to birds that are protected by the MBTA.

G1: The NPS is aware of the MBTA and is mitigating to minimize any potential impact to non-target birds that would fall under the MBTA. This project is a significant conservation action to benefit many bird species in the long term. Upon the successful removal of rats from the island, there will be a rebound of seabirds and landbirds that are currently impacted by rats. In the long term, the restoration of bird habitat on Anacapa Island will enhance the local bird population protected under the MBTA.

Superintendent, Channel Islands National Park 2

G2 2. To minimize the occurrence of secondary poisoning to non-target species, we recommend that rat carcasses (and other carcasses encountered that may contain rodenticide) be retrieved until no carcasses are found for five days.

G3 3. To avoid effects to the federally endangered island malacothrix (*Malacothrix squalida*), we recommend that project personnel working on the island be briefed on the appearance and occurrence of island malacothrix habitat. Although individual plants will not be present during the time of year when project activities are occurring, symbolic fencing (i.e., flagging) around the perimeter of known locations could help alert project personnel to the presence of this sensitive habitat.

In addition, we believe that the beneficial effects of rat eradication on sensitive seabird species, especially Xantus' murrelets (*Synthliboramphus hypoleucus*) and ashy storm-petrels (*Oceanodroma homochroa*), will be maximized by simultaneously addressing other threats to G4 these species. As you are well aware, we are concerned that the squid fishery around Anacapa Island has been increasing predation of these species by barn owls and western gulls due to its creation of an unnaturally light environment. Once rats are removed, Xantus' murrelets and ashy storm-petrels may be attracted to areas that may increase their susceptibility to predation, thereby creating a "sink" situation. We recommend that NPS continue its cooperative efforts with the Service and the Channel Islands National Marine Sanctuary to encourage the fishery and its regulating entity, the California Department of Fish and Game, to take action in reducing this form of mortality.

We look forward to reviewing the final EIS when it becomes available. Should you have any questions regarding these comments, please contact Bridget Fahey of my staff at (805) 644-1766.

G2: The risk of secondary poisoning of scavengers is already partially mitigated by the fact that most rats and mice (87-100%) will die below ground after exposure to the rodenticide. However, NPS will further mitigate against secondary poisoning through removal of any carcasses found above ground. Regularly scheduled "sweeps" of the island will be conducted by personnel seeking and retrieving any carcass found after rodenticide application. Sweeps will be conducted until no carcasses are found for 5 days.

G3: The endangered Island Malacothrix (*Malacothrix squalida*) is found on Middle Anacapa Island. To mitigate against any damage to this species, the NPS botanists will identify and mark known locations of this endangered plant. Personnel working on Middle Anacapa Island will be advised of the presence of the plant and will be briefed thoroughly on techniques to minimize disturbance/trampling of the area surrounding malacothrix locations.

G4: The Park has been concerned about the squid fishery around Park islands. We have submitted suggestions to the California Department of Fish & Game for measures that would mitigate impacts to seabirds.

Pacific Seabird Group

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Channel Islands N.
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Protection
Transp.
Marine Sci.
NBS - Terr.
NBS - Mar.

DEDICATED TO THE STUDY AND CONSERVATION OF PACIFIC SEABIRDS AND THEIR ENVIRONMENT

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To: Mr. Tim Setnicka, Superintendent
Channel Island National Park
1901 Spinnaker Dr.
Ventura, CA 93001

From: Pacific Seabird Group (PSG)
Re: **Draft Environmental Impact Statement for the Anacapa Island Restoration Project (AIRP)**
Date: 11 September 2000

Thank-you for the opportunity to comment on the AIRP. As you know, the Pacific Seabird Group (PSG) is an international organization of professionals engaged in research on, education about, and conservation of seabirds. With over 500 members, PSG is the largest group of seabird experts in the United States. PSG regularly comments on proposed projects concerning seabird conservation and restoration, and has recently authored a volume on seabird restoration[i].

PSG applauds and supports agencies and organizations which attempt to remove introduced species from islands, particularly in cases where the introduced predator has been shown to have deleterious effects on seabird populations. Such is the case with many rat introductions. PSG supports the proposal for 100% removal of introduced black rats, *Rattus rattus*, from Anacapa Island, and the Emergency Response Plan (ERP) to keep the island rat-free. However, we do take issue with or have concerns about several aspects of the rat eradication plan, as written. In general, the message pervading the DEIS is that seabirds are more important to preserve and conserve than other species, including endemic species. PSG does not support this view. We have listed and elaborated on each point below.

Timing
Although PSG is listed in the DEIS as an organization receiving the document, in fact, the DEIS did not reach us until the week prior to the end of the comment period. Given the Labor Day holiday, this left precious few working days for our members to comment. In future, and specifically with the FEIS, PSG would appreciate more time to read and review documents. Because the timeline imposed by this late receipt of the DEIS made your deadline unreasonable, Dr. Julia K. Parrish, Chair of PSG spoke with Steve Ortega on 1 November 2000, and obtained an extension of several days from him.

Use of PSG Opinion
We note that Chapter 3 pg 32 states:

> "The population decline of the Xantus' Murrelet in conjunction with the threats that face this species, has led the Pacific Seabird Group (PSG) to formulate a petition to list the species for protection under the Endangered Species Act. The PSG is a group dedicated to the study and conservation of Pacific seabirds and their environment. Rationale for the group to petition for listing the Xantus' is based on the following (PSG Annual Meeting: Summary Notes 2000):
> Low Population size
> Expansion of commercial squid fishery
> Potential oil spill impacts
> Introduced predators (Rats)"

The Executive Council - the elected representatives of PSG - were not aware that we had done this at this past, or any other, annual meeting. No request for information on PSG's opinion on the merits of listing the Xantus' Murrelet was sent to either the Chair of PSG or the Vice-Chair for Conservation, Craig Harrison.

The Executive Council has shifted control of Xantus' Murrelet issues to the Xantus' Murrelet Committee, chaired by Bill Everett and Ken Briggs. As such, Bill and Ken are responsible for directing committee actions, including any actions by the committee members to draft potential listing petitions. At the present time, the Xantus' Murrelet Committee is in the process of editing a draft petition to list the Mantu's Murrelet as endangered under the Endangered Species Act, to be submitted to the Executive Council in future. At that time, the Executive Council will read and review the draft, and decide whether to submit the document as a listing petition, to amend the draft and submit it as a listing petition, or to drop the issue. Before this formal process in completed, PSG has no opinion about the merits of petitioning to list the Xantus' Murrelet, and we certainly would not issue any statement listing specific reasons for such a listing.

H1 **PSG insists that the language in the FEIS be changed to reflect the fact that PSG has not yet rendered an opinion on the merits of or reasons for listing Xantus' Murrelets.**

Documentation of Harm

Actual documentation of the harm rats have delivered to seabirds, specifically Xantus' Murrelets and Ashy Storm-petrels, is seriously lacking in the DEIS. As far as we can determine, either Gerry McChesney or Harry Carter (the document gives both credit in different sections for the same data) did a habitat survey and determined that Xantus' Murrelets only use 2 sites out of the available habitat (listed as 1,510 sites). This figure, by the way, is mis-quoted as 0.4%, but is actually 0.1% (0.4% would be six nests). There is no mention of how this habitat survey was conducted, the objective criteria used in the survey, or the specific results of the survey. There are no habitat-specific data presented.

In Chapter 3, page 33, the DEIS goes on to say that "both eggs showed evidence of mammalian predation and were in areas where rats appeared to be common." However, only a few sentences later, the document states :Murrelets on Anacapa Island are mostly limited to nesting in areas inaccessible to rats or where rats occur infrequently." Thus, it is confusing to us, without seeing H2 any of the actual data, what the situation really is. Are rats coincident with Murrelet nests or not? Are rats responsible for the egg predation (as is insinuated) or is it possible that the endemic deer mouse is the culprit? As you are probably aware, mice have been documented as predators on small seabird eggs[8].

Because the rationale for rat eradication appears to be the low numbers of Xantus' Murrelets and the potential for nesting of Ashy Storm-petrels, **PSG would like to see a much more detailed presentation of the science linking rats to seabird decline on Anacapa Island**. Specifically, PSG recommends:

H3 (1) Inclusion of any historical data pointing to larger than present breeding populations of Xantus' Murrelets or Ashy Storm-petrels, or even greater use of island habitat than present.

H4 (2) Inclusion of the habitat types sampled, the sampling methods used, and the specific numeric outcomes, including any statistics.

H5 (3) Inclusion of any evidence of rat predation.

Endemic Deer Mice

Although PSG strongly supports the eradication of introduced predators, including rats, on islands housing seabirds, we do lend our support at any cost. With specific reference to the AIRP, PSG is concerned about the lack of documentation of the specific mitigation efforts which will be undertaken to insure the continued health - at present levels of genetic diversity - of the endemic

3

H1: Chapter 3 page 40 will be changed to read as follows:

> "The executive committee of the Pacific Seabird Group has authorized a committee to draft a petition to list the Xantus Murrelet for protection under the Endangered Species Act." The Pacific Seabird Group, however, has yet to render an opinion on the merits or reasons for listing Xantus' Murrelet."

H2: The most current information of seabird predation, including Xantus' Murrelet predation, by rats is from surveys conducted in 1997 (summarized in McChesney et. al. 2000) , 2000 (H.Carter unpublished data), and 2000 (P. Martin pers. comm).

Since publishing of the DEIS, the cited "H.Carter Unpublished Data pg 33 DEIS" is now a published report (see citation McChesney et al. 2000). Results of the survey show that they found evidence of nesting murrelets at only two sites in areas that were fully accessible to rats, or 0.4% of 505 potential sites investigated on ground surveys. Both eggshells showed evidence of rodent predation and were in areas where rats appeared to be common. In contrast, at Santa Barbara Island (where rats do not occur), similar surveys in 1991 found murrelet eggshell fragments in 29.4% of potential sites, including 27.9% of crevice and 39.6% of shrub sites.

H.Carter (unpublished data), researchers collecting baseline Xantus' Murrelet population data noted the following during sea cave nest surveys: Eleven nests were found in sea caves with known nesting in the past at Anacapa Island. Some caves with previous nesting were empty. No murrelets were handled and none were flushed from nests during surveys. About 4-5 eggs appeared to have been depredated by rats.

P.Martin (Unpublished data), monitoring gull productivity grids in June 2000 found evidence of rat chewed carcasses on 10 gull chicks. Evidence strongly suggests rat predation because of the condition of the carcass (brain cavity opened and eaten), and location of where the carcasses were found (thick brush with numerous rat burrows). It is not known if the gulls were previously dead, or if rats preyed upon the chicks.

Evidence of rat impacts to the Xantus' Murrelet including: low nesting numbers in suitable habitat as compared to Santa Barbara Island; low population numbers in comparison to Santa Barbara Island; evidence of rat predation on murrelet eggs; and extremely low nesting success in areas known to be accessible to rats when considered together suggests that rats are suppressing Xantus' Murrelet population numbers on Anacapa Island, an area that has similar nesting habitat availability as rat free Santa Barbara Island.

Anacapa Island deer mouse, *Peromyscus maniculatus anacapae*. The proposed rodenticide in the preferred alternative (brodifacoum) is quite powerful - single ingestion leads to death. Although the language is delicate, it is clear that many mice will be killed and there is the distinct possibility

H6 that the entire population will be wiped out. The stated mitigation for this is to sequentially treat the island (apparently the island is actually divided into several land masses, although this is never spelled out very clearly) with aerial application of rodenticide: one year one side, the next year the other side. Chapter 2, page 13 states:

> "The sequential treatment of the islets will ensure that there is always a viable population of deer mice on one of the three Anacapa islets."

It is unclear why this should be the case.

In Chapter 4, page 63, the argument is made that because rats are competitively dominant to mice,

H7 rats will consume all or the majority of the bait before the mice can get to it. The supposition is that enough of a remnant population of mice will be left alive that this population can rebuild, apparently unharmed. However, in Chapter 1, page 2, the document states that the rat population fluctuates between 750 and 2000 annually. Thus, it would seem extremely difficult to estimate an application amount of brodifacoum which would selectively target rats, leaving none for the mice.

Chapter 2, page 13 goes on to state: "The following management actions may be implemented: Captive breeding population on island or on the mainland." Given the difficulty of correctly measuring rodenticide application to target only rats, PSG assumes that this step must be implemented. **PSG recommend's that the FEIS include a detailed section on exactly how the endemic deer mouse population will be maintained**, including:

H8 (1) How the population be sampled a priori to determine the number of mice needed in such a program, and from which locations throughout the three islets, to ensure the viability and genetic health of the population.

H9 (2) The specific capture, handling, and captive breeding methods.

H10 (3) Release sites and dates, relative to the rat eradication schedule, and post-release monitoring methods.

Human Visitation

According to the DEIS, Anacapa Island is visited annually by 16,000 visitors. This figure includes individual campers, and counts of people brought to the island by park concessionaires (the bulk of the total). Although these people are confined to one part of the island (East Anacapa), one wonders what effect they have on the lack of nesting by seabirds. More importantly, this level of visitation is a potential vehicle for rat re-introduction, a subject mentioned in general (although this particular route of re-introduction is not explicitly discussed). The mitigation for re-introduction is an Emergency Response Plan which includes the provision (Chapter 1, page 4):

4

H3: No pre-rat historical breeding population data is known to exist for the Xantus' Murrelet or other seabirds for Anacapa Island. Because no pre-rat population data is available the Park has to rely on: 1) population data comparisons between Anacapa and Santa Barbara Island; 2) known rat impacts to seabird colonies on other islands; and 3) direct evidence of rat predation on Anacapa Island seabirds to make an assessment on the impact rats are having on Anacapa Island seabird colonies. The Park's assessment is that rat impacts are suppressing the crevice nesting seabird population on Anacapa Island. This assessment is consistent with the suggestions given by species experts that eradicating rats to protect crevice-nesting seabirds is a necessary conservation project.

H4: The most complete assessment of potential nesting habitat for crevice-nesting seabirds on Anacapa Island was done by McChesney et. al (2000). The executive summary of this report can be found in Appendix D.

H5: See H2.

H6: The treatment of the islets would be carried out over a two year period. East Island would be treated in Year 1. In Year 2, Middle and West Island would be treated. In between treatment of East and Middle/West Islands, mice could be moved from Middle and West Island to rat-free East Island. The mouse population would be allowed to grow, and individuals would be transported over to Middle and West Island post eradication thereby ensuring the viability and genetic diversity of the mouse population. This mitigation measure may be implemented independently or in conjunction with other mitigation measures outlined in Chapter 2.

H7: Both mice and rats are rodents, and the bait will be attractive to both species. It is a logistical challenge to eradicate rats without having a significant impact on the local Deer Mouse population. The NPS recognizes the need for the conservation of the Anacapa Deer Mouse and is a priority of the AIRP. The NPS will ensure the genetic diversity and viability of the Deer Mouse population is protected (See H8 –H10).

H8: The conservation and management of Anacapa Island deer mice is a high priority for the AIRP. The genetic and morphological status of the Anacapa Deer Mouse has been investigated using genetics, morphometrics and computer modeling (mitochondrial DNA (mtDNA) analysis, morphometric discriminant function analysis and population viability analysis (see Pergams et al. 2000)). The morphological and genetic analysis confirms that the Anacapa Deer Mouse is a distinct subspecies when compared to other populations from the mainland and other islands. The mice on each islet are not genetically distinct from the other islets indicating that the population could be managed as one unit. In other words, the mice across all three islets are genetically indistinct. The results of the computer modeling have indicated that 1000 mice collected across all three islets would be adequate to ensure a viable and genetically diverse population.

"3) Control rodents at all departure points, including planes, boats, and helicopters that transport people and materials to the Islands."

Unfortunately, the document does not explain how this will happen. Because tourists are such a large presence on the island, and they are brought to the island by concessionaires, **the DEIS should contain specific implementation plans to make sure tourists and concessionaires as potential rat vectors are controlled**. PSG would like to see this added to the FEIS.

H11

Effects on Raptors

The DEIS admits that secondary effects are likely for raptors which prey on rodents, as many striken mice and rats will die outside of their burrows: Chapter 4, page 63 states:

"There would be extensive secondary poisoning of the birds of prey with the use of brodifacoum or bromadiolone."

Potential mitigation includes a supplemental feeding program started before the rodenticide application and continuing through until after the baiting period, and/or a program to find and collect all (most?) of the carcasses before the raptors can get to them. However, the document makes extensive mention of the fact that large portions of the island are not accessible by humans, hence the need for aerial application of rodenticide. Thus it would seem that the stated raptor mitigation strategy is suspect. **PSG would like to see a discussion of the numbers and species of raptors likely to be affected, as well as a detailed and logistically manageable implementation plan for mitigating the effects of rodenticide application.**

H12

Conclusion

The use of aerial broadcast of toxicants is controversial due to the appearance of an indiscriminant application of powerful poisons. This public perception is compounded by secondary poisonings of non-target species and can only be dispelled though extensive public education. PSG recommends extreme caution in the design and implementation of the Anacapa Island rat eradication project because this first use of a critically important tool to seabirds – aerial application of powerful rodenticides - must not fail on any level. In short, this inaugural eradication must be flawless in order to not engender a public backlash. From what we know and have read of the public perceptions regarding the Anacapa eradication as well as the level of documentation in the DEIS, we feel the public still has significant doubts about the process, the justification for use, and the guaranteed outcome. If proper documentation and adequate public outreach and education efforts means delaying the project one or two years until: (1) the FEIS can be rewritten as outlined above, (2) the bait formulation is granted by the EPA, (3) the public is informed and generally supportive, (4) a colony of endemic deer mice is established off-island, and (5) PSG decides whether to petition for endangered species status for Xantus' Murrelets, then a successful eradication can be virtually guaranteed and we will wholeheartedly endorse this project.

5

H9/H10: *Peromyscus* spp. are one of the most ubiquitous small mammals in North America. These populations are highly tolerant to disturbance and habitat alteration and populations are very resilient. They readily breed and do well in captivity. Populations of *Peromyscus* are managed in laboratories such as at the Brookfield Zoo in Brookfield, Illinois, or the Peromyscus Genetic Stock Center at the University of South Carolina. The capture, handling and breeding methodology has been well documented in the scientific literature. Consultation with *Peromyscus* and genetic experts from the Brookfield Zoo and University of Illinois is underway to develop a protection plan that will incorporate handling/breeding methodology to ensure genetic diversity and a viable population. The plan will include a re-release schedule including monitoring ensuring that the population will remain viable post eradication. The Effectiveness and Validation Monitoring program will aid in the development of an effective management program for the Anacapa Deer Mouse by identifying problem areas that would allow changes to the protection plan prior to completion of the baiting.

Changes to the Deer Mouse protection plan have been incorporated into Chapter II, page 17.

H11: The Non-Native Rodent Introduction Prevention Plan has been adequately outlined on page 14. The basic premise is that through active rodent control around all departure points, as well as a strong educational component, there would be a low probability of re-introducing rats on to the island.

H12: The numbers and species of raptors likely affected by the program have been discussed in Chapter IV, page 73. Secondary poisoning of birds of prey is of concern to the AIRP. Mortality of individual non-target birds will be mitigated where possible. However, from an ecological perspective such mortality is only significant if it causes a long term population decline. There are no endemic birds of prey on Anacapa Island. The birds of prey on the Channel Islands are habitat limited, i.e., there are more birds than there is available habitat. Most of the birds of prey, as well as ravens, are killed in the vicinity of Least Tern breeding colonies in an ongoing effort to protect this endangered species from predation. The ongoing nature of predatory bird control around Least Tern colonies suggests that any decrease in predatory birds due to the rat removal on Anacapa will be temporary.

Consultation with the Predatory Bird Research Group (PBRG), University of California, Santa Cruz, is underway to develop mitigation plans for birds of prey. The Effectiveness and Validation Monitoring program will aid in the development of an effective raptor mitigation program which may include any or all aspects of the mitigation as outlined on page 73.

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Index

Appendix A

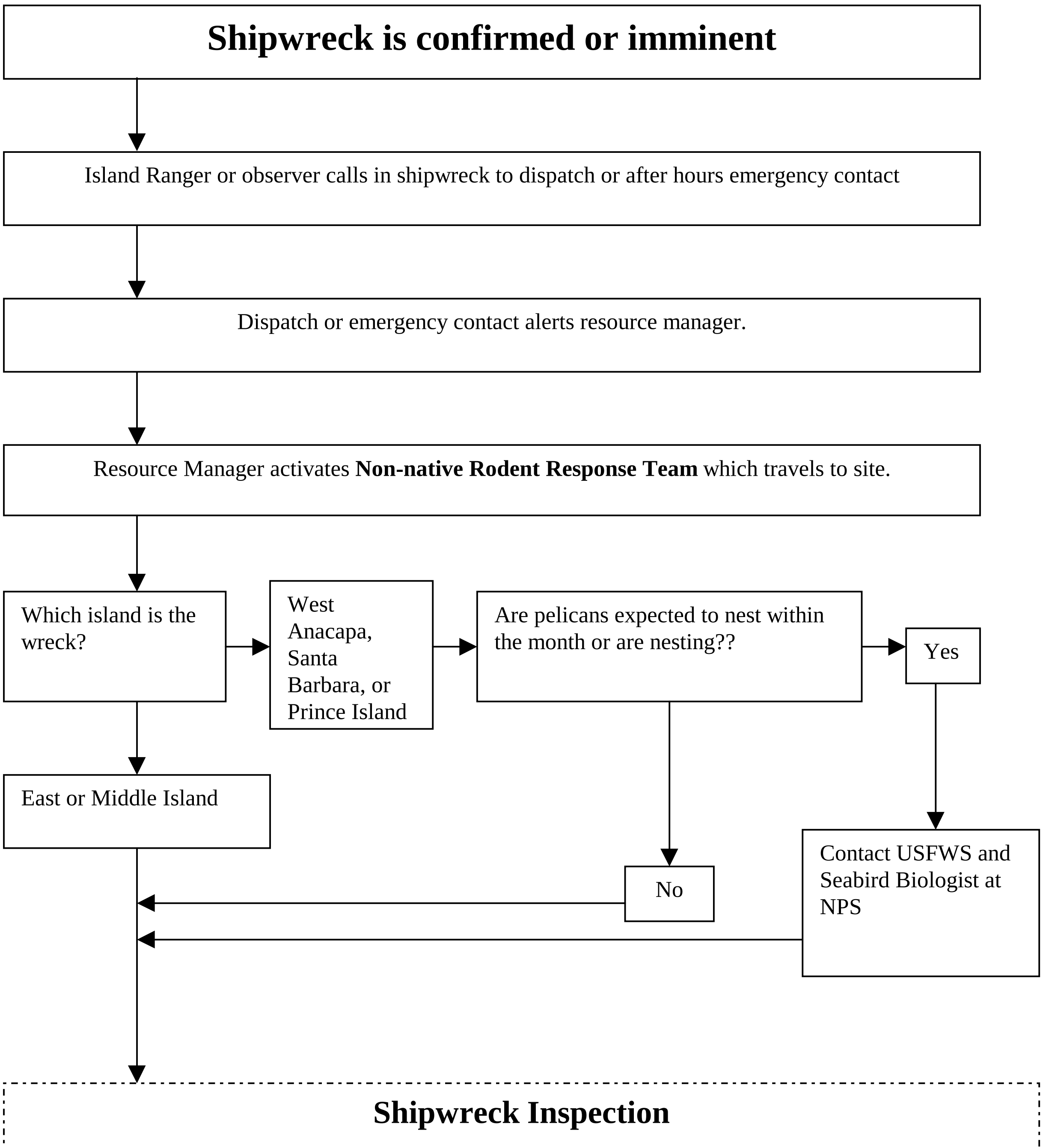
This appendix is divided into two sections: the Shipwreck Response Plan and the Rat Detection Response Plan. Each of the response plans are in flowchart form, designed for ease of reading and required steps to implement an eradication. The objective of this document is to provide a pathway for managers and personnel to successfully implement the eradication of introduced rodents. This flow chart is designed to serve as a guide for immediate action. However, the recommended actions should be followed up as soon as possible by a meeting of the AIRP working group to examine the available information and design the best possible plan. The Shipwreck Response Plan is designed to direct actions of managers and personnel toward implementing the Rat Detection Response Plan. Once rats are confirmed on the islands, the Rat Detection Response Plan directs personnel and managers toward a resolution, i.e., eradication of the introduced rodent. If rats would be introduced via transport of equipment or goods, the Rat Detection Response Plan would be implemented, bypassing the Shipwreck Response Plan.

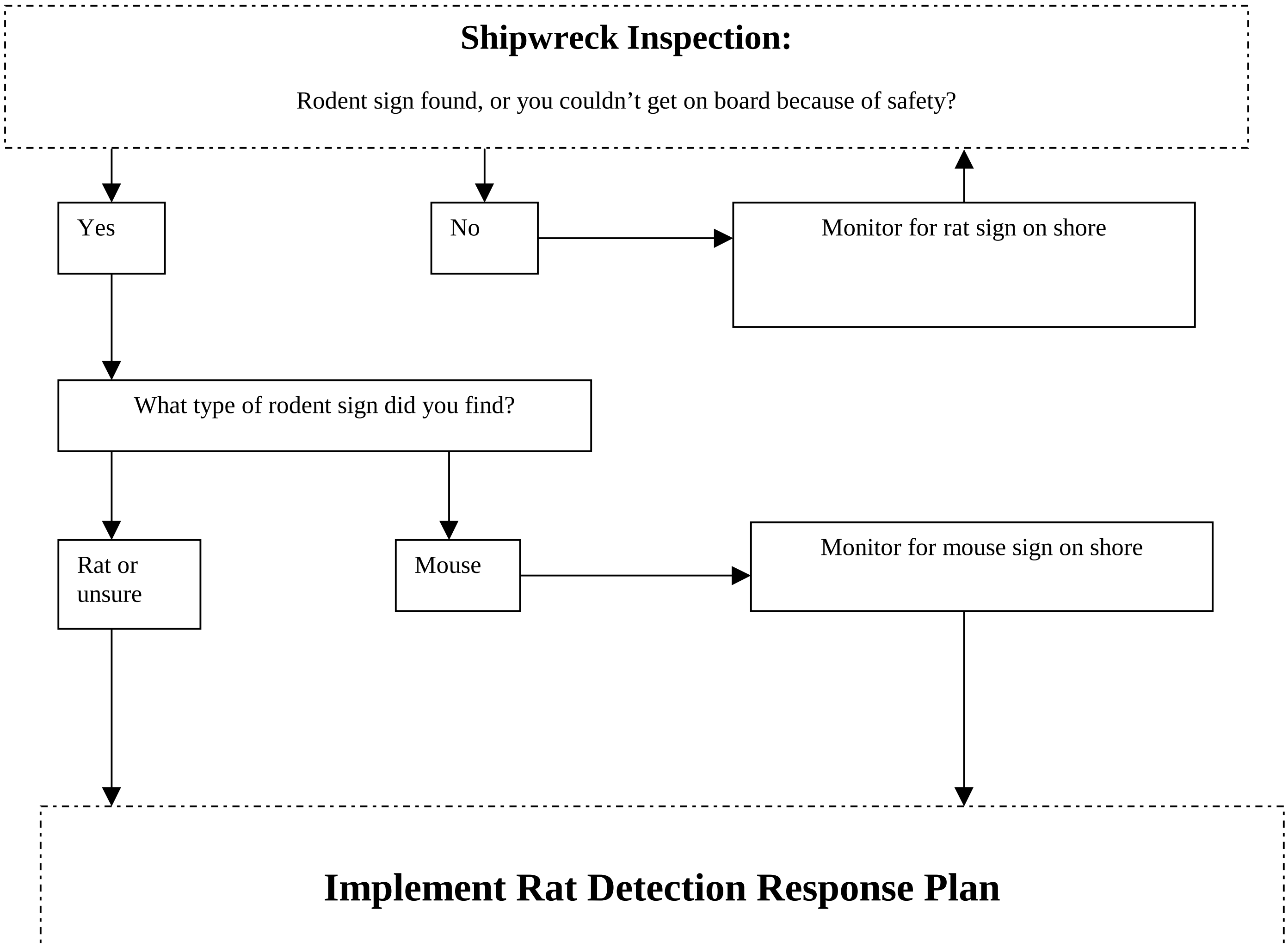
The plans follow on the next pages.

AIRP: Shipwreck Response Plan

Objective: The objective of this plan is to provide a pathway for managers and personnel to respond to shipwrecks that potentially could introduce non-native rodents to Anacapa Island.

Instructions: Follow the flowchart to implement an appropriate action. A description for each box is attached. Be clear about each step before moving on.

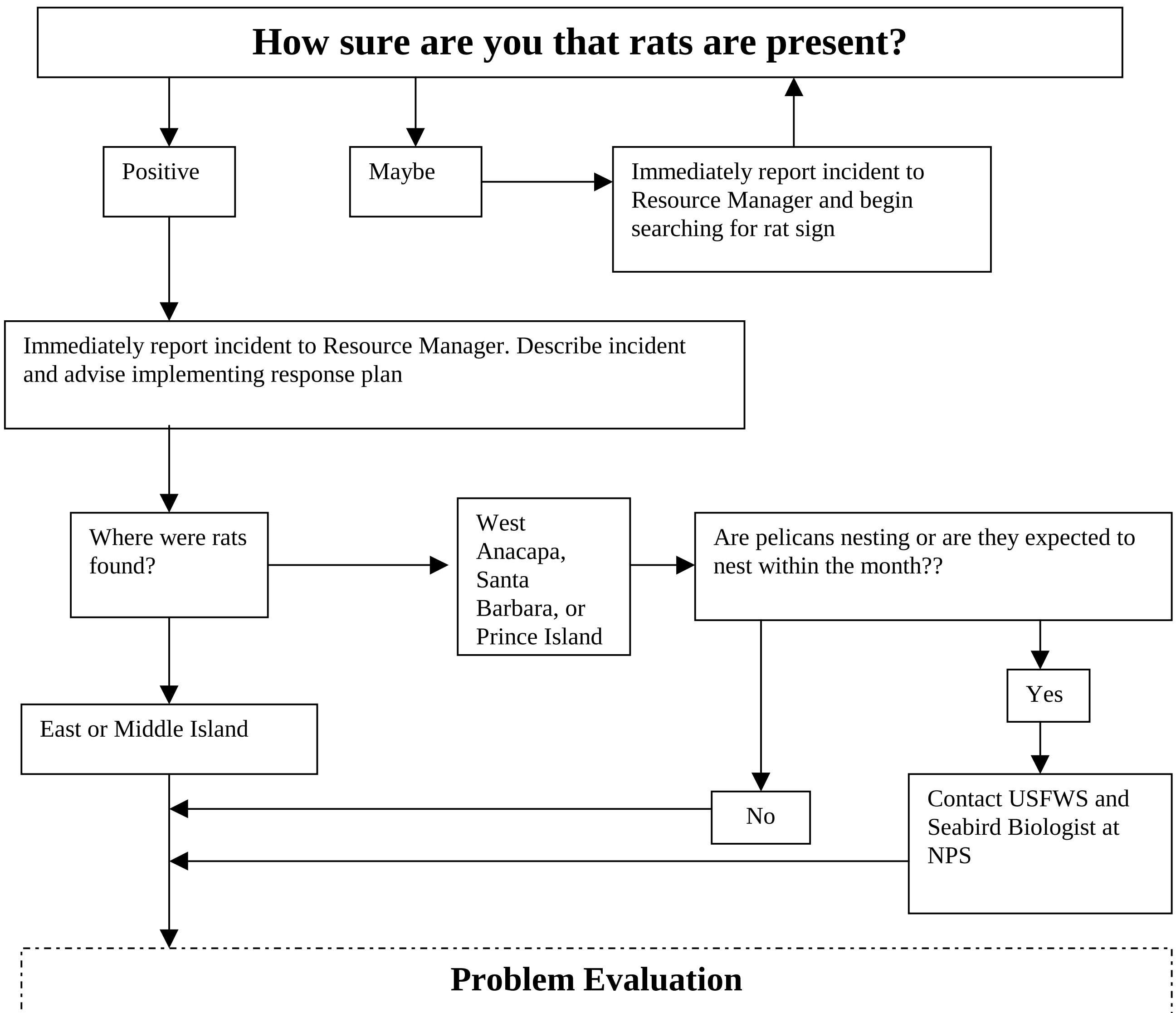


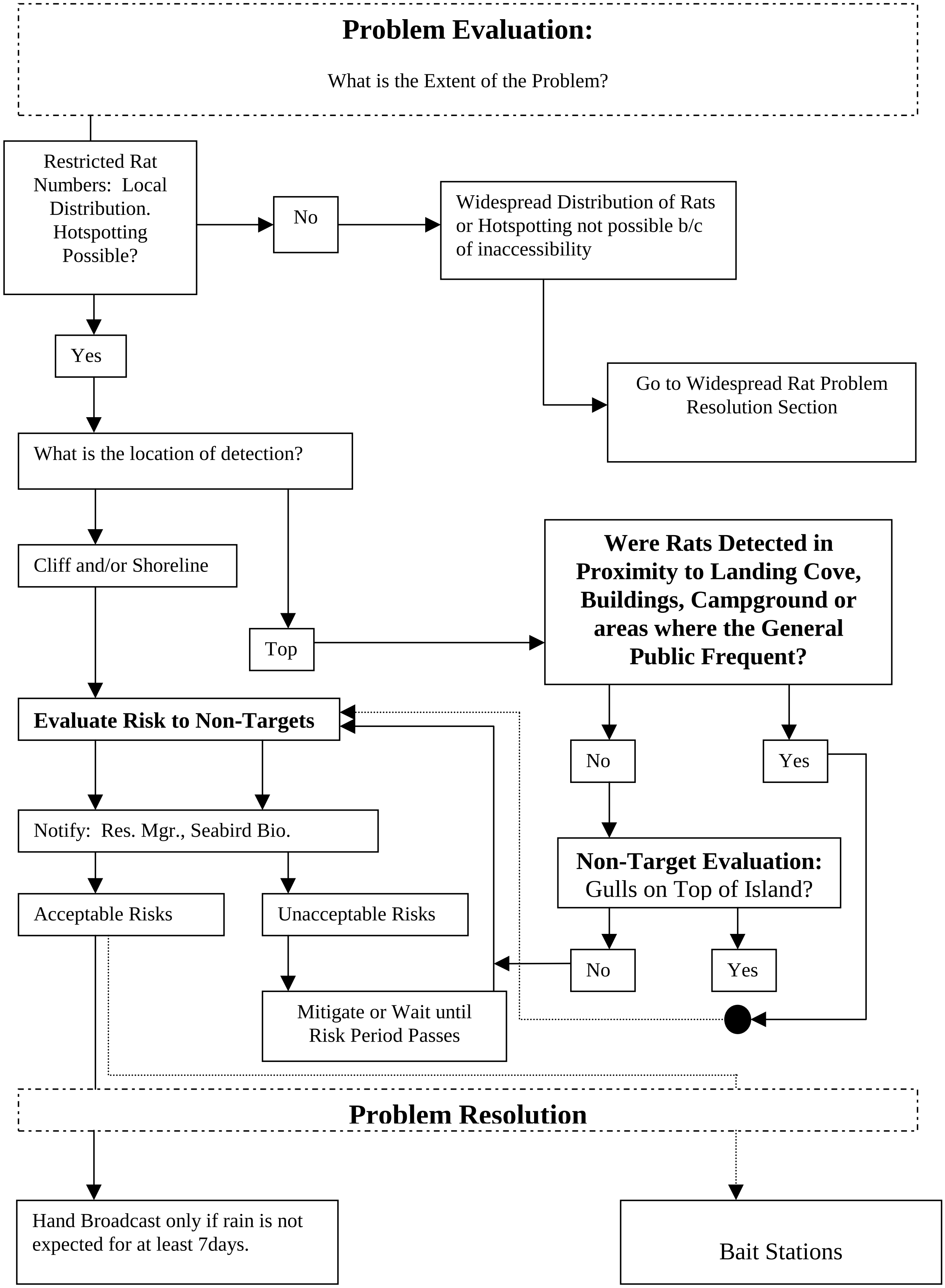

Shipwreck Inspection:
Rodent sign found, or you couldn't get on board because of safety?
Yes
No
Monitor for rat sign on shore
What type of rodent sign did you find?
Rat or unsure
Mouse
Monitor for mouse sign on shore
Implement Rat Detection Response Plan

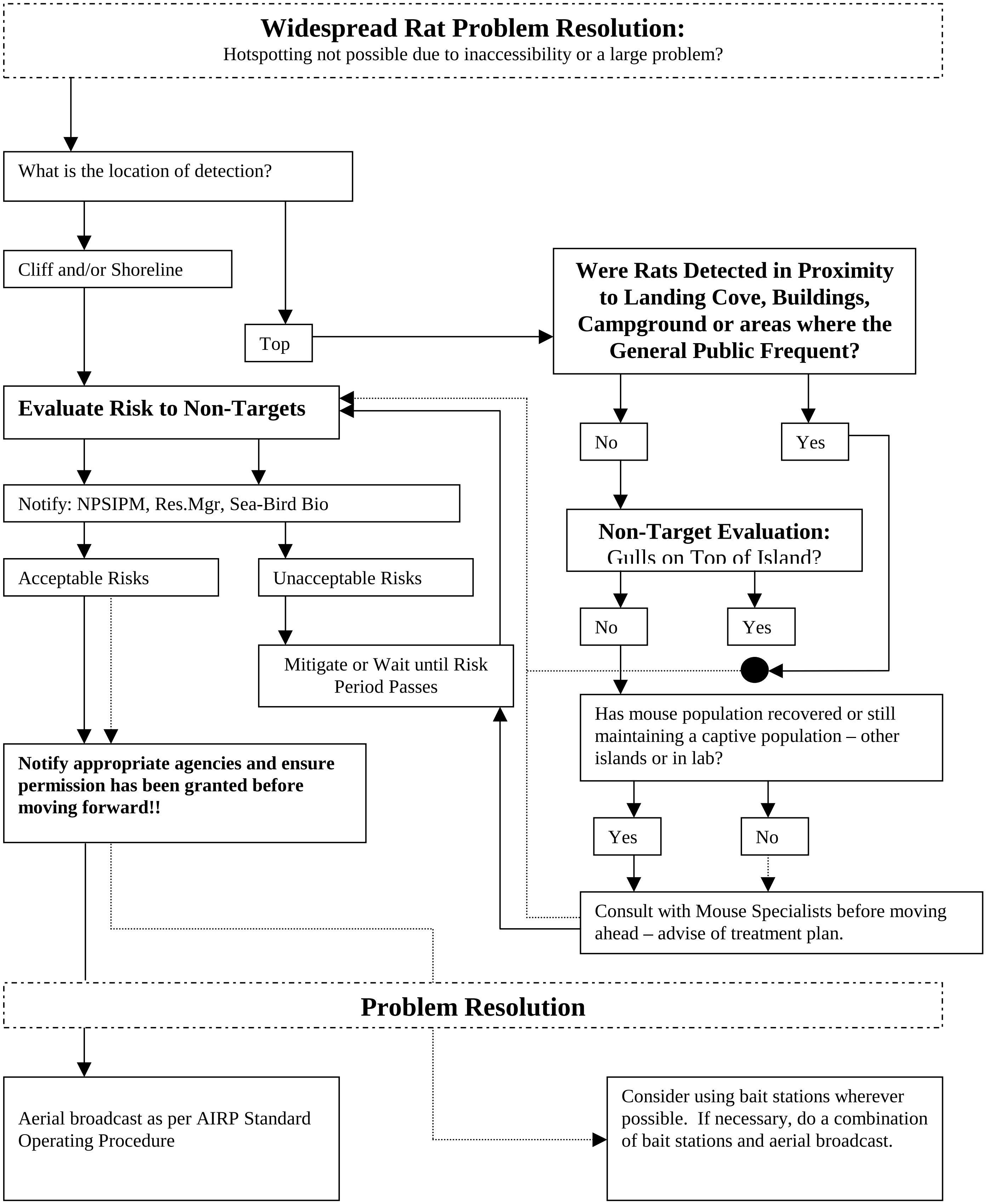
AIRP: Response Plan for Positive Detection of Rats Post Eradication

Potential Situation: Rats have been detected due to incidental introduction or shipwreck. Tools and budgets necessary are available.

Instructions: Follow the flowchart to implement an appropriate action. Be clear about each step before moving on.




Problem Evaluation:
What is the Extent of the Problem?
Restricted Rat Numbers: Local Distribution. Hotspotting Possible?
No
Widespread Distribution of Rats or Hotspotting not possible b/c of inaccessibility
Go to Widespread Rat Problem Resolution Section
Yes
What is the location of detection?
Cliff and/or Shoreline
Top
Were Rats Detected in Proximity to Landing Cove, Buildings, Campground or areas where the General Public Frequent?
Evaluate Risk to Non-Targets
No
Yes
Notify: Res. Mgr., Seabird Bio.
Non-Target Evaluation:
Gulls on Top of Island?
Acceptable Risks
Unacceptable Risks
No
Yes
Mitigate or Wait until Risk Period Passes
Problem Resolution
Hand Broadcast only if rain is not expected for at least 7days.
Bait Stations


Widespread Rat Problem Resolution:
Hotspotting not possible due to inaccessibility or a large problem?
What is the location of detection?
Cliff and/or Shoreline
Top
Were Rats Detected in Proximity to Landing Cove, Buildings, Campground or areas where the General Public Frequent?
No
Yes
Evaluate Risk to Non-Targets
Notify: NPSIPM, Res.Mgr, Sea-Bird Bio
Acceptable Risks
Unacceptable Risks
Mitigate or Wait until Risk Period Passes
Non-Target Evaluation:
Gulls on Top of Island?
No
Yes
Has mouse population recovered or still maintaining a captive population – other islands or in lab?
Yes
No
Consult with Mouse Specialists before moving ahead – advise of treatment plan.
Notify appropriate agencies and ensure permission has been granted before moving forward!!
Problem Resolution
Aerial broadcast as per AIRP Standard Operating Procedure
Consider using bait stations wherever possible. If necessary, do a combination of bait stations and aerial broadcast.

Appendix B

The Birds of Channel Islands National Park

(adapted from: Jones et al. 1985)

Symbols:

Abundance: a – abundant; c – common; u – uncommon; o – occasional; r – rare; x – accidental

Seasonal Occurrence: FR – former resident; FT – fall transient; FV – former visitor; IR – introduced resident; R – resident; SR – summer resident; ST – spring transient; SV – summer visitor; V – visitor; WV – winter visitor

- \- breeds on islands noted.

		San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island
LOONS						
	Red – throated Loon	oWV	uWV	uWV	oWV	oWV
	Pacific Loon	cWV oSV	aWV oSV	cWV	uWV	cWV
	Common Loon	cWV oSV	cWV	uWV	oWV	oWV
GREBES						
	Horned Grebe	uWV	cWV	uWV		
	Eared Grebe	aWV oSV	aWV oSV	aWV	aWV	aWV
	Western Grebe	uWV	cWV	cWV	oWV	oWV
ALBATROSSES						
	Black – footed Albatross	rV		rV		
SHEARWATERS						
	Northern Fulmar	oWV	uWV	uWV	oWV	oWV
	Pink – footed Shearwater	oSV	oSV	oSV	oSV	oSV
	Sooty Shearwater	uSV	uSV	uSV	uSV	uSV
	Black-vented Shearwater	rWV		rFT		rFT
STORM-PETRELS						
	Leach's Storm-Petrel*	uSR				
	Ashy Storm-Petrel*	cSR		uSR		cSR
	Black Storm-Petrel*					cSR

TROPICBIRDS					
Red-billed Tropicbird	rSV		xFT	xST	xFT
PELICANS					
Brown Pelican	aV	aV	rR*	aR*	aR*
CORMORANTS					
Double – crested Cormorant Cormorant	cR*	cV	cR*	cR*	cR*
Brandt's Cormorant*	aR	aR	aR	aR	aR
Pelagic Cormorant*	cR	cR	cR	cR	uR
FRIGATEBIRDS					
Magnificent Frigatedbird	xST			rSV	xSV
HERONS, EGRETS, BITTERNS					
Great Blue Heron	oV	uV	uV	oV	oV
Cattle Egret	xWV	oWV	oWV	oWV	rWV
Green-backed Heron			oST	xFT	
Black-crowned Night-Heron		xWV	oFT rST		xST
GEESE, DUCKS					
Greater White-fronted Goose		oFT		FV	
Snow Goose	xWV	oWV	oWV	xFT	
Brant	rWV	oWV	oWV	xST	oST
Canada Goose	xWV	oWV	oWV		rWV
Wood Duck			rFT		
Green-winged Teal		cWV	oWV	xWV	
Mallard		oWV xSV	oWV		
Northern Pintail	xSV rFT	cWV	oWV		xFT
Blue-winged Teal		oFt oST	oFT oST		
Cinnamon Teal	xFT	uWV	uWV	xFT	
American Wigeon		cWV	xFT		
Surf Scoter	aWV oSV	aWV oSV	aWV oSV	aWV	cWV
White-winged Scoter	cWV	cWV oSV	cWV	oWV	rST
Red-breasted Merganser	uWV	uWV	uWV	oWV	xST
Ruddy Duck	rFT	oWV	xSV		
OSPREY, HAWKS, EAGLES					
Osprey	rFT		oFT xST	rFT rST	rFT
Bald Eagle	FR	FR oWV	FR	FR	FR xV
Northern Harrier	oWV xSV	oWV xSV	oWV	oWV	oWV

	Sharp-shinned Hawk	oFT	oWV	uWV		
	Cooper's Hawk	oFT oST	oWV	uWV		rFT
	Red-tailed Hawk	uR*	uR*	uR*	uR*	xSV uWV
	Golden Eagle	xV	rV	oWV		
FALCONS						
	American Kestrel*	uR	cR	cR	uR	uR
	Merlin	rFT rST	oWV	oWV		xST
	Peregrine Falcon	FR uIR*	FR oV	FR oV	FR oWV	FR oWV
PHEASANTS, TURKEYS, QUAIL						
	Chukar*		uIR			
	Common Peafowl*			uIR		
	Wild Turkey*			uIR		
	California Quail*		cIR	cIR		
RAILS, COOTS						
	Virgina Rail			rWV		xFT
	Sora		xFT	oST	xST	xSV
	American Coot		xWV	uWV xSV+	uWV	rFT
PLOVERS						
	Black-bellied Plover	aWV uSV	aWV uSV	cWV uSV	rWV	uWV
	Lesser Golden-Plover	oV	xFT	xWV		xST
	Snowy Plover	cR*	cR*	cR*		xST
	Semipalmated Plover	oWV	oFT oST	oFT oST		xFT
	Killdeer	oFT rST	cR*	cR*	oFT	rST
	Mountian Plover	FV	oWV			
OYSTERCATCHERS						
	American Oystercatcher			rR*	xR+	xSV
	Black Oystercatcher*	cR	cR	cR	cR	cR
SANDPIPERS, PHALAROPES						
	Greater Yellowlegs	oFT oST	oFT oST	oFT oST	xFT	
	Solitary Sandpiper	xFT	xFT	oFT	xFT	
	Willet	cWV uSV	aWV uSV	cWV uSV	uWV	uWV oSV
	Wandering Tattler	cWV uSV	cWV oSV	cWV oSV	cWV uSV	cWV uSV
	Spotted Sandpiper	oWV	oWV	uWV	uWV	oST oFT
	Whimbrel	cWV uSV	cWV uSV	cWV uSV	oWV	cWV uSV

Long-billed Curlew	oV	uWV	oFT oST		uSV
Marbled Godwit	uWV oSV	cWV uSV	uWV oSV		rST
Ruddy Turnstone	cWV	cWV oSV	uWV oSV	oST	oFT oST
Black Turnstone	aWV uSV	aWV oSV	cWV uSV	cWV	uWV oSV
Surfbird	rST	oFT	xST	rFT rST	xST
Sanderling	cWV	aWV oSV	aWV oSV	xFT	rFT
Western Sandpiper	oFT oST	uWV	oFT oST	oFT	xST
Least Sandpiper	uWV	cWV	oWV	xFT	rFT rST
Baird's Sandpiper		rFT	xFT		
Pectoral Sandpiper	rFT	oFT	xFT		xFT
Dunlin	oFT	uWV	oWV	xST	
Short-billed Dowitcher	rFT rST	xSV	xFT	xFT	xST
Long-billed Dowitcher	xFT	oWV		xFT	
Common Snipe		rFT rST	uWV	xFT	rFT
Red-necked Phalarope		oST oFT	oST	oST oFT	
Red Phalarope		oST oFT	oST	oSt oFT	
JAEGERS, GULLS, TERNS					
Parasitic Jaeger		xWV	oV	oV	
Franklin's Gull	xST			rFT rST	xST
Bonaparte's Gull	oWV	uWV	uWV	oWV	oWV
Heermann's Gull	cWV oSV	aWV oSV	aWV oSV	cWV oSV	uWV oSV
Mew Gull	uWV	uWV	cWV	uWV	
California Gull	cWV	cWV	cWV	uWV	uWV
Herring Gull	uWV	uWV	uWV	xST	oWV
Western Gull*	aR	aR	aR	aR	aR
Glaucous-winged Gull	cWV	oWV	oWV	oWV	oWV
Black-legged Kittiwake	uWV	uWV	uWV	uWV	uWV
Royal Tern	cWV	cWV	cWV	oWV	oWV
Forster's Tern	xFT	oFT		xST	
AUKS, MURRES, PUFFINS					
Common Murre	oWV FR	uWV	uWV	uWV	xST
Pigeon Guillemot*	cSR	cSR	cSR	uSR	cSR
Xantus' Murrelet*	uSR		uSR	uSR	aSR

	Cassin's Auklet	aR*	oV	uR*	oV	uR*
	Rhinoceros Auklet	oWV	oWV	oWV	oWV	oWV
	Tufted Puffin	FR	rV	FR	FR	FR
		xSV				
PIGEONS, DOVES						
	Rock Dove	oV	oV	oV	oV	oV
	Band-tailed Pigeon	oST	oST	uWV		oSV
		xSV				
	White-winged Dove	xFT	rFT		rFT	rFT
			xWV			rST
	Mourning Dove	cSV	cR*	cR*	cSV	cSV+
					rWV	rWV
BARN-OWLS						
	Common Barn-Owl*	uR	uR	uR	uR	uR
TYPICAL OWLS						
	Burrowing Owl	uWV	uWV	uWV	uWV	uR*
	Long-eared Owl	oWV	xST			oV
	Short-eared Owl	rWV	uWV			uR*
	Northern Saw-whet Owl			uR*		
GOATSUCKERS						
	Lesser Nighthawk			rSt	oFT	uST
						rFT
	Common Poorwill			uWV	rST	xFT
SWIFTS						
	Chimney Swift					rST
	Vaux's Swift	xST	oFT	uFT	uFT	oFT
			oST	oST	oST	oST
	White-throated Swift	rST	uR*	cR*	uSR*	oSV
HUMMINGBIRDS						
	Anna's Hummingbird	cSR*	oST	uR*	rST	oST
			xFT		oFT	oFT
	Costa's Hummingbird	rST		oST	rST	oST
		rSV		rFT	rSV	rFT
	Rufous Hummingbird	xST	xFT	xWV		uST
			xST	xST		xFT
	Allen's Hummungbid	cR*	cR*	cR*	cR*	oFT
						oST
KINGFISHERS						
	Belted Kingfisher	oWV	oV	uWV	uWV	uWV
						xSV
WOODPECKERS						
	Lewis' Woodpecker		rWV	uWV	xFT	xFT
	Acorn Woodpecker	xST	rWV	cR*	rWV	xFT
	Yellow-bellied Sapsucker			oWV		
	Red-breasted Sapsucker	rWV	uWV	uWV	xFT	
	Northern Flicker	uWV	uWV	cR*	uWV	uWV

						xSV
TYRANT FLYCATCHERS						
	Olive-sided Flycatcher	oST		oFT oST	xST	uST oFT
	Western Wood-Pewee	uST	uST uFT	cST cFT	uST uFT	cST uFT
	Willow Flycatcher			oFT	oST oFT	uST uFT
	Hammond's Flycatcher	rST	xST		rST	oST
	Dusky Flycatcher					oST
	Gray Flycatcher				rST	oST
	Western Flycatcher	cST cFT	cSR*	uSR*	rSR*	cST cFT
	Black Phoebe	uR+	cR*	uSR*	uWV	uWV
	Say's Phoebe	cWV xSV	vWV	cWV	cWV	cWV
	Ash-throated Flycatcher	oST oFT		uSR*	uST cFT	cST cFT
	Cassin's Kingbird	xST	rV	xFT	oFT	rST oFT
	Western Kingbird	oST	oST xFT	uST uFT	oST oFT	uST uFT
	Scissor-tailed Flycatcher	xST			rST	xST
LARKS						
	Horned Lark	aR*	aR*	aR*	oWV FR	aR*
SWALLOWS						
	Purple Martin			xFT		rST
	Tree Swallow	xST xFT	oST		xFT	oST
	Violet-green Swallow	xSV	xFT xSV	xST xSV	xST xFT	oST
	Northern Rough-winged Swallow	xFT	xST oFT	xST		oST
	Cliff Swallow	xST xFT	xST xFT	oST rFT	oST oFT	oSV
	Barn Swallow*	cSR	cSR	cSR	cSR	uSR
JAYS, CROWS						
	Scrub Jay*			cR		
	Clark's Nutcracker			rWV		
	Common Raven	FR oV	aR*	aR*	uR	FR xST
BUSHTITS						
	Bushtit			cR*	xSV	
NUTHATCHES						
	Red-breasted Nuthatch	uWV	uWV	uR*	xFT	oST oFT
	White-breasted Nuthatch			rWV		

CREEPERS						
	Brown Creeper		rWV	oWV		
WRENS						
	Rock Wren*	cR	cR	uR	uR	uR
	Canyon Wren			rR		
	Hermit Warbler	oST	oST	oST	cST	cST
		xFT	uFT	uFT	oFT	oFT
					xWV	
	Palm Warbler	rFT	xFT	oFT		xST
		xST				oFT
	Blackpoll Warbler		xST	oFT	xFT	rST
			rFT			oFT
	Black-and-white Warbler	xFT	xST	xST		oST
				xWV		rFT
	American Redstart	xST	oFT	oFT	xST	rST
		xFT			oFT	oFT
	Ovenbird					oST
						oFT
	Northern Waterthrush		xFT	rFT	xST	rST
	MacGillivray's Warbler	xFT	oFT	oST	oST	uST
				oFT	oFT	uFT
	Common Yellowthroat	uWV	oFT	uWV	oFT	oST
			xWV	xSV	xST	xSV
						oFT
	Wilson's Warbler	uST	uST	uST	uST	uST
		uFT	uFT	uFT	cFT	cFT
				xWV		
	Yellow-breasted Chat	xST	xFT	xFT	xST	oST
					xFT	xFT
TANGERS						
	Summer Tanger			xSV		rST
	Western Tanger	oST	oST	oST	uST	uST
		oFT	uFT	uFT	uFT	cFT
GROSBEAKS, BUNTINGS, SPARROWS						
	Rose-breasted Grosbeak	xFT		rST		uST
						oFT
	Black-headed Grosbeak	uST	oST	cSR*	uST	cST
		oFT	oFT	xWV	uFT	uFT
	Blue Grosbeak	xST	oFT	rST		oST
				rFT		rFT
	Lazuli Bunting	oST	oST	uST	cST	cST
			oFT	uFT	uFT	uFT
	Indigo Bunting	xST			rST	uST
						oFT
	Green-tailed Towhee	xST		oFT	oFT	oST
		xFT		xWV		oFT

	Rufous-sided Towhee	oFT xST	cR*	cR*	oWV	uFT rWV
	Rufous-crowned Sparrow*			cR	uR	
	Chipping Sparrow	uST uFT	cSR*	cSR* xWV	cSR*	uST cFT
	Clay-colored Sparrow			xFT	xFT	oFT xST
	Brewer’s Sparrow				xST rFT	xST rFT
	Vesper Sparrow		oFT	oFT	oFT	oST uFT oWV
	Lark Sparrow		uFT oWV	xST cWV	oST xSV uFT	oST oFT
	Black-throated Sparrow			xFT	xST oFT	oST rFT
	Lark Bunting					rFT
	Savannah Sparrow	cWV	cWV	cWV	uST cFT	cWV
	Grasshopper Sparrow			uSR*	xST	rST
	Fox Sparrow	oWV	oWV	cWV	oST oFT	oWV
	Song Sparrow	aR*	aR*	uR*	xFT	FR
	Lincoln’s Sparrow	oST oFT	oFT xWV	uWV	oWV	oWV
	Golden-crowned Sparrow	uWV	cWV	aWV	cWV	cWV
	White-crowned Sparrow	cWV	aWV	aWV	aWV	aWV
	Dark-eyed Junco	oST	cWV	cWV	oST cFT	uST cFT
	Chestnucollared Longspur					rFT
ORIOLES, BLACKBIRDS						
	Bobolink	xST rFT	xFT		oFT	oST oFT
	Red-winged Blackbird		oST oFT	uR*	oFT	oST oFT
	Tricolored Blackbird		xFT	oST		rST
	Western Meadowlark*	cR	aR	cR	cR	cR
	Yellow-headed Blackbird	rFT	oST oFT	oST oFT	oST oFT	oST oFT
	Brewer’s Blackbird	oST oFT	oST	oST	oST oFT	oST oFT
	Brown-headed Cowbird	oFT xST	uWV	uWV	oST uFT	uST uFT
	Hooded Oriole	xST	xFT		oFT	oST oFT

	Northern Oriole	oST	xST oFT	oST oFT	oST uFT	uST uFT
FINCHES						
	Purple Finch	xST	oWV	uWV		oST
	House Finch	aR*	aR*	cR*	cR*	FR oV
	Red Crossbill			oV		
	Pine Siskin		xST	uWV	oST oFT	rWV
	Lesser Goldfinch	uSR*	cR*	cR*	xST uFT	oST uFT
	Lawrence’s Goldfinch	xST	oST oFT	oST oFT xWV	oST oFT	oST oFT
	American Goldfinch	xWV xSV	oWV	oWV		rST
OLD WORLD SPARROWS						
	House Sparrow	xST	xST FR	xST		oST xFT

ACCIDENTAL SPECIES

Pied-billed Grebe (SMI, SRI)
Least Storm-Petrel (SMI)
Brown Booby (SMI)
American White Pelican (AI)
Great Egret (SRI)
Snowy Egret (SRI, SCI, SBI)
Northern Shoveler (SRI, SCI)
Lesser Scaup (SRI, AI)
Harlequin Duck (SMI)
Black Scoter (SMI, SRI, SCI)
Common Golden Eye (SRI, SCI)
Black-shouldered Kite (all islands)
Swainson's Hawk (SCI)
Rough-legged Hawk (SCI, SBI)
Prairie Falcon (SRI, SCI, SBI)
Black-necked Stilt (SCI)
American Avocet (SCI)

Least Flycatcher (SRI)
Eastern Flycatcher (SMI, SRI, SBI)
Bank Swallow (SMI, SBI)
American Crow (SRI, AI)
American Dipper (SCI)
Gray Catbird (SCI)
Bendire's Thrasher (AI, SBI)
Red-throated Pipit (SMI, SCI)
Gray Vireo (SBI)
Philadelphia Vireo (AI, SBI)
Red-eyed Vireo (SBI)
Lucy's Warbler (SCI)
Northern Parula (SMI, SBI)
Cape May Warbler (SRI, SBI)
Black-throated Blue Warbler (SMI, SRI)
Black-throated Green Warbler (SMI, SCI, SBI)

Lesser Yellowlegs (SCI)
Upland Sandpiper (SBI)
Red Knot (SMI, SRI)
Wilson's Phalarope (SBI)
Pomarine Jaeger (SRI, SCI, AI, SBI)
Ring-billed Gull (SMI, SCI, SBI)
Thayer's Gull (SMI, SCI, AI)
Glaucous Gull (SMI)
Caspian Tern (SRI)
Artic Tern (SRI, SCI)
Craveri's Murrlett (SBI)
Horned Pufin (SMI, AI)
Spotted Dove (SBI)
Ringed Turtle-Dove (SBI)
Flammulated Owl (SBI)
Great Horned Owl (SBI)
Black Swift (SCI, AI)
Calliope Hummingbird (SBI)
Nuttall's Woodpecker (SMI, SRI, SCI)
Northern (Yellow-shafted) Flicker (AI, ABI)
Blackburnian Warbler (SCI, SBI)
Graces's Warbler (SCI)
Bay-breasted Warbler (SRI, SBI)
Kentucky Warbler (SBI)
Canada Warbler (SRI)
Painted Redstart (SCI)
Dickcissel (SBI)
Anerican Tree Sparrow (SCI)
Black-chinned Sparrow (SCI, SBI, AI)
Sage Sparrow (SCI, SBI)
Swamp Sparrow (SCI)
White-throated Sparrow (SCI, AI, SBI)
Harris' Sparrow (SBI)
McCown's Longspur (SBI)
Lapland Longspur (SRI, SBI)
Rusty Blackbird (SRI, SCI)
Scott's Oriole (SCI, AI)

ANACAPA ISLAND- AI
SAN MIGUEL ISLAND- SMI
SANTA CRUZ ISLAND- SCI
SANTA BARBARA ISLAND-SBI
SANTA ROSA ISLAND- SRI

Appendix C
Island Rat Eradications Worldwide

Species	Island	SIZE (HA)	Technique	Reference
R. norvegicus	Cox, Canada	10	Brodifacoum	Kaiser et al. 1997
R. norvegicus	Otata, NZ	15	Brodifacoum & 1080	Veitch & Bell 1990
R. exulans	Korapuki, NZ	17	Brodifacoum	Veitch & Bell 1990
R. rattus	Great Bird, Antigua	20	Brodifacoum	K. Lindsay pers. comm.
R. rattus	Tawhitinui, NZ	21	Brodifacoum	Taylor 1993
Rattus rattus	Ille Aux Aigrettes, Mauritius	25	Brodifacoum	B. Simmons, pers. comm.
R. rattus	Somes, NZ	32	Brodifacoum	Veitch & Bell 1990
R. norvegicus	Titi, NZ	32	Brodifacoum	Veitch & Bell 1990
R. exulans	Double, NZ	32	Brodifacoum	Veitch & Bell 1990
R. norvegicus	Lucy, Canada	40	Brodifacoum	Buck 1995
Rattus exulans *Rattus rattus*	12 Islets in the New Caledonia Group	48.5	Brodifacoum	B. Simmons, pers. comm.
R. norvegicus	Rasa, Mexico	60	Brodifacoum	J. Ramirez pers. comm.
R. norvegicus	Ailsa Craig, UK	>60	Warfarin	B. Zonfrillo, pers. comm
Rattus exulans	Onoeo, Pitcairn Group, Pacific	62	Brodifacoum	B. Simmons, pers. comm.
Rattus rattus *Mus musculus*	Flat Island, Mauritius	67	Brodifacoum	B. Simmons, pers. comm.
R. rattus	San Roque, Mexico	70	Brodifacoum & Bromethalin	Tershy & Croll 1996
Rattus exulans	Ducie, Pitcairn Group, Pacific	74	Brodifacoum	B. Simmons, pers. comm.
Rattus exulans	Raratoka (Centre Island), NZ	86	Brodifacoum	B. Simmons, pers. comm.
R. norvegicus	Stanley, NZ	100	Brodifacoum aerial spread	Buckle & Fenn 1992
Rattus rattus	Bird Island, Seychelles	101	Brodifacoum	B. Simmons, pers. comm.
R. norvegicus	Mokoia, NZ	133	Brodifacoum	Veitch & Bell 1990
Rattus exulans	Long Island, NZ	142	Brodifacoum	B. Simmons, pers. comm.
Rattus exulans	Putauhini, NZ	144	Brodifacoum	B. Simmons, pers. comm.
R. norvegicus	Breaksea, NZ	170	Brodifacoum	Veitch & Bell 1990
R. norvegicus	Whale, NZ	173	Brodifacoum	Veitch & Bell 1990
Rattus exulans	Inner Chetwode, NZ	195	Brodifacoum	B. Simmons, pers. comm.
R. norvegicus	Brown, NZ	200	Bromadiolone	D. Veitch pers. comm.
Rattus exulans *Rattus norvegicus*	Whakaterepapanui, Puangiangi and Tinui, NZ	220	Brodiafacoum	B. Simmons, pers. comm.

R. norvegicus	Ulva, NZ	259	Brodifacoum	Taylor 1993
R. rattus	St. Paul, Indian Ocean	800	Brodifacoum aerial spread	T. Micol pers. comm.
R. norvegicus	Kapiti, NZ	2000	Brodifacoum aerial spread	D. Veitch pers. comm.
R. norvegicus	Langara, Canada	3000	Brodifacoum	Kaiser et al. 1997

Appendix D (McChesney et al. 2000)

EXECUTIVE SUMMARY

The Department of Fish and Game (Habitat Conservation Planning Branch) sponsored the Humboldt State University and U.S. Geological Survey to conduct an assessment of potential nesting habitat for Xantus' Murrelets (*Synthliboramphus hypoleucus*) and other small, crevice-nesting seabirds at Anacapa Island, California, in 1997. Both ground and boat techniques were used to search for nests and estimate the number of potential nest sites. We focused on the upper portions of West Anacapa since this islet appeared to possess a considerable amount of accessible, potential habitat. A total of 1,510 (range = 848-1,303) potential nest sites for Xantus' Murrelets and other similiar-sized crevice-nesting seabirds (e.g., Cassin's Auklet *Ptychoramphus aleuticus*) were estimated (not including potential sites in sea caves). The majority of sites were on West Anacapa Island (53.8%), followed by East Anacapa (27.5%) and Middle Anacapa (18.6%) islands. Of these potential sites, 91% were in rock crevices and 9% were in shrubs (mostly Island Buckwheat *Eriogonum grande*). A large proportion of potential nesting habitat occurred in the steep, largely inaccessible slopes and cliffs of the island, particularly on the north side. Sixty-two percent of sites were estimated from either ground or boat surveys, and 38% of sites were counted directly from ground surveys. About 100 additional potential nest sites may occur in sea caves at Anacapa Island, but these were not fully assessed. The remains of 23 eggs at 20 nest sites was the only evidence obtained of murrelet nesting in 1997. Eighteen nests were in sea caves on the West and Middle islands, and two nests were in rock crevices among the cliffs of the West and East islands. Of the 23 eggshells found, 9% were determined to have hatched, 56% had been rodent-depredated, and 35% had unknown fates.

The remains of a rodent-depredated Cassin's Auklet eggshell found in Pinnacle Cave (West Anacapa) represented the first documented nesting record for this species on Anacapa Island. No evidence of nesting by storm-petrels (*Oceanodroma* spp.) was obtained. A large but unmeasured proportion of potential rock crevice sites showed evidence of use by introduced Black Rats (*Rattus rattus*). Rat predation probably has been the main cause for long-term decline in the breeding population of Xantus' Murrelet and possibly other seabird species on Anacapa Island. Other factors that may have contributed to decline have been predation by feral cats (*Felis catus*, now extirpated) and mortality from oil pollution. We estimated only 50-200 breeding pairs of Xantus' Murrelets on Anacapa Island in 1997. These numbers appear low relative to the amount of potential habitat and to numbers that likely bred in the past. In the absence of rats, we consider that several hundred to low thousands of breeding pairs of murrelets could breed at Anacapa Island, based on potential habitat available. Thus, Anacapa Island could be a major colony if restored. Further studies using a variety of techniques are needed to more fully assess population sizes of Xantus' Murrelets and other seabirds, and to assess impacts of small mammals and other threats to seabirds at Anacapa Island. Conservation measures, especially the eradication of rats, likely would enhance murrelet and other seabird populations on Anacapa Island.