



Farallon Islands

National Wildlife Refuge

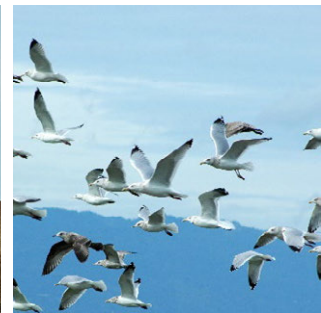
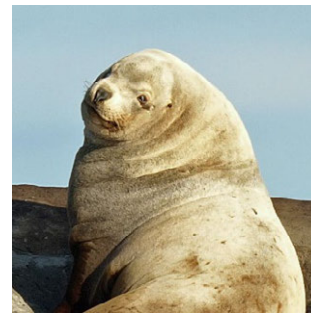
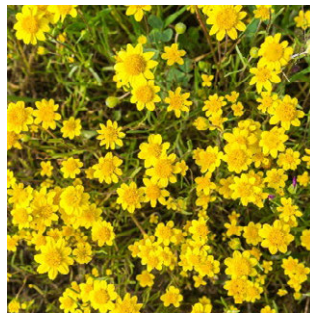
Invasive House Mice
Eradication Project





Overview

Farallon Islands National Wildlife Refuge history and background.





Location of the Farallon
Islands National Wildlife
Refuge ~~and specifically the~~
~~South Farallon Islands~~
~~where mouse eradication~~
~~project will occur~~

approximately 30 miles west
of San Francisco, CA



About Farallon Island

National Wildlife Refuge

- 120 acres (49 ha)
- 350 feet high (113 m)
- Rugged and remote
- Some islands designated wilderness



Farallon Island Seabirds

- World's largest colonies of ashly storm-petrel, Brandt's cormorant, and western gull
- Numbers of breeding seabirds are only about 1/3 of what they were before human impacts
- One of the foremost natural laboratories for monitoring changes in the North Pacific Ocean ecosystem



Largest Seabird Colony in the Contiguous U.S.

300,000 Breeding Seabirds—13 Species

Brandt's Cormorant



Ashy Storm-Petrel



Western Gull



Tufted Puffin



Common Murre



Pigeon Guillemot



Rhinceros Auklet



Cassin's Auklet

Largest Seabird Colony in the Contiguous U.S.

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Pigeon Guillemot



Rhinoceros Auklet



Cassin's Auklet

Farallon Islands Wildlife

- Islands provide important breeding and resting habitat.
- Pinnipeds were formerly decimated by seal hunters.
- Protection of islands as a National Wildlife Refuge has provided a safe haven, and pinniped numbers are recovering.



Five Species of Pinnipeds —3,000 – 6,000 Animals

California Sea Lion



Harbor Seal



Steller Sea Lion (threatened)



Northern Elephant Seal



Northern Fur Seal

Five Species of Pinnipeds

—3,000 – 6,000 Animals

California Sea Lion



Harbor Seal



Steller Sea Lion (threatened)



Northern Elephant Seal



Northern Fur Seal

Extensive Human History

Early 19th century

- Marine mammal hunting

Late 19th century

- Commercial egg~~ing~~
- Construction of lighthouse and houses, lighthouse keepers
- North and Middle Farallon Islands and Noonday Rock established as **National Wildlife Refuge** in 1909 by President Theodore Roosevelt



Early to mid-20th century

- Lighthouse keepers
- U.S. Navy radio station

1969 – present

- South Farallon Islands added to the Farallon Islands National Wildlife Refuge
- Stewardship, long-term monitoring, and research of island ecosystem



Research and Monitoring on the Island for 50+ Years

Today, our long-term
data sets form
baseline knowledge.

- Breeding seabird populations, demographics, ecology
- Pinniped populations and demographics
- Migrant birds
- Seabird predation
- Migrant burrowing owls
- Arboreal salamanders
- Farallon camel crickets
- Vegetation
- Cetaceans
- White sharks
- Intertidal communities



Pre-Eradication Studies

Studies conducted to inform the Southeast Farallon Island invasive mouse eradication project

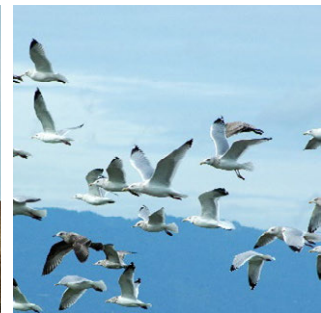
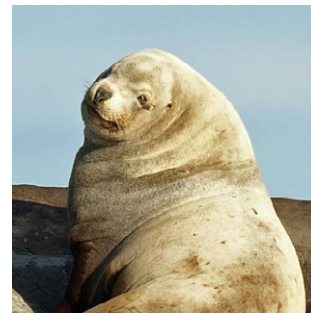
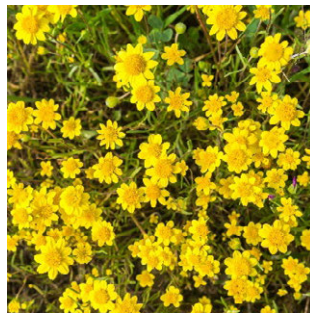
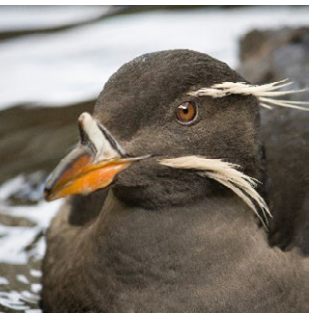
More than ### Studies Conducted

- House mouse density estimate
- Bait palatability and preference trials
- Bait exposure rates (efficacy)
- Bait station field test
- Mapping of accessible and sensitive areas
- Collection of mouse samples and genetic analysis
- Bait degradation trials
- Gull hazing trials
- Gull risk assessment
- Impacts of mice on ashly storm-petrels
- House mouse diet
- Salamander hazard study
- Conservation measures: Seabird, salamander, cricket, burrowing owl, plant populations
- Black abalone survey



The Problem

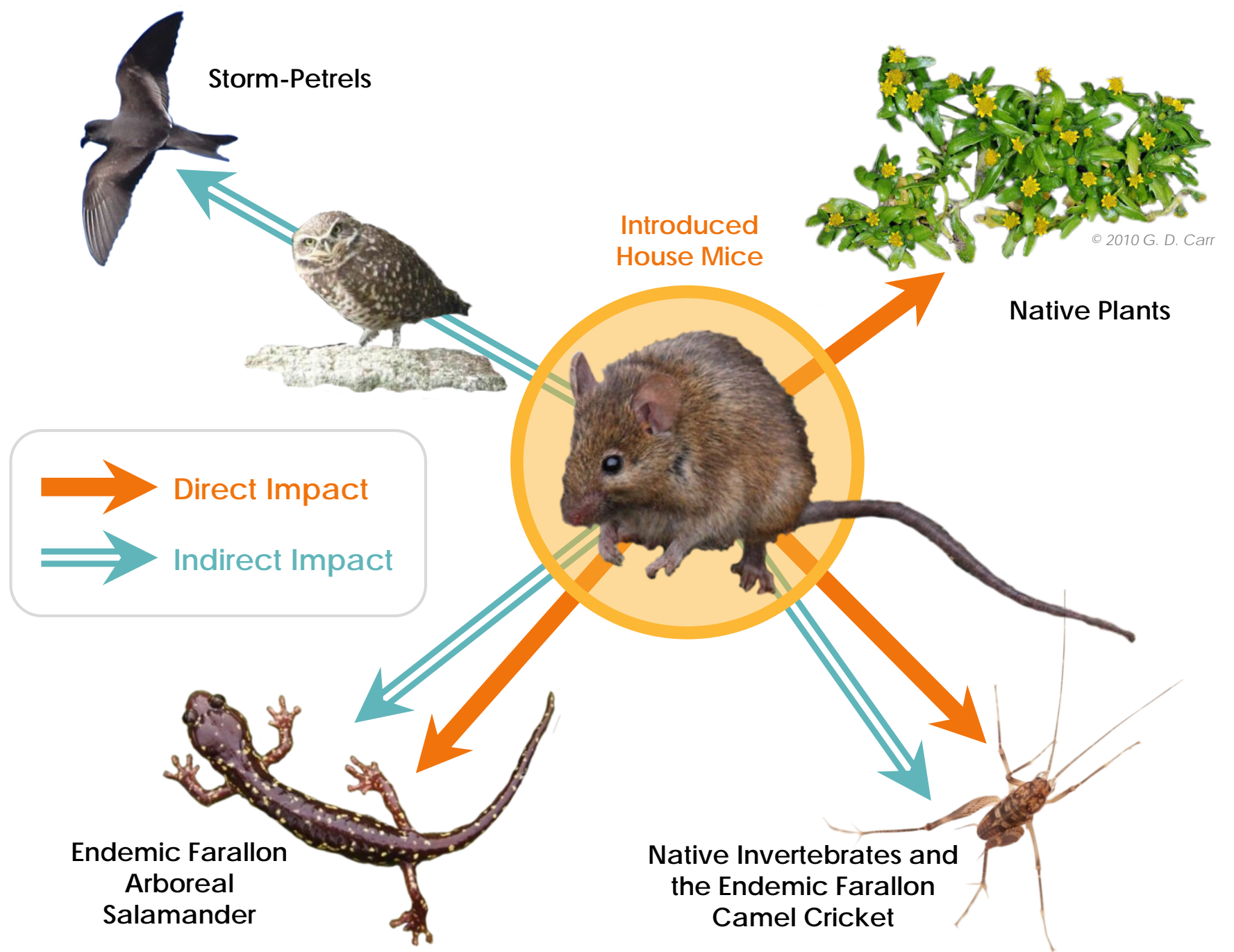
The effect of invasive house mice on Farallon Island



Ecosystem Damage from Invasive House Mice on Southeast Farallon Island



Mouse on Farallon Islands (Matt Brady)



Density of Invasive House Mice on Southeast Farallon Island

- ~~Density estimate of approximately 500 mice per acre~~
- ~~House mouse densities commonly range from 4 to 20 per acre~~

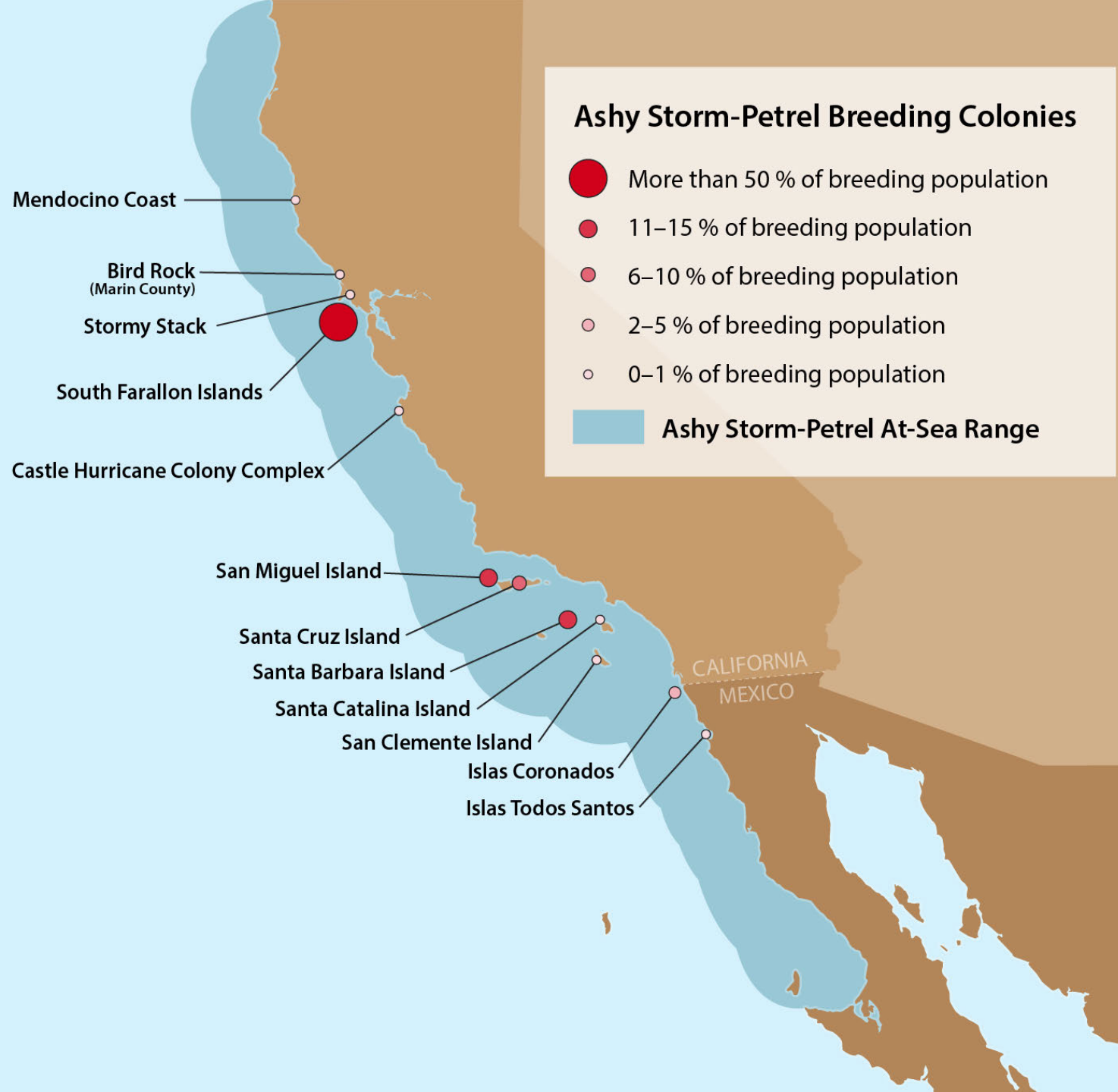


Highest Reported Density of Invasive House Mice for Any Island in the World



Distribution of Ashy Storm-Petrel

- World population **fewer than 10,000** breeding birds



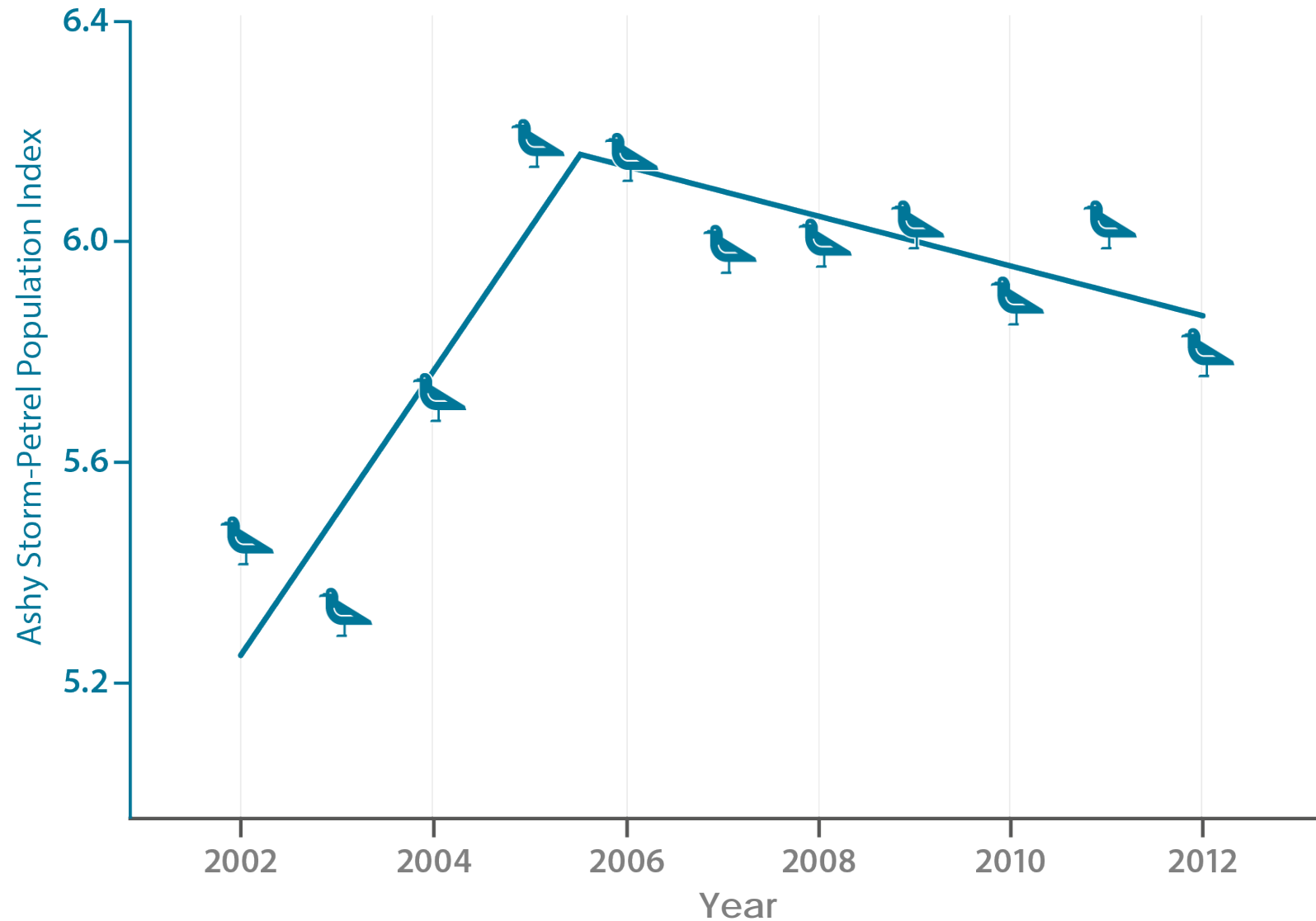
Population Index of Ashy Storm-Petrel



Source: Nur et al. 2019. *Evaluating population impacts of predation*, Ecosphere 10 (10).



Population Index of Ashy Storm-Petrel (compared with Burrowing Owl Predation Index)



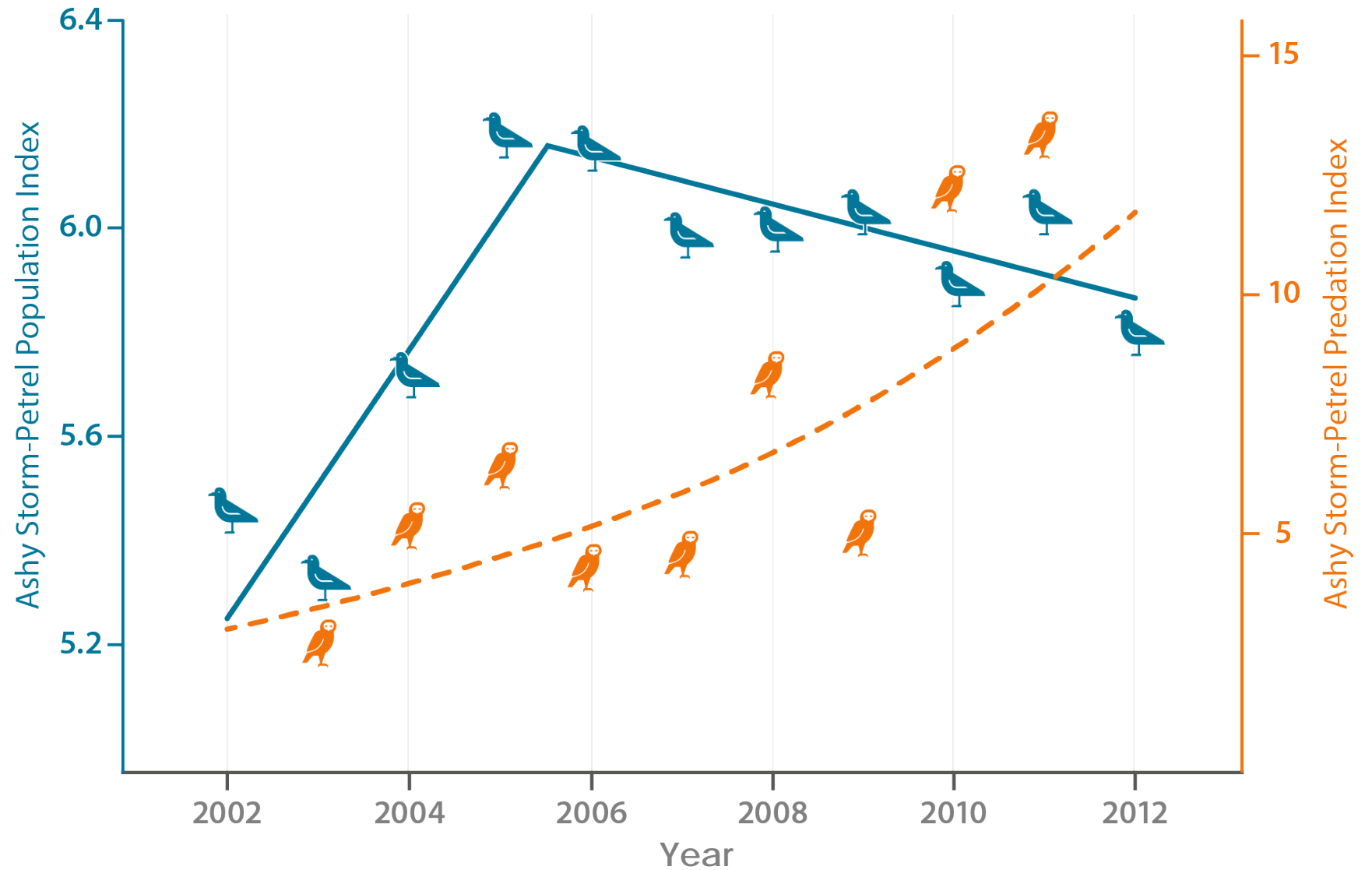
Population Index of Ashy Storm-Petrel



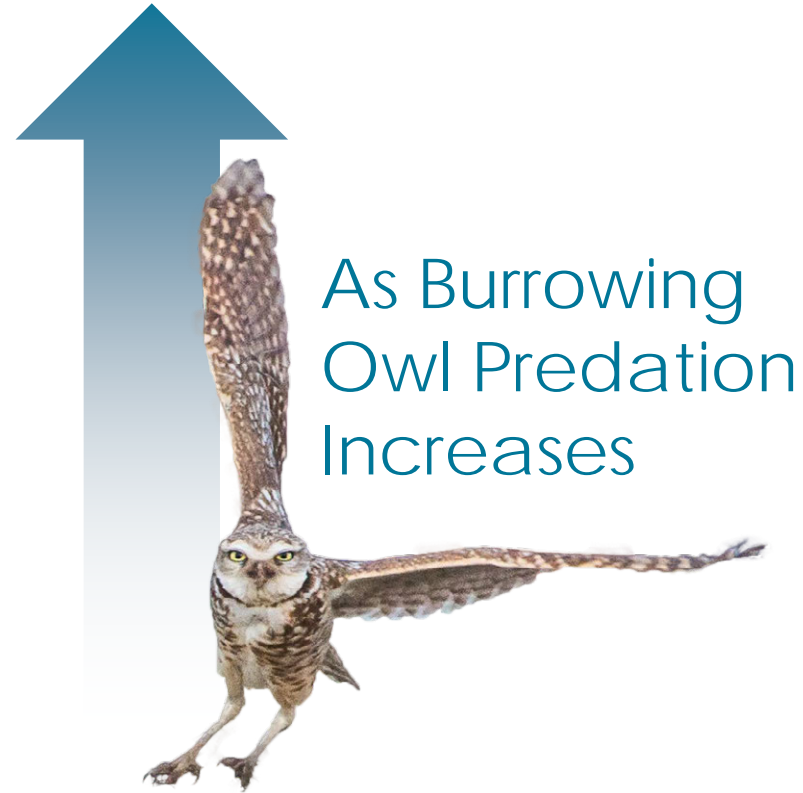
Source: Nur et al. 2019. *Evaluating population impacts of predation*, Ecosphere 10 (10).



Population Index of Ashy Storm-Petrel (compared with Burrowing Owl Predation Index)



Ashy Storm-Petrels and Burrowing Owls

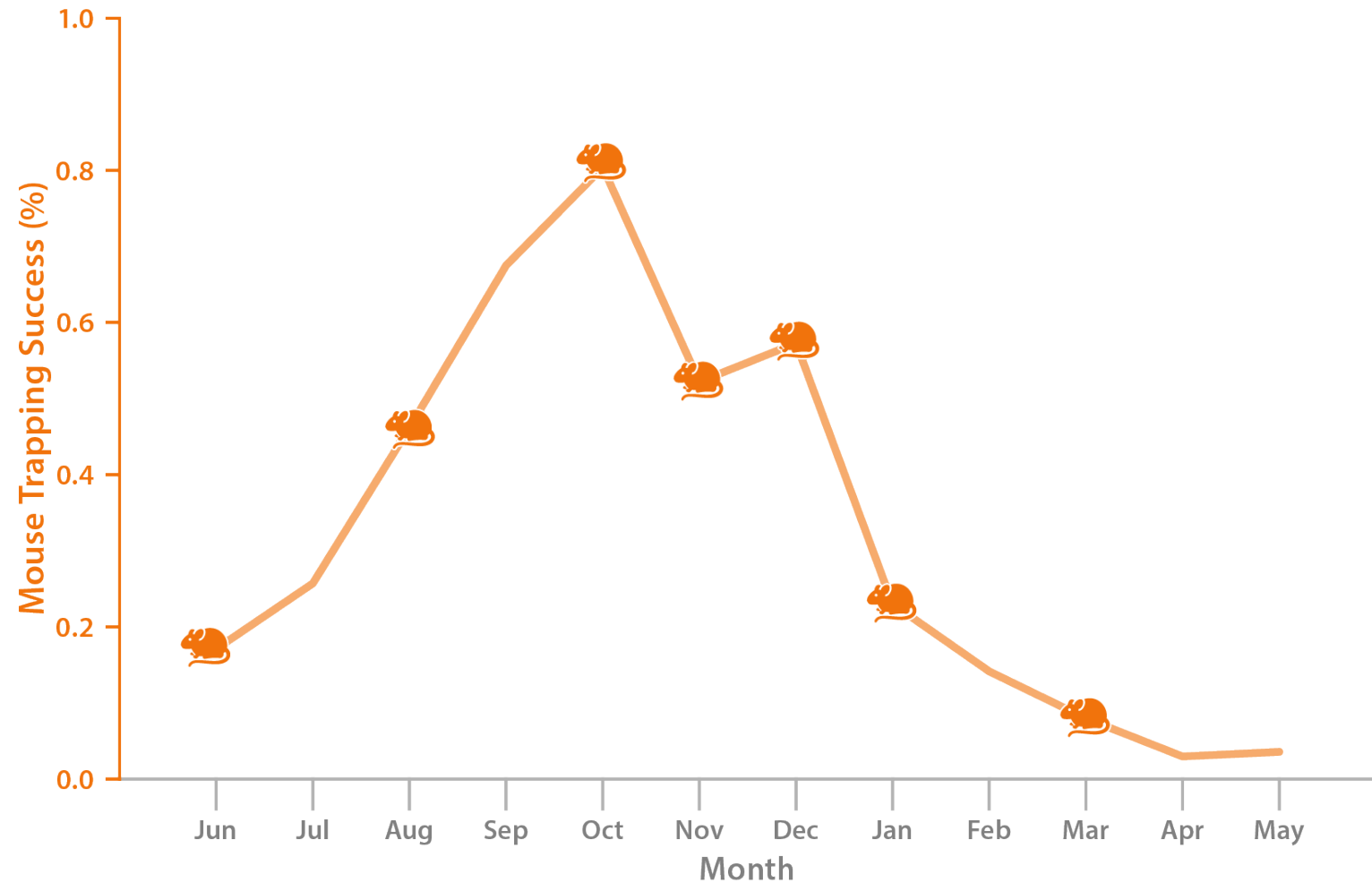


Relationship of Mouse and Owl Abundance with Ashy Storm- Petrel Predation

Mouse Trapping
Success



Mouse on Farallon Islands (Matt Brady)



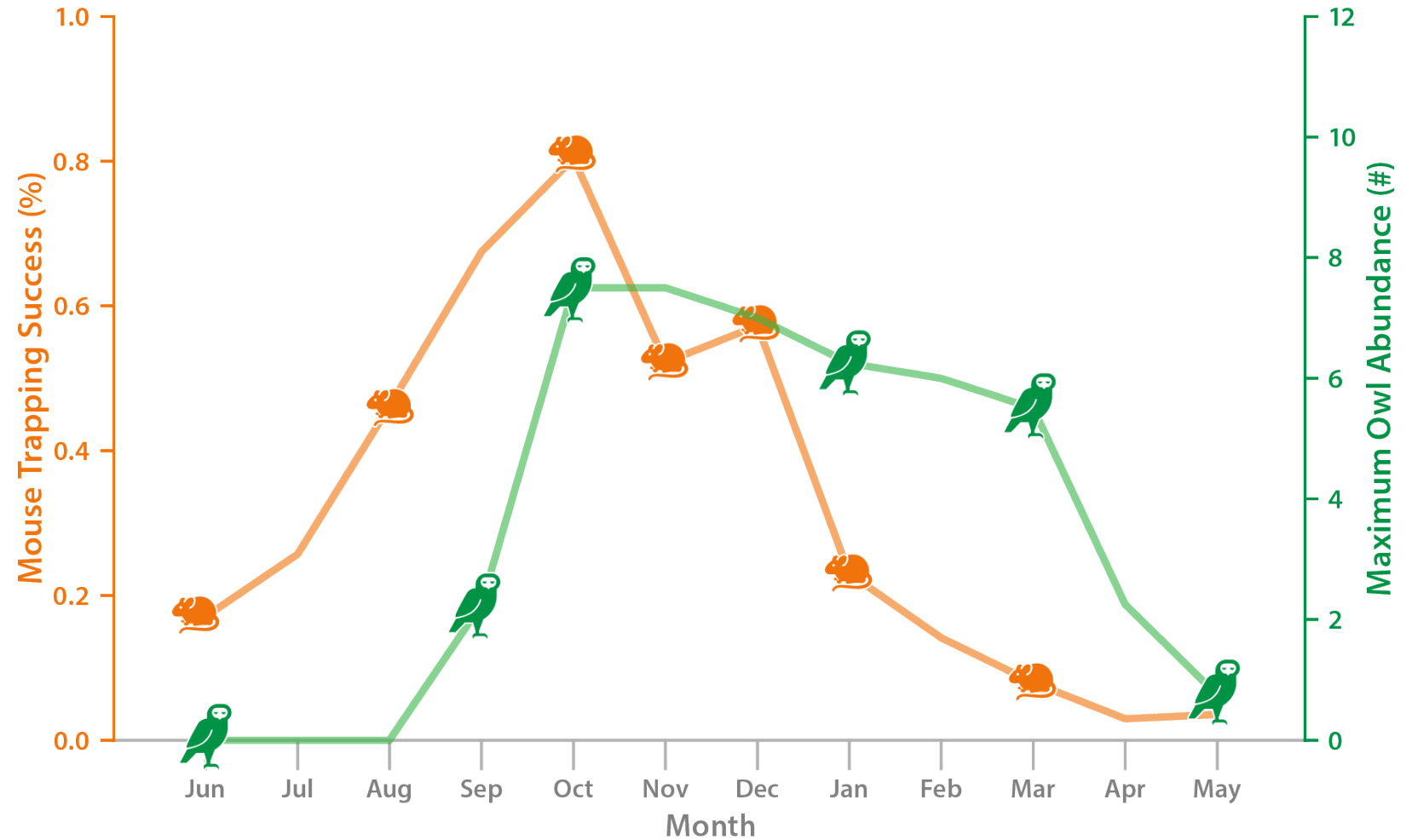
 Mouse trapping success (proportion)



Source: Nur et al. 2019



Relationship of Mouse and Owl Abundance with Ashy Storm-Petrel Predation

Maximum Burrowing Owl Abundance



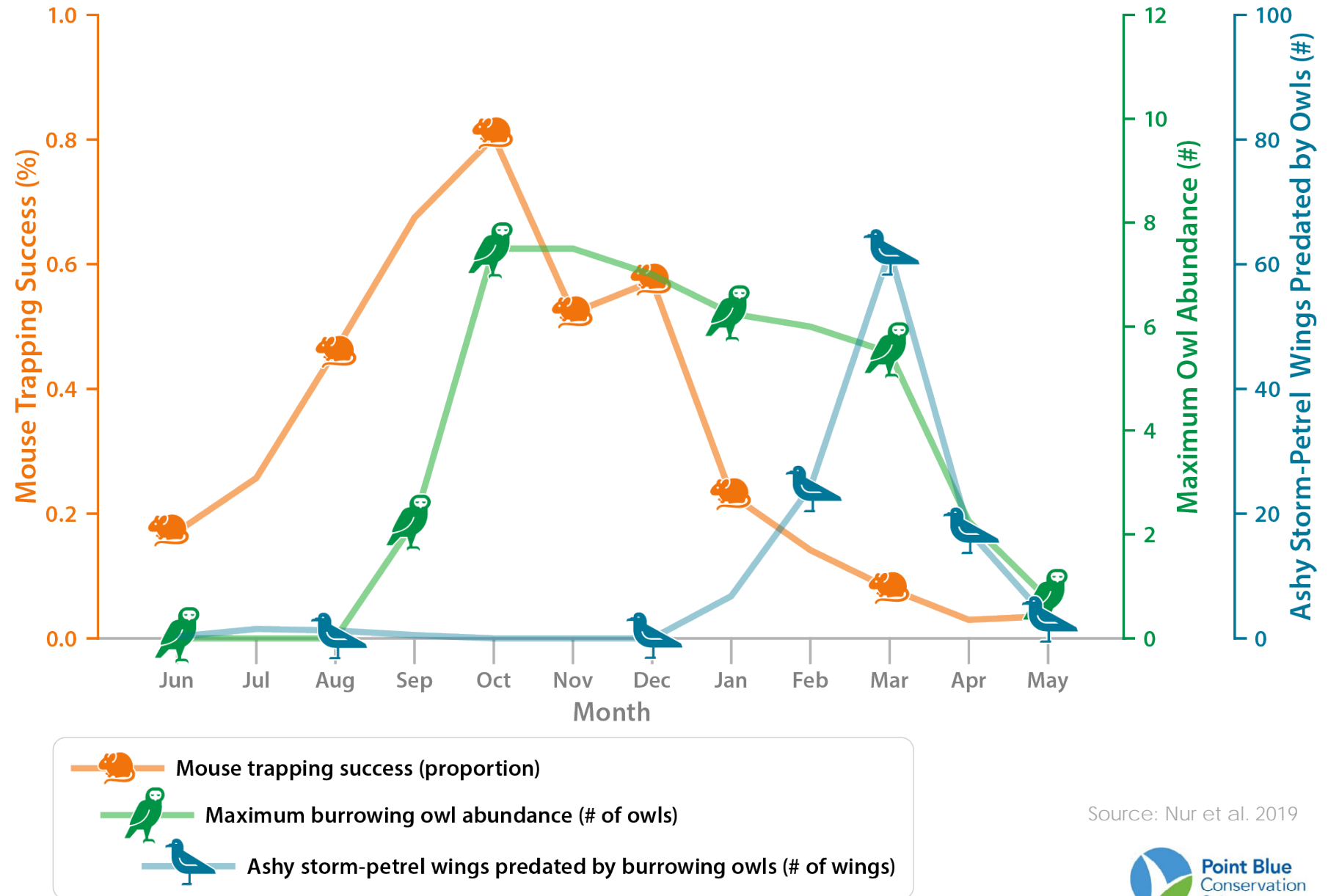
-  Mouse trapping success (proportion)
-  Maximum burrowing owl abundance (# of owls)

Source: Nur et al. 2019



Relationship of Mouse and Owl Abundance with Ashy Storm-Petrel Predation

Ashy Storm-Petrel
Wings Predated by
Burrowing Owls



Source: Nur et al. 2019

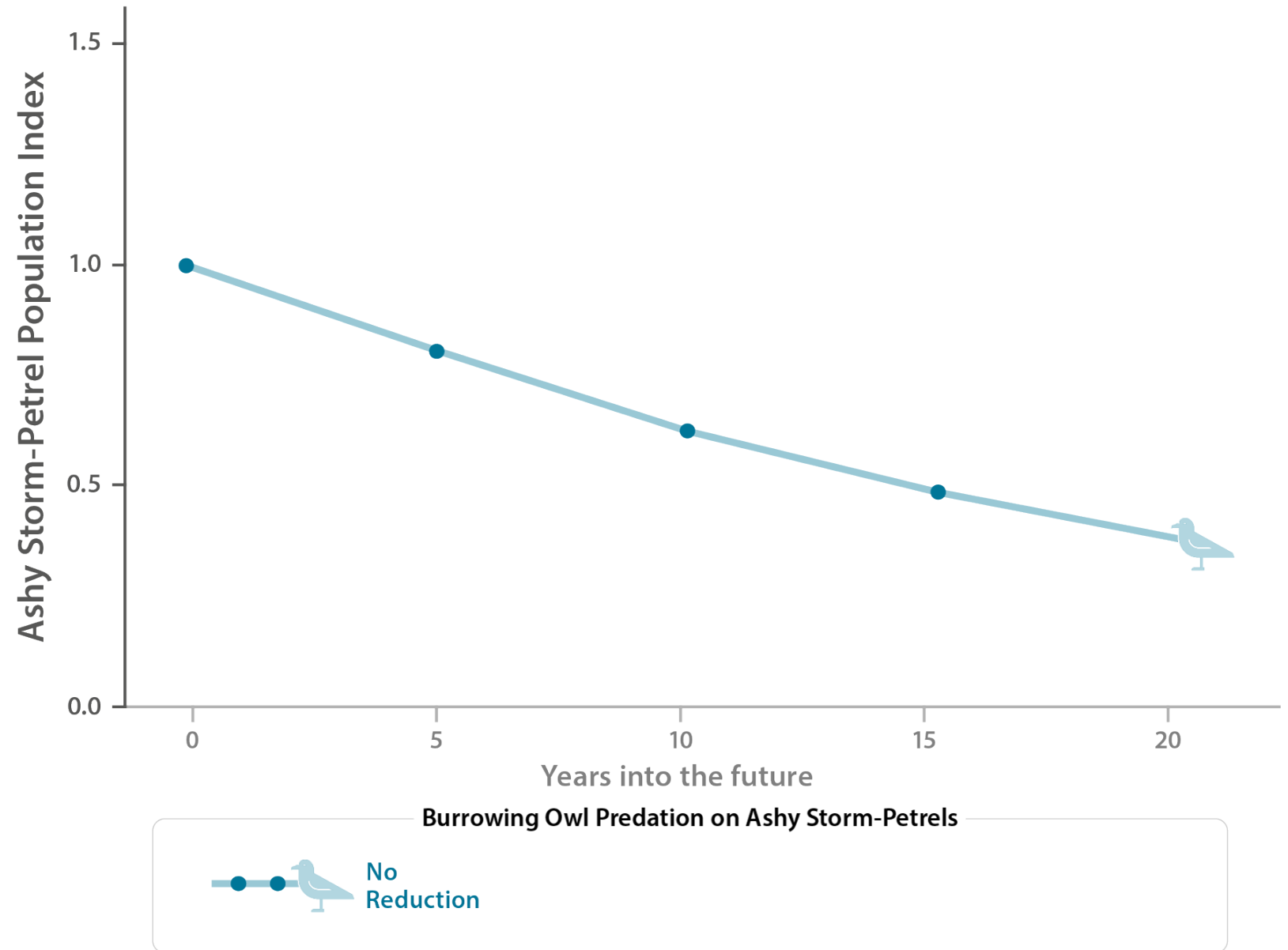


Projected Ashy Storm-Petrel Trends With and Without Owl Predation Reduction

"Moderate Decline" scenario



Ashy storm-petrel remains beneath burrowing owl roost. Photo by P. Pyle.



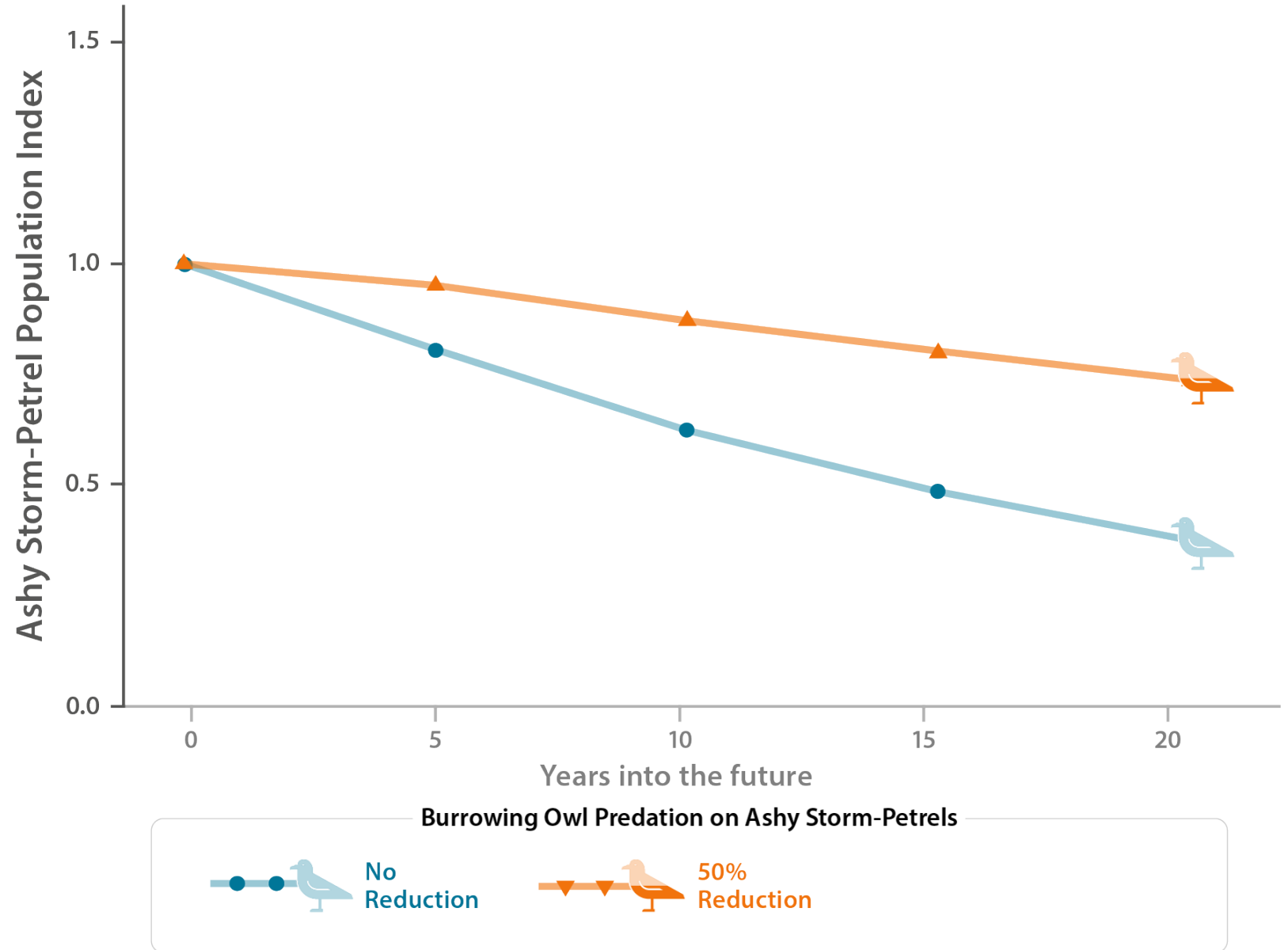
Source: Nur et al. 2019.

Projected Ashy Storm-Petrel Trends With and Without Owl Predation Reduction

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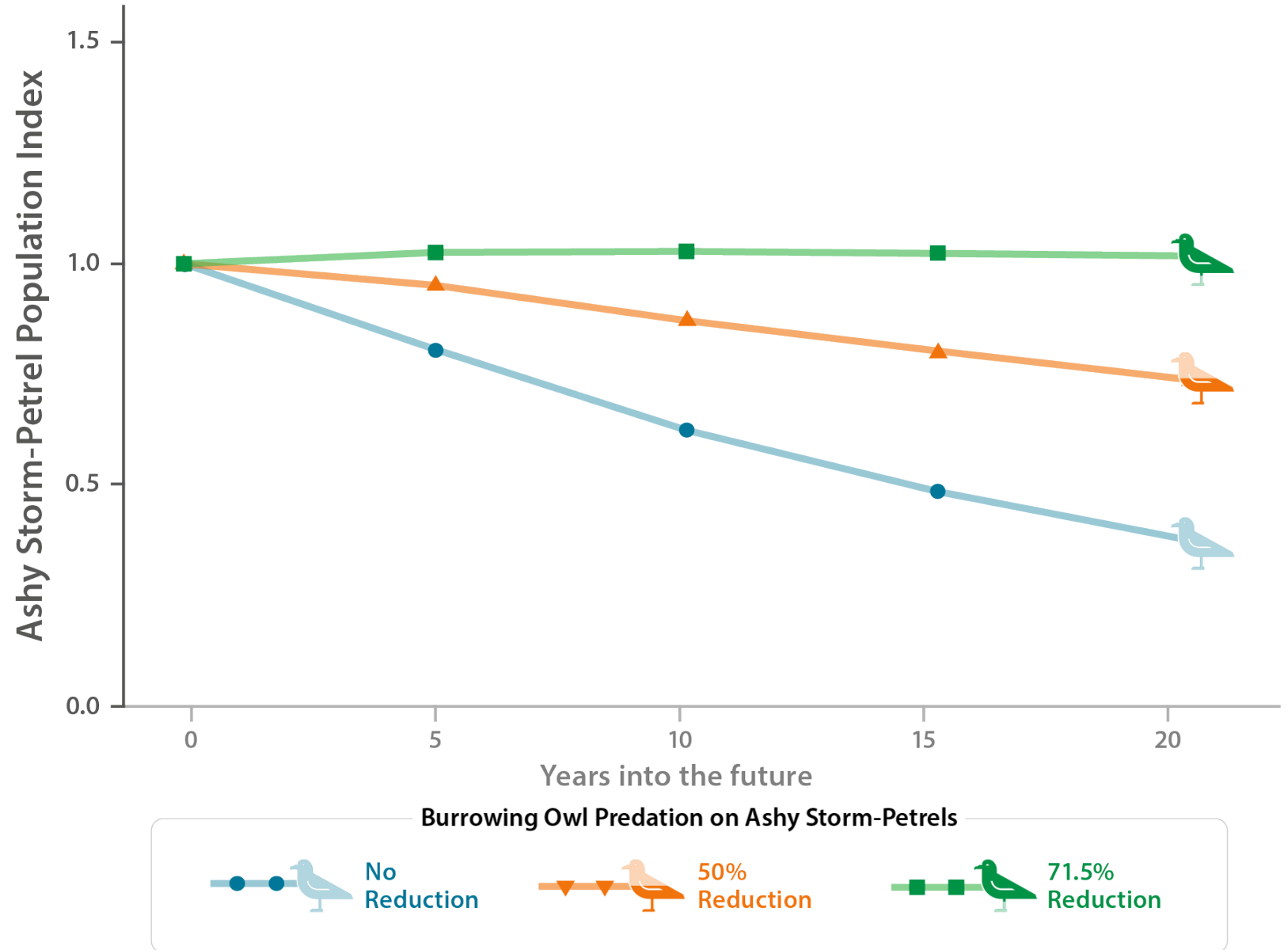
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Projected Ashy Storm-Petrel Trends With and Without Owl Predation Reduction

"Moderate Decline" Scenario



Ashy storm-petrel remains beneath burrowing owl roost. Photo by P. Pyle.



Source: Nur et al. 2019.

Expected Benefits of Eradicating Mice

Decreases in

- Owl predation on ashy storm-petrel
- Mouse and owl predation on crickets & other invertebrates
- Mouse competition with salamanders
- Mouse herbivory of native plants

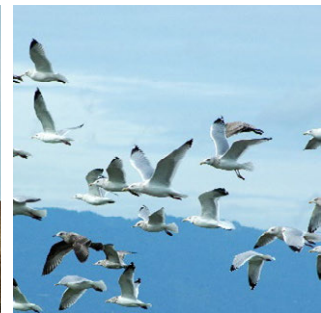
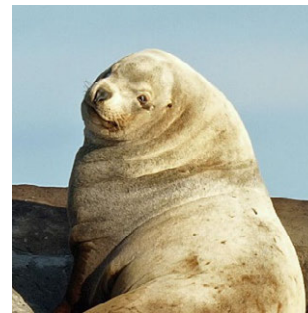
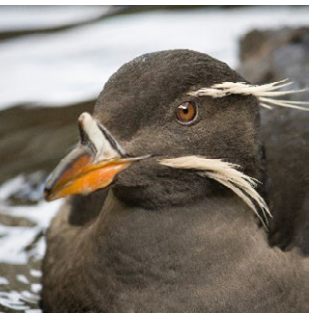
Increases in

- Ashy storm-petrels
- Native plants
- Endemic salamanders
- Endemic camel crickets
- Other invertebrates
- Native ecosystem function



Finding a Solution

Developing action plans and evaluating alternatives



Lessons Learned

Recommendations implemented from the Ornithological Council review of nontarget mortality with the Rat (Hawadax) Island, AK project.



- a) Develop an Environmental Impact Statement to assess the expected effects and allow for adaptive management during implementation.



- b) Prepare contingency plans as part of the operational planning phase.



- c) Obtain required permits.

- d) Work with the USDA/APHIS in consultation with EPA; obtain a supplemental bait label if deemed necessary.



- e) Conduct pre-eradication trials to determine appropriate application rates.



- f) Evaluate mitigation measures, including gull hazing and include in action alternatives to minimize impacts to nontargeted resources.



- g) Monitor bait availability during implementation.



- h) Ensure that the eradication operation is fully staffed for the duration of the implementation.



- i) Allow the operational team the opportunity to fully review the operational plan.



- j) Develop a detailed and clearly laid out command structure to be used during the operation.



Comparison of Rodent Control on Mainland vs. Eradication on Islands



Eradication on Islands Conservation Use of Brodifacoum

Goal

Restore ecosystem by complete removal of invasive species

Outcome

100% removal of all individuals required

Length of Operation

One-time operation that usually is completed in a few weeks

Positive Impact

Permanent; ecosystem wide; often measurable within 1–2 years

Negative Impact

Limited short-term impacts to nontarget resources

Regulatory Oversight

Registered with the EPA—NEPA and various federal, state, and local authorizations required



Control on Mainland Overuse of Brodifacoum



Local reduction of the rodent population



Complete removal impossible



Sustained for long periods or revisited periodically in perpetuity



Highly limited in extent, degree, and duration



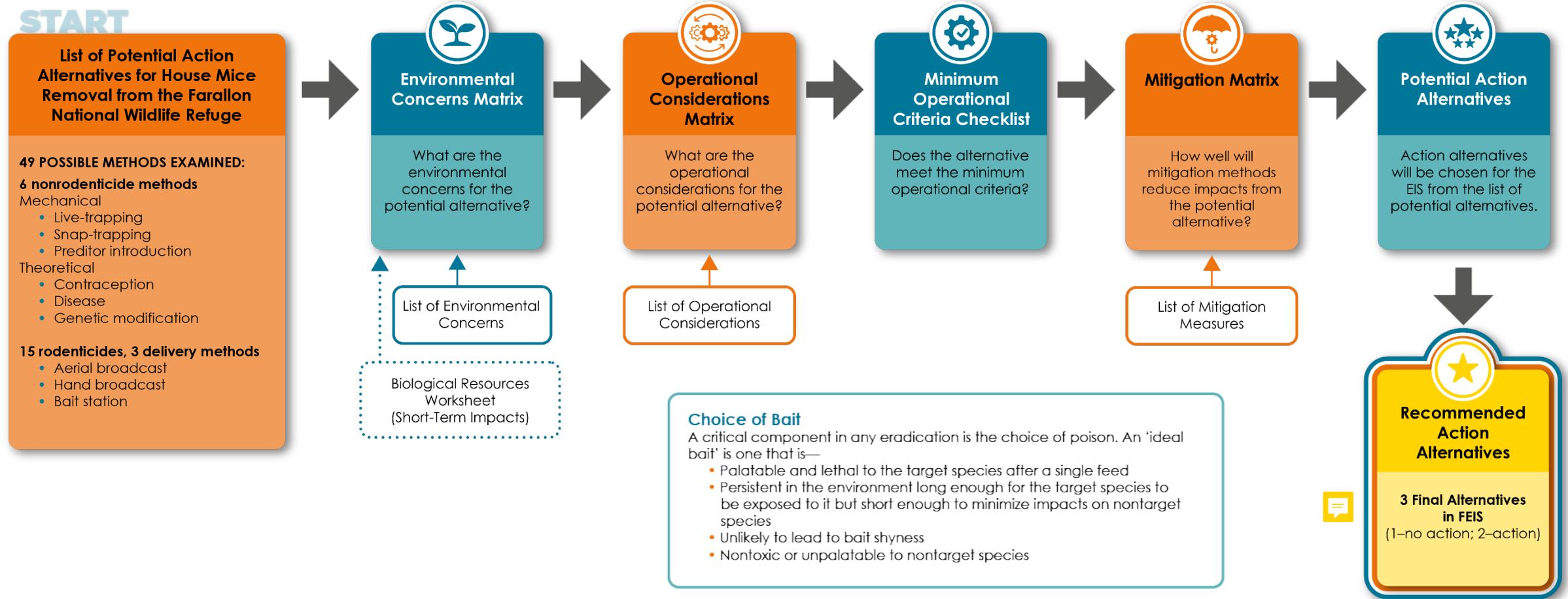
Chronic impacts to nontarget resources



Applicator license—typically, no other authorizations required



Alternative Selection



Alternative Selection

List of Potential Action Alternatives for House Mice Removal from the Farallon National Wildlife Refuge

49 POSSIBLE METHODS EXAMINED:

6 nonrodenticide methods

Mechanical

- Live-trapping
- Snap-trapping
- Predator introduction

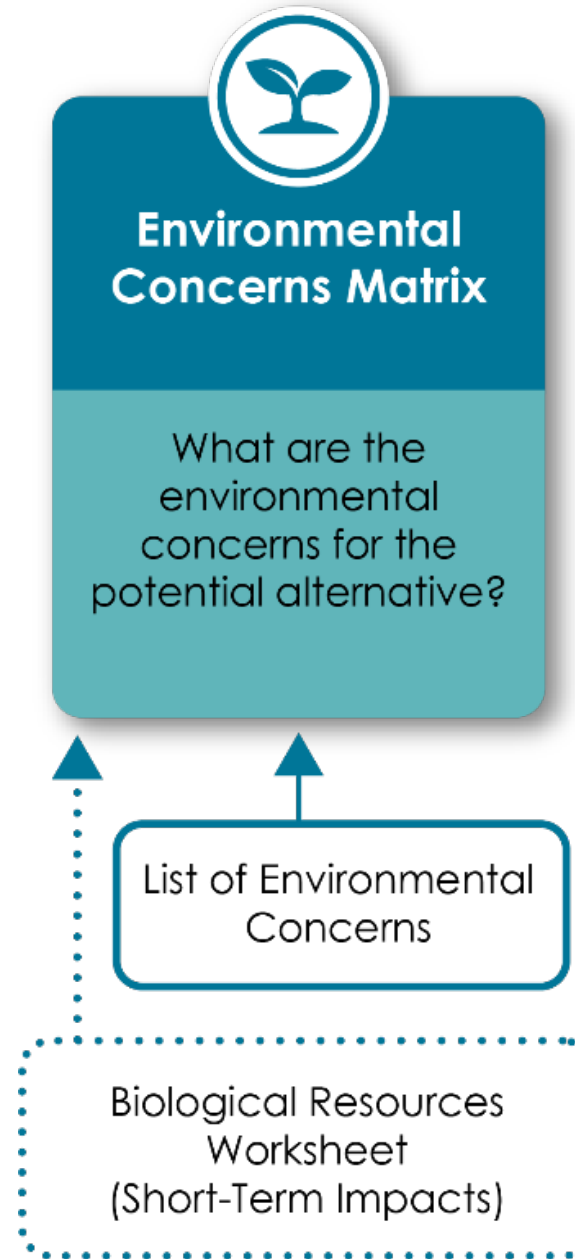
Theoretical

- Contraception
- Disease
- Genetic modification

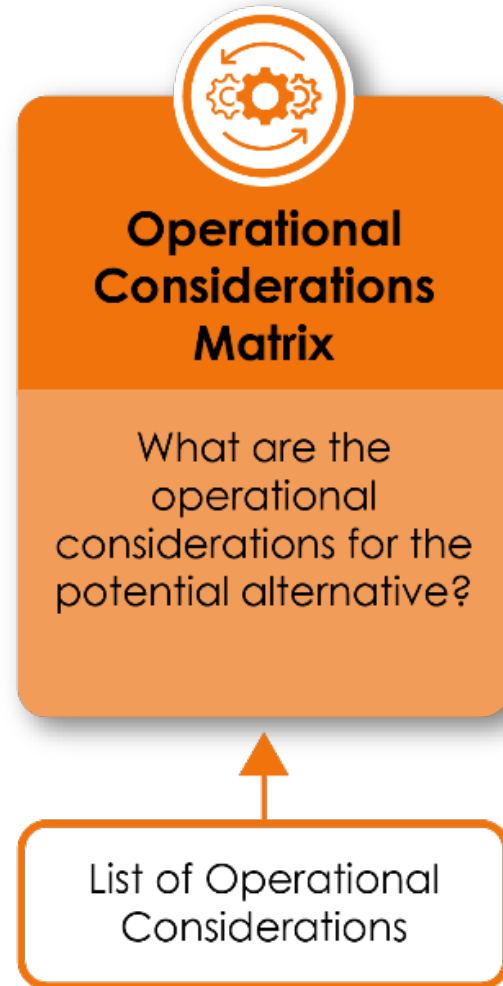
15 rodenticides, 3 delivery methods

- Aerial broadcast
- Hand broadcast
- Bait station

Alternative Selection



Alternative Selection



Alternative Selection



Minimum Operational Criteria Checklist

Does the alternative
meet the minimum
operational criteria?

Alternative Selection



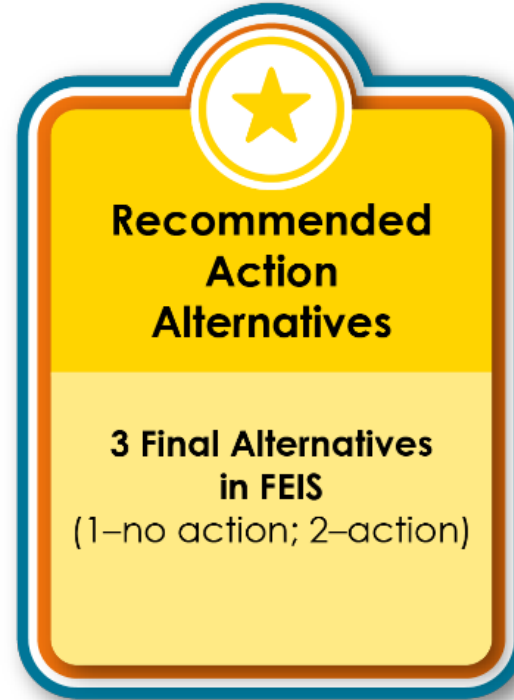
Alternative Selection



Potential Action Alternatives

Action alternatives
will be chosen for the
EIS from the list of
potential alternatives.

Alternative Selection

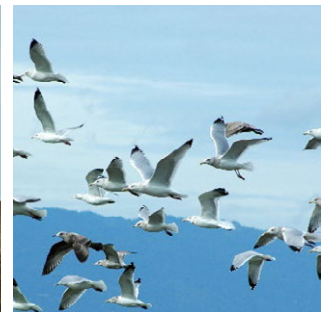
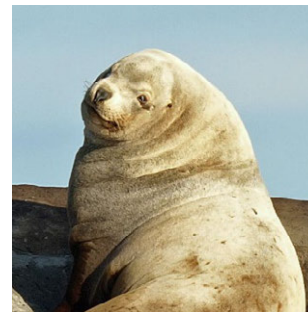
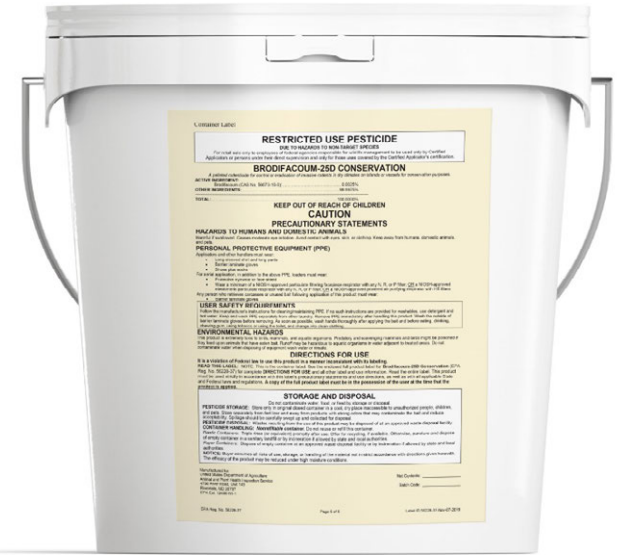


Alternative Selection

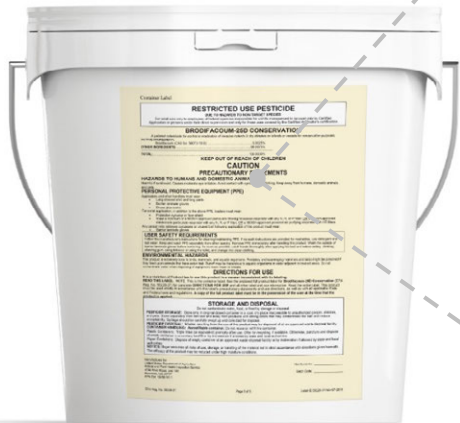


Brodifacoum-25D Conservation

Labeling and legislative oversight



Key Pesticide Label Items



BRODIFACOUM-25D CONSERVATION

- ▶ A pelleted rodenticide for control or **eradication** of invasive rodents in dry climates **on islands** or vessels for **conservation**.
- ▶ This product is to be used for the protection of State or Federally listed Threatened or Endangered Species or other species determined to require special protection.
- ▶ **RESTRICTED USE PESTICIDE:** For retail sale **only** to employees of Federal agencies responsible for wildlife management, to be used **only** by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.
- ▶ It is a violation of Federal law to use this product in a manner inconsistent with its labeling.



Draft State Bill on Anticoagulant Use

An act to amend Section 12978.7 of, and to add Section 12978.8 to, the Food and Agricultural Code, relating to pesticides.



LEGISLATIVE COUNSEL'S DIGEST

AB 1788, as amended, Bloom. Pesticides: use of anticoagulants.

(1) Existing law regulates the use of pesticides and authorizes the Director of Pesticide Regulation to adopt regulations to govern the possession, sale, or use of any pesticide, as prescribed. Existing law prohibits the use of any pesticide that contains one or more of specified anticoagulants in wildlife habitat areas, as defined. Existing law exempts from this prohibition the use of these pesticides for agricultural activities, as defined. Existing law requires the director, and each county agricultural commissioner under the direction and supervision of the director, to enforce the provisions regulating the use of pesticides. A violation of these provisions is a misdemeanor.

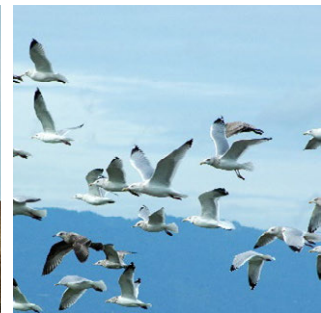
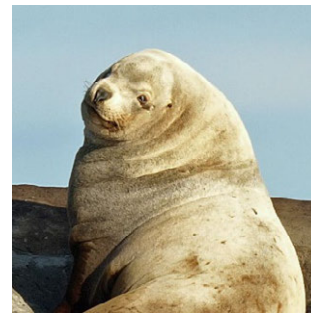
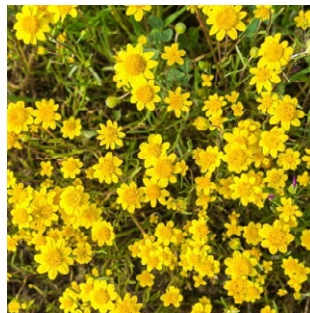
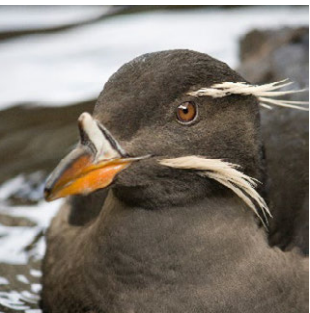
This bill would create the California Ecosystems Protection Act of 2019 and expand this prohibition against the use of a pesticide containing specified anticoagulants in wildlife habitat areas to the entire state. The bill would expand the exemption for agricultural activities to include activities conducted in certain locations and would also **exempt** from its provisions the use of pesticides by any governmental agency employee who uses pesticides for public health activities, a mosquito or vector control district that uses pesticides to protect the public health, and the **use of any pesticide or rodenticide used for the eradication of nonnative invasive species inhabiting or found to be present on offshore islands** in a manner that is consistent with all otherwise applicable federal and state laws and regulations.

(2) Existing law provides that the above-described provisions do not preempt or supersede any federal statute or the authority of any federal agency.

This bill would additionally provide that these provisions do not preempt or supersede special local need or emergency exemptions for the use of pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act.

Operations

Operational details and pre-application activities



Operational Details

Action Attribute	Proposed Action
Toxicant type/product	▶ Brodifacoum-25D conservation (Bell Labs)
Primary bait delivery method (~90%)	▶ Aerial broadcast
Supplementary bait delivery method (~10%)	▶ Hand broadcast, bait station
Timing: Start of application	▶ Fall
Environmental conditions	▶ Long-term weather forecast that predicts less than 25 knots of wind and five fine days (four fine nights) with no significant rainfall (less than 6mm)
Number of aerial applications	▶ 2
Time between applications	▶ 10-21 days
Minimum length of exposure required to ensure eradication	▶ 4 days following each application
Anticipated bait pellet application rates	▶ 24 lb/acre (16 lb/acre +8 lb/acre) 27 kg/ha (18 kg/ha +9 kg/ha)
Anticipated total amount of rodent bait that would be applied	▶ 2,917 lb (1,323 kg)
Concentration of rodenticide within rodent bait	▶ 0.0025%



Operational Details

(continued)

Action Attribute	Proposed Action
Anticipated total amount of rodenticide to be applied	▶ 33g
Anticipated hours of flight time required for aerial bait application actions	▶ About 11 hours (~5.5 hours x 2)
Total helicopter time over island for bait application	▶ About 6 hours (~3 hours x 2)
Total operational days	▶ Up to 21 days (2 drops 10-21 days apart)
Projected bait availability and palatability to gulls	▶ Up to 5 weeks
Anticipated hours of flight time required for gull hazing	▶ Up to 70 hours (2 hours daily for 5 weeks)
Actions to minimize risk to nontarget species	▶ Timing of operation, gull hazing, raptor capture, salamander capture, carcass removal, use of bait stations
Actions to minimize bait drift	▶ Baiting of areas above MHWS only, flying only in wind speeds of less than 30 kts, use of deflector and dribble buckets



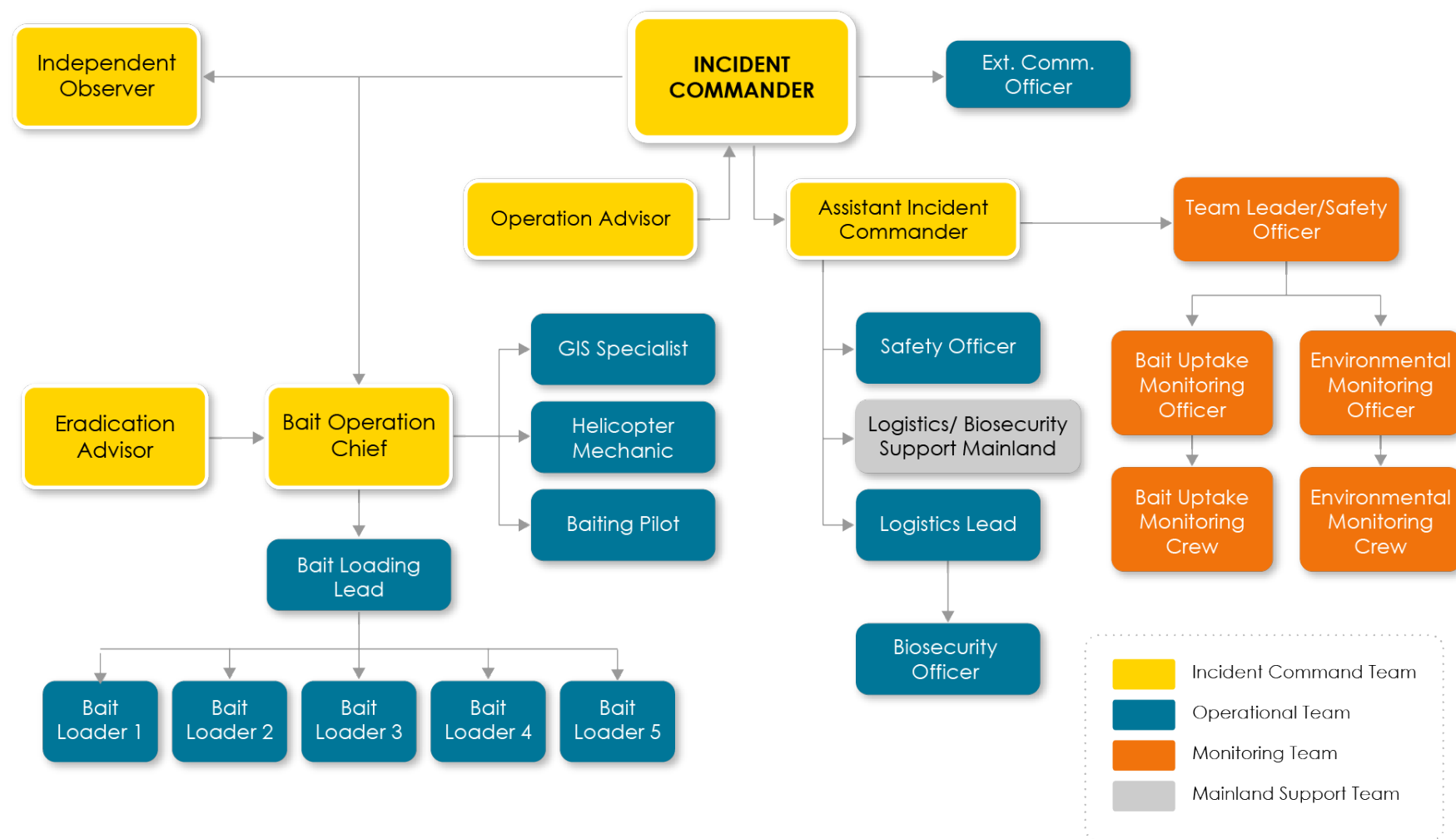
Pre- Application Activities

Operational activities must be completed before bait application

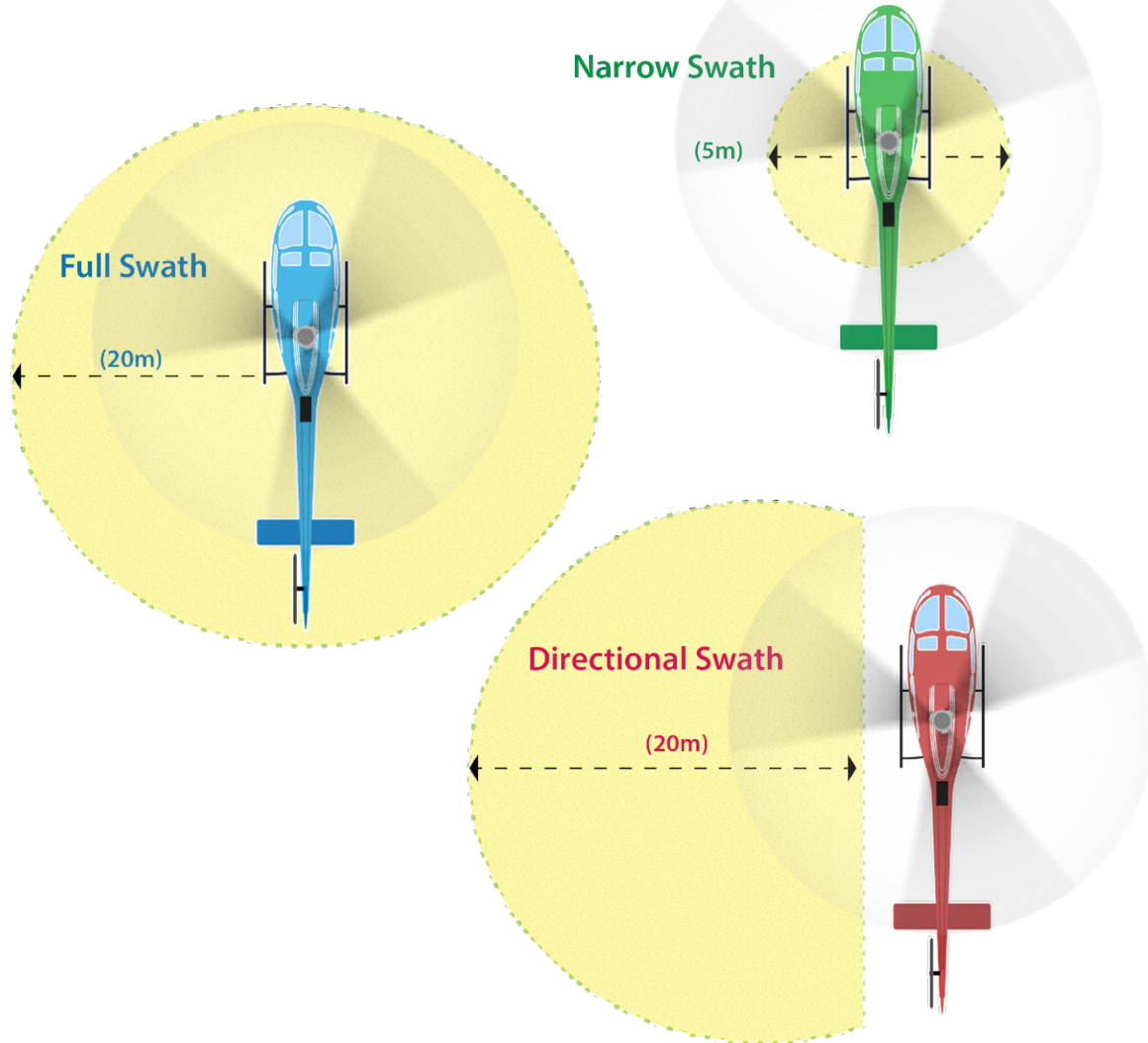
- Purchasing bait and materials
- Preparing contracts/agreements for all operational aspects, including appropriate helicopter support, aviculturist, and veterinarian
- Constructing aviaries (e.g., burrowing owl, peregrine falcon) and on-island capture-and-hold trials
- Mapping helicopter lines
- Improving island biosecurity quarantine procedures
- Establishing all pre- and post-application monitoring program protocols



Typical Incident Command Structure



Bait Application

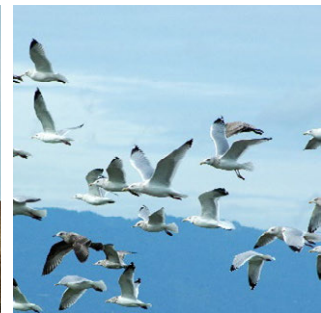
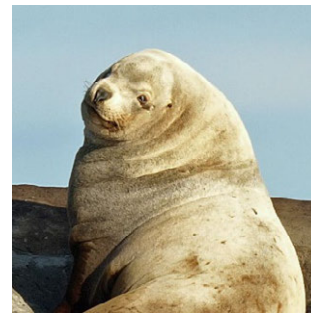
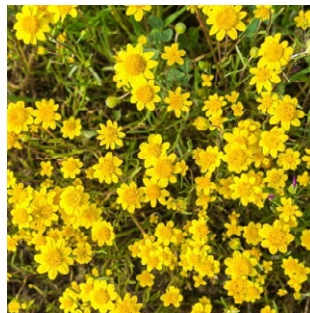
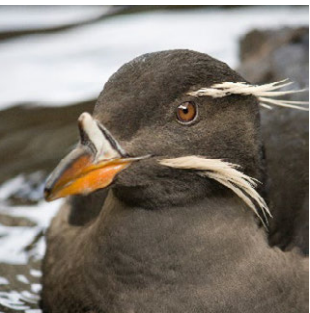


- Dose rate, bait direction and swath width can all be controlled within set limits.
- Differential GPS to guide the helicopter along a set of pre-determined flight transects.
- Plots of the actual path flown will be inspected in real time to ensure complete coverage.
- Variable swaths allow effective baiting on different terrains without baiting marine environment.



Protective Measures

Ensuring minimal impact on island ecology



Protective Measures

- Operations
- Timing
- Gull hazing
- Capture of birds of prey
- Capture of salamanders
- Carcass removal
- Monitoring and adaptive management



Protecting wildlife and habitats during operations



Tools for Gull Hazing

Treatment Type

Product Examples

Biosonic

bird distress calls; varying sound patterns

Pyrotechnic

cracker shell, screamer rocket, cannon

Laser

penlight laser, avian dissuader laser

Mechanical

human, helicopter

Passive visual cues

gull effigy, owl decoy, mylar tape

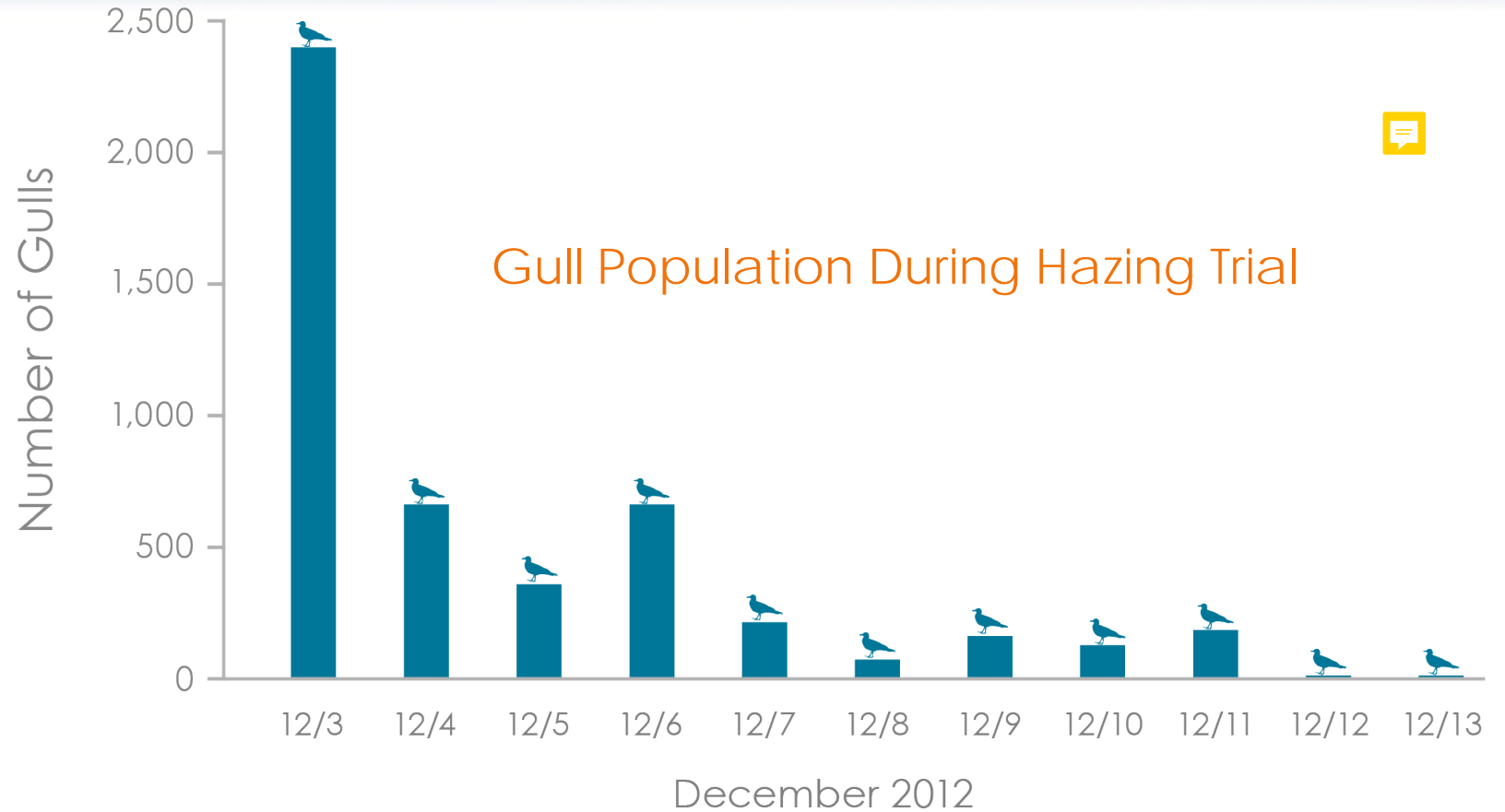


Laser used to haze roosting gulls from
Sugarloaf at dusk



Gull Hazing Success

During hazing trials, gull numbers declined from as high as 2,500 gulls to ~0, and nearly all those gulls were successfully hazed from the Farallon Island.





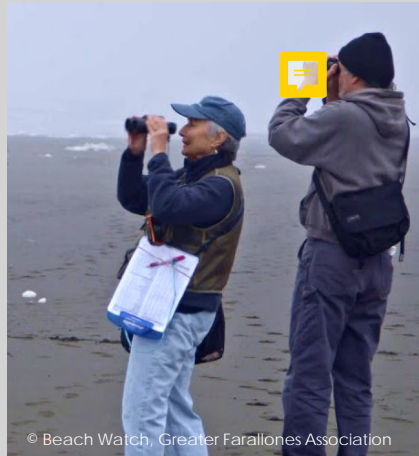
Late Fall/Early Winter
major gull roosting
areas on Southeast
Farallon Island



Eradication Monitoring

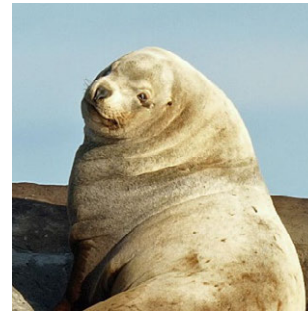
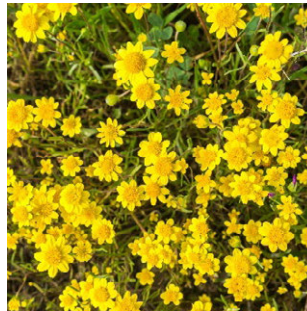
Monitoring operations will include the following:

- Bait application rates
- Bait uptake by mice
- Birds
- Salamanders and camel crickets
- Intertidal invertebrates
- Subtidal fish, invertebrates
- Water
- Soil
- Mainland beach watch



Contingencies

Identifying triggers and contingency responses to minimize impact on nontarget resources



Nontarget impacts to terrestrial or marine biota



Outline the triggers the U.S. Fish and Wildlife Service will use to identify the need for response action and the contingency responses that will be put in place to minimize the consequences of eradication activities to nontarget biota.

- Identify potential deficiencies in gull hazing program.
- Respond to monitoring results indicating that significant impacts to a species' population or exceedance of allowable take by permit seem likely to occur under current conditions.
- Follow Incident Command structure.
- Include list of action options.



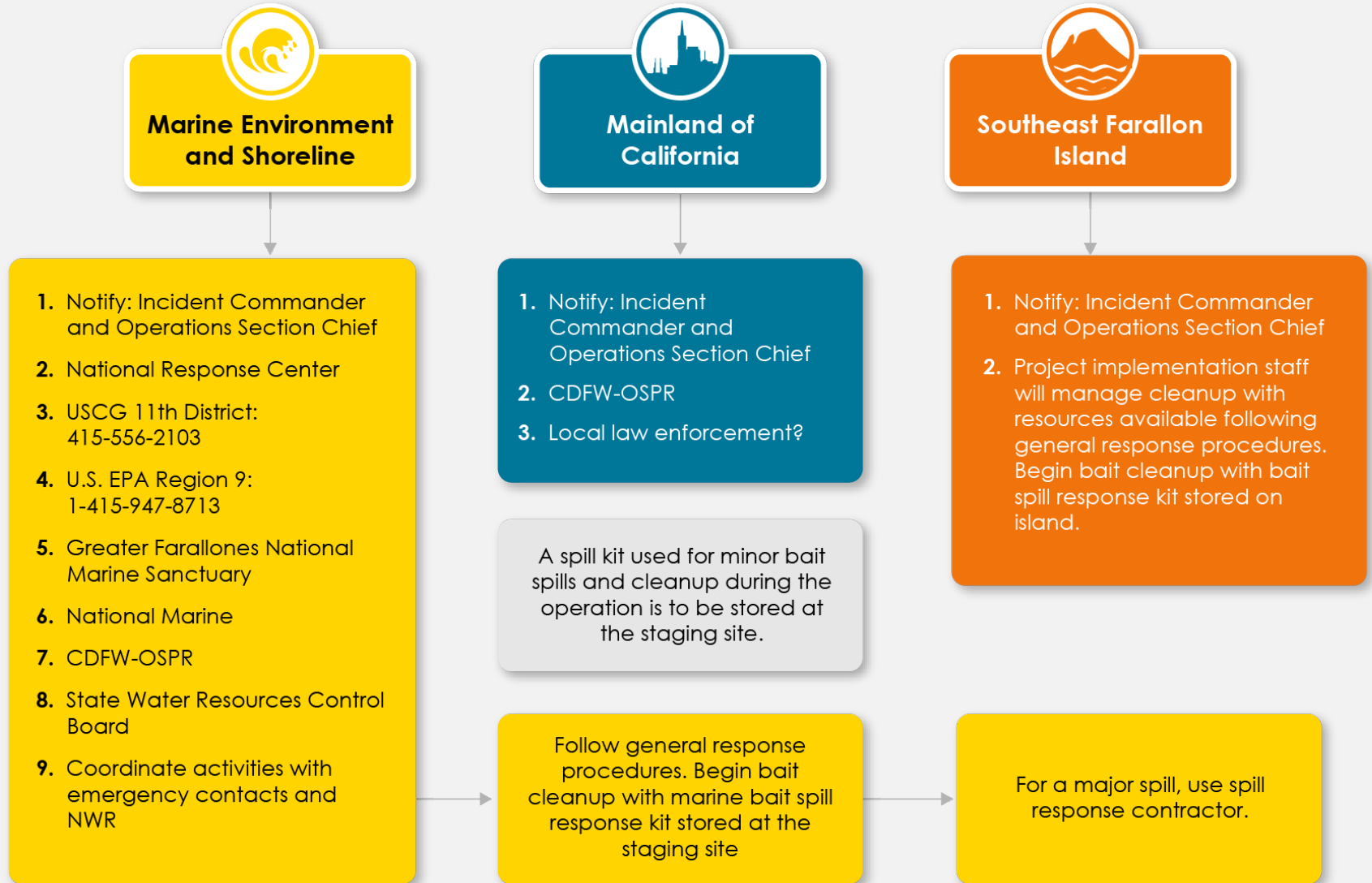
Bait Spill

Key Items of a Spill Response Plan

- Description of responsibilities
- Precautions
- Response activities
- Notifications

Response Resource and Preparedness Activities

- Equipment, supplies, services, and personnel
- Communications and control
- Preparedness activities



Bait Spill



SCENARIO

PRECAUTIONS

RESPONSE

Bait Enters Marine Environment

- Bait in secure water-resistant containers
- Shipping only when sea conditions are suitable
- Helo off loading only when conditions are suitable
- Only one bait container airlifted at a time
- Container attached by at least two straps that individually exceed maximum capacity limits of load
- Aviation, maritime, and shipping regulations followed
- Flight log maintained

- National Response Center and other Federal and State authorities notified immediately
- All possible attempts made to determine a safe and feasible way to recover the bait container(s)
- USFWS staff document the coordinates of spill and support response authorities to recover lost container(s)
- Spill kits carried onboard vessels transporting bait

Bait-Spreading Bucket Lost into Marine Environment

- Spreader bucket not loaded over capacity
- Helo not loaded over capacity
- Aerial bait spread only when conditions are suitable
- Experienced pilot
- Helo remains within 200 m of land
- Bucket attached by at least two straps that individually exceed maximum capacity limits of load
- Aviation regulations followed
- Flight log maintained

- National Response Center and other Federal and State authorities notified immediately
- USFWS staff document the coordinates of spill and support response authorities to recover lost bucket and any uncontained bait
- Spill kits carried onboard vessels transporting bait

Bait-Spreading Bucket Spilled into Terrestrial Environment

- Spreader bucket not loaded over capacity
- Helo not loaded over capacity
- Containers placed on stable, flat surfaces
- Sufficient number of personnel used
- Aerial bait spread only when conditions are suitable
- Experienced pilot
- Bucket attached by at least two straps that individually exceed maximum capacity limits of load
- Aviation regulations followed
- Flight log maintained

- USFWS staff document spill location and initiate bait recovery
- Spill kit available on Southeast Farallon Island

Nontarget Impact Scenarios



Scenario 1

~~Hazing not effective prior to broadcasting bait~~

Potential Triggers

Daily hazing effectiveness less than XX %.

Greater than XX # of gulls present on the island for a significant period of time (e.g., more than 30 minutes).

Potential Response

• Increase hazing effort or modify methods.

• Delay broadcast until sufficient hazing success is achieved.

Last resort action: Cancel rodenticide bait application and re-evaluate project.

Scenario 2

Hazing effectiveness declines after bait application (1st or 2nd application)

Potential Triggers

XX # of gulls observed consuming bait pellets or roosting in baited areas.

Discovery of XX # fresh gull carcasses showing signs of rodenticide poisoning.

Potential Response

• Increase hazing effort or modify methods (i.e., more pyros, more effigies, more human presence).

• Reduce bait exposure by manually collecting or destroying pellets in difficult-to-haze areas.

Last resort action: Manually collect or destroy pellets across all accessible areas.
Cancel second bait drop if Scenario 2 occurs between 1st and 2nd bait application.

Nontarget Impact Scenarios

(continued)



Scenario 3

Sick, dying, or dead gulls, suspected of being poisoned, observed in tourist areas

Potential Triggers

More than five dead or dying gulls are reported within a 5-day period from one location.

More than 10 dead or dying gulls are reported within a 5-day period from one location within the City of San Francisco other than on a beach.

More than 25 dead or dying gulls are reported within a 5-day period from one location within the City of San Francisco other than on a beach.

Dead or dying gulls are being reported in several areas.

Potential Response

- Staff or trained volunteer(s) is dispatched to collect the birds (if possible) and conduct a survey of the area for additional birds, which also would be collected. Birds would be taken to a previously identified facility for necropsy and collection of tissue samples for analysis of anticoagulant rodenticide. Carcasses would then be incinerated.

- Surveys of other nearby tourist areas are conducted for the presence of dead or dying gulls suspected of anticoagulant rodenticide poisoning.

- Facility is notified to report any other dead or dying birds suspected of anticoagulant rodenticide poisoning.

- Standardized surveys are designed and conducted within popular tourist areas for the presence of dead or dying gulls suspected of anticoagulant rodenticide poisoning.

- Dispatch press release that dead or dying gulls have been observed at certain tourist areas. Include information about what to do if a dead or dying gull is found, including keeping pets away from potentially poisoned wildlife.

Nontarget Impact Scenarios

(continued)



Scenario 4

Hazing results in pinniped take that is likely to exceed allowable numbers

Potential Triggers

Pinniped take (especially flushing) is significantly higher than expected.

Stampeding behavior is observed.

Pinniped take limits for one or more of the five species may be met.

ANY pinniped mortality is observed.

Potential Response

- ▶ • Modify hazing methods (i.e., use fewer pyros).
- ▶ • Reduce hazing in the areas that are most sensitive to pinniped take.
- ▶ • Consult with NOAA and the Marine Mammal Laboratory to increase take limits.
- ▶ • Eliminate hazing near major pinniped haul-outs areas.

Last resort action: Cease all hazing activity.

Note: This may be required if any pinniped mortality is observed.

Nontarget Impact Scenarios

(continued)



Scenario 5

Bait application operation results in high pinniped take that is likely to exceed allowable numbers

Potential Triggers

Pinniped take (especially flushing) is significantly higher than expected.

Stampeding behavior is observed.

More than 25 dead or dying gulls are reported within a 5-day period at one location within the City of San Francisco other than a beach.

ANY pinniped mortality is observed.

Potential Response

- ▶ • Modify rodenticide bait application methods.
- ▶ • Increase altitude of helicopter for aerial applications.
- ▶ • Notify facility to report any other dead or dying birds suspected of anticoagulant rodenticide poisoning.
- Restrict helicopter activity to areas without high concentrations of pinnipeds. Hand-bait those areas if accessible.
- Reduce hazing in the areas that are most sensitive to pinniped take.
- Consult with NOAA and the Marine Mammal Laboratory to increase take limits.
- Eliminate baiting near major pinniped haul-out areas.

Last resort action: Cease all bait application activity.
Note: This may be required if any pinniped mortality is observed.

Nontarget Impact Scenarios

(continued)



Scenario 6

Sick, dying, or dead marine fish suspected of being poisoned

Potential Triggers

An individual crab or fish sample tests positive for anticoagulant rodenticide between first and second bait applications or following the second bait application.

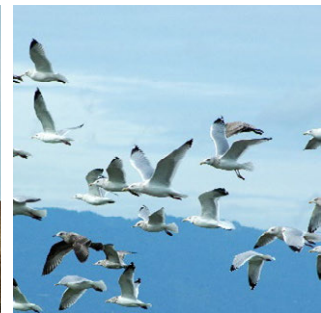
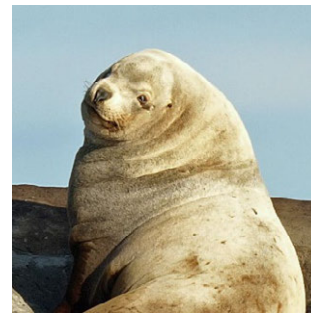
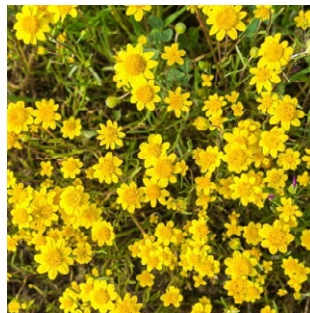
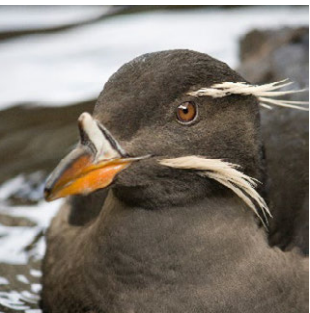
Five or more crabs or fish test positive for anticoagulant rodenticide between first and second bait applications or following the second bait application.

Potential Response

- Immediate notification of USFWS, CDFW, and NOAA personnel.
- Consider implementing protocol to collect additional samples for immediate analysis of anticoagulant rodenticide.
- Conduct eradication team meeting to discuss improved baiting strategy to further minimize bait drift.
- Consult with CDFW and NOAA to determine communication with fishing community.
- If warranted, meet with Federal, State, and local agencies and fishing community to discuss potential fishery action.
- Consider implementing protocol to collect additional samples for immediate analysis of anticoagulant rodenticide; consider expanding geographic scope or diversity of marine species within sampling program.
- Consider cancelling second bait drop.

Success Stories

Past successes for rodent eradication on islands



SUCCESS STORY

Ancapa Islands

Benefits Achieved:

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SUCCESS STORY

Hawadax Island

(Formerly known as Rat Island)

Benefits Achieved:

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Worldwide Mouse Eradication

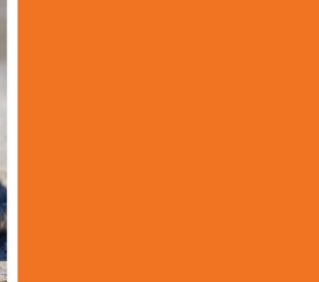
- **57** successful mouse eradications worldwide since 1971
- **>600** successful rodent (rats or mice) eradications worldwide
- **Nearly 100%** successful since 2007 (at least 28 of 32 attempts)
- **5** eradications in U.S. (all rats):
 - Anacapa Island (Channel Islands NP, CA)
 - Midway Atoll & Palmyra Atoll NWRs (U.S. Pacific Islands)
 - Hawadax/Rat Island (Alaska Maritime NWR, AK)
 - Desecheo NWR (Puerto Rico)





Organizations in Support of the Farallon Island Invasive House Mouse Eradication Project





Restore & safeguard
one of the most ecologically
important island
ecosystems in
the world.

