PROJECT BRIEF

Santa Cruz Island Biosecurity:
Development of a Comprehensive Plan to Restore and Maintain Island Biodiversity

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SANTA CRUZ ISLAND PROJECT OVERVIEW

Santa Cruz Island (SCI), the largest of the Channel Islands off the Southern California coast, is characterized by its remarkably unique ecosystem and habitat. SCI is home to over 1,000 species, 60 of which are endemic to the Channel Islands. In 1978 The Nature Conservancy (TNC) acquired the western 78% of SCI, and in 1980 the eastern portion of the island was converted into the Channel Islands National Park along with 4 other islands in the Channel Islands chain. Currently, SCI is managed jointly by the National Park Service (NPS) and TNC with the common mission to protect native ecosystems and species diversity.

An important part of protecting this unique ecosystem is the management of invasive species. Historically, SCI management has been forced to take a fairly reactionary approach in response to the introduction of non-native species to the island. TNC alone has spent more than $11 million dollars in the past 10 years eradicating invasive species and attempting to restore and protect endemic island biodiversity. The purpose of this group project is to inform a more proactive approach to invasive species management through the development of a more effective and cost justified prevention plan.

Deliverables:

- A framework for the evaluation of risk
- A database with prevention protocols, and their costs and effectiveness
- Protocol recommendations based on current priority species
- Rapid response plans for key species
- A review of educational techniques

BACKGROUND RESEARCH

Invasive Species Impacts

Invasive species are a major cause of species extinctions worldwide (Vitousek et al. 1996). Island biota is thought to be more prone to the effects of non-native species invasions due to the geographic isolation under which they evolved. There are both biological and economic costs associated with invasions. Biosecurity plans are developed in order to prevent and mitigate these impacts.

Biosecurity

Biosecurity is the application of protocols and policies to protect an area or a population from biological harm, premised on the concept that an ounce of prevention is equal to a pound of cure. Biosecurity is a multifaceted process that generally consists of research, risk prioritization, prevention protocols, early detection, rapid response, education, eradication, and review. For this project, we focused on risk prioritization and prevention protocol evaluation.

Risk Management

The risk associated with invasive species is the magnitude of the ecological consequence resulting from an invasion, weighted by the likelihood that the species will become invasive (Bartell & Nair 2004). Risk management is the process of identifying or establishing control factors that can change the magnitude and likelihood of these consequences in order to achieve a net benefit (Purdy 2010).

BIOSECURITY DECISION PROCESS

We developed the following process to identify invasive species targets and inform the selection of appropriate management action (Figure 1):

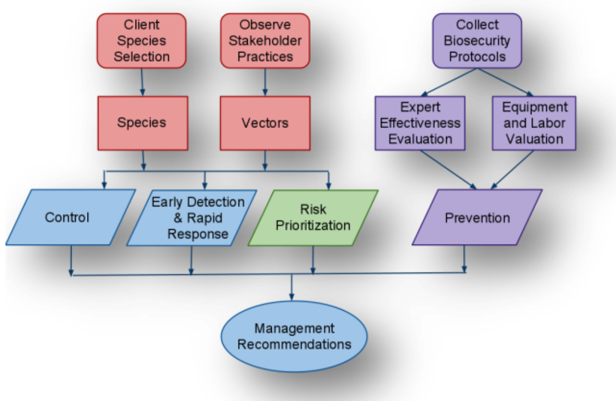

Figure 1. Process for developing a biosecurity plan.

1) Species and Vector Characterization

The first step in biosecurity decision making is to identify and characterize the potential threats. Threat species are identified using literature reviews and communication with local and regional experts about existing and emerging threats. Information outlined in each species characterization includes a physical description, natural and invasive range, habitat, dispersal, historical impacts, introduction pathways to SCI, options for eradication or control, and the costs associated with these efforts where available. Vectors are selected based on historical introductions for the selected species and current stakeholder practices.

2) Risk Prioritization

The risk posed by each species is based on its ability to be introduced and establish on the island, and the potential impact on the ecosystem. We developed a risk evaluation worksheet in order to assess the risk posed by each species-vector combination and rank those risks relative to each other. The evaluation worksheet is based on the steps of the invasion process for a species to become invasive. The tool consists of two sections representing the probability of establishment and the magnitude of consequences. Each section has preliminary criteria for analysis, which serve to screen out those species that are not a threat, and subsections representing the controlling factors for the section overall. Each section receives its own score of High, Medium, or Low. Scores for probability of establishment and magnitude of consequence are multiplied together to get a score for the risk of the species-vector combination to SCI (Figure 2). Each unique value represents a different level of risk. Uncertainty in the evaluation process is made explicit and typically treated with a precautionary approach.

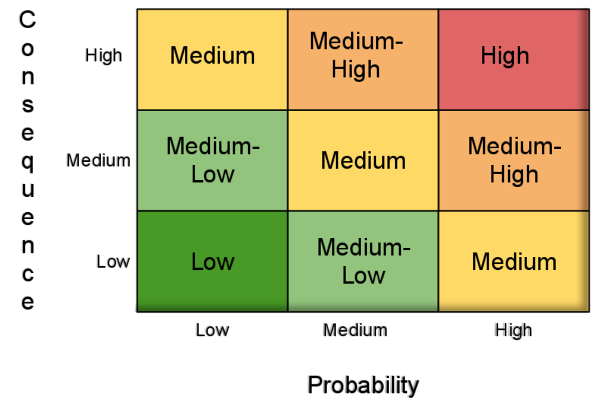

Figure 2. Risk categories on a probability x consequence matrix

3) Protocol Evaluation

Prevention protocols are management actions that reduce the risk of introduction of an invasive species. Prevention protocols are gathered from existing biosecurity plans and species-specific best management practices. They are evaluated on three criteria: the degree of risk from the species being prevented, the effectiveness, and its cost.

4) Decision Making

Risk can be reduced either by reducing the probability of invasion through prevention protocols or by reducing the consequences through early detection, rapid response, control or eradication. Reducing the probability of introduction is chosen when available protocols are able to prevent species of high risk, are effective, and have a reasonable cost given any budgetary restrictions. Reducing consequences is chosen when the vectors for introduction cannot be fully addressed through protocols, when the cost of effective control or eradication is lower than the cost of prevention, or when introduction risk is too low to justify preventative action.

PROCESS OUTCOMES

Species and Vector Characterization

Threat species were identified by TNC and NPS (Table 1). Vectors relevant for each priority species were identified through literature review, expert consultation, and review of stakeholder practices (Table 2).

Microorganisms/Fungi

- Canine Diseases: Distemper (Morbillivirus Canine Distemper Virus); Rabies (Lyssavirus rabies); Parvovirus
- Earthworms
- Planarians (*P. manokwari*)
- Sudden Oak Death (*Phytophthora ramorum*)
- West Nile Virus (*Flavivirus West Nile Virus)*
- Chytrid fungus (*Batrachochytrium Dendrobatidis*)

Terrestrial Plants

- Cape Ivy (*Delairea odorata)*
- Fountain Grass (*Pennisetum setaceum)*

Terrestrial Animals

- Argentine Ants (*Linepithema humile*) re-invasion
- Red Imported Fire Ants (*Solenopsis invicta*)
- Gold-spotted oak borer (*Agrilus coxalis)*
- Cats *(felis catus)*
- Raccoons (*Procyon lotor*)
- Rats (*Rattus sp*)
- House Mice (*mus musculus*)
- NZ Mud Snail (*Potamopyrgus antipodarum*)
- Squirrel (*Sciurus* sp)

Table 1. The species selected by TNC and NPS.

Potential Vectors

Aircraft	Lumber
Animals	IPCO boats
Bulk soil	NPS boats
Containers	Personal gear
Staff & Contractor footwear	Plants
Dumpster	Private boats
Firewood	Vehicles
Visitor Footwear	Wind
Foodstuffs	Water

Table 2. Vectors to SCI.

Risk Prioritization

Using the risk evaluation tool, each of the vector-species combinations of concern was assigned a risk score. The species of highest priority are those with a high risk and these species will be the first to have management action determinations made for them (Figure 3).

Protocol Selection, Evaluation, and Database

Protocols have been gathered from the following biosecurity plans which are currently being implemented elsewhere:

- Chatham Islands Biosecurity Strategy Draft
- Codfish Island-Whenua Hou Biosecurity
- Non Native Species Prevention Plan for Channel Islands National Park
- Rangitoto/Motutapu Biosecurity Plan
- Southland Conservancy Island Biosecurity SOP Best Practice Manual
- Southland Conservancy Island Biosecurity Plan

High Risk

Cape Ivy: Aircraft, animals, bulk soil, misc. equipment and supplies, personal gear, vehicles, and water
Domestic cat: Dumpster
West Nile Virus: Animals
Rabies (other wild animals): Dumpster
Rabies (raccoons): IPCO, NPS, and private boat
Canine Distemper (raccoons): IPCO, NPS, and private boat
Parvovirus (domestic animals): Private boat
Parvovirus (raccoons): IPCO, NPS, and private boat
New Zealand Mud Snail: Staff and contractor footwear, misc. equipment and supplies, and vehicles
Raccoon: Dumpster
Rats: Aircraft, container, dumpster, IPCO boat, NPS boat, personal gear, and private boat

Figure 3. High risk species-vector combinations

Effectiveness was determined through consultation with biosecurity experts who currently implement these strategies. Experts categorized protocols as effective, recommended, not effective, infeasible, or no information. Preliminary cost estimates have been determined based on market cost of equipment and the estimated labor cost of implementation.

A Microsoft Access database has been created to organize information about all of the protocols initially gathered for this project. The database is used to categorize protocols that could be useful on SCI based on effectiveness, cost, and risk priorities. The database can be updated with new information about protocols, species, and vectors in order to better inform management decisions.

Decision Making

Recommended protocols were selected to reduce risk at all high risk species-vector combinations for the lowest cost, while choosing protocols that were recommended by experts wherever possible.

EFFECTIVE PUBLIC EDUCATION

TNC hopes to augment their prevention protocols with a public education campaign for all island visitors, particularly the recreational boating community, advocating the importance of preventing invasive species introductions. We drew on literature from the marketing field and from studies that examine the efficacy of public education campaigns to provide a review of recommended techniques to assist in this effort. We also developed a survey to gauge the attitudes and knowledge of the private boating community which is currently being administered. Survey responses can be used as the basis for education strategies. Posters were developed to advertise this survey and the permitting process for the island. We included additional educational prevention protocols in our recommendations.

CONCLUSIONS

- Management decisions will be based on individual risk tolerance of managers and financial feasibility. This decision process will allow managers to prioritize biosecurity risk and determine the appropriate management action.
- Risk assessment provides a logical framework for analyzing potential species threats to Santa Cruz Island and is a method for prioritizing management action.
- Data regarding the effectiveness of individual prevention protocols, biosecurity plans, and the costs associated with eradication and control is rare and would greatly improve the ability for mangers to make informed biosecurity management decisions.
- New information about invasive species, biosecurity technologies, techniques, and calculating risk will become available in the future. It is important to reevaluate and incorporate changes into the existing plan according to these new innovations.

NEXT STEPS

Going forward, TNC and NPS will be responsible for deciding which protocols to implement and how to compliment them with other aspects of biosecurity. We recommend that island managers implement an audit and review process on an annual or biennial basis to incorporate new information using the tools presented here and update the plan based on the observed effectiveness of protocols and changes to priorities. The audit and review process would include assessing new threats, evaluation of the current plan, an internal audit of stakeholder compliance, and a passive adaptive management program, which includes monitoring, evaluation of results, and incorporation of new information.

New threats are certain to arise, as are new techniques for preventing, monitoring, and controlling individual species. The tools presented here can continue to be used to make decisions when circumstances change, however, it is important to note that the output of any future analysis using this method will be only as good as the information that goes into it. The steps outlined to develop or amend a biosecurity plan are meant to guide the necessary research about species and island biology and ecology, analysis of cost and effectiveness of potential actions, and communication between agencies. Therefore, the utility of this process is not that it is a perfect recipe, but rather, that it identifies the information that must be made explicit in biosecurity plan development.

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http://bren.ucsb.edu/~santacruz