

## The Problem



Map of Santa Cruz Island and its location along the California coast. TNC manages 76% of the island. The remaining 24% is part of Channel Islands National Park.

Santa Cruz Island (SCI) is a unique island ecosystem managed jointly by the National Park Service (NPS) and The Nature Conservancy (TNC) with a common mission to protect native ecosystems and biodiversity. This relies in part on the management of invasive species, a biological threat to which island species tend to be particularly sensitive. To date, managing this threat has been done in a largely reactive manner, through the eradication of invasive species and restoration of native populations at a cost of \$11.4 million over ten years from TNC alone. Island managers are in need of a more cost effective way of managing invasive species risks.

## Biosecurity

The purpose of this group project is to inform the development of a proactive approach to invasive species management through the development of an island biosecurity plan. Biosecurity is the application of protocols and policies to protect an area or a population from biological harm. Within the field is the concept that an ounce of prevention is equal to a pound of cure, or that preventative policies will be a more cost effective than reactive ones. For this project, we focused on developing a framework for determining risk, prioritizing action, and evaluating prevention protocols.

### Biosecurity consists of:

- Research
- Risk prioritization
- Prevention protocols
- Early detection
- Rapid response
- Education
- Control & eradication
- Audit & review

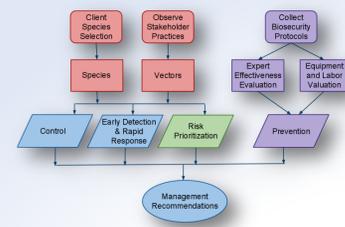


Left: Previous reactive invasive species management approaches required the capture and captive breeding of the island fox population while golden eagles were removed from the island. Center: Current proactive biosecurity measures include educating private boaters about biosecurity through the permit process and transporting rodent proof packaging to the island and (Right).

## 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 (Purdy 2010). Given budgetary restraints, the challenge is to prioritize species for management action based on the relative risks associated with their invasions (Stohlgren & Schnase 2006). This project has developed and completed the initial phase of an informed and repeatable framework for prioritizing the ecological risks to Santa Cruz Island posed by invasive species and an evaluation of the cost and effectiveness of potential management responses to those risks.

## Biosecurity Decision Framework



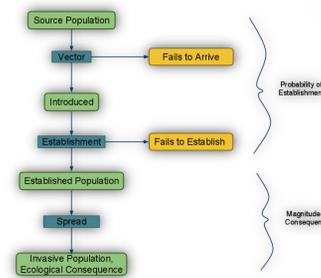
Conceptual model of the biosecurity plan development methodology

### 1. Species & Vector Characterization

The first step in biosecurity decision making is to identify potential threats based on the latest research on invasive species and threats present on nearby and similar locations. Background information on these species is gathered in order to identify what life history traits might make each species a threat to the island ecosystem. This includes the ability for the species to reach the island. The means by which a potential threat arrives on the island is referred to as a vector. Vectors were identified based on which vessels arriving on the island may have played a role in historical introductions for each threat.

### 2. Risk Evaluation & Prioritization

Next, species which could potentially threaten the island are ranked to determine which should be priority management targets. The risk posed by each species is based on the ability for the species to be introduced and established on the island and the impact it would have on the island ecosystem. Risk is vector-dependent, because the characteristics of a vector determines the frequency and magnitude at which the invader may arrive. We developed a risk evaluation process based on the steps of the invasion process in order to score the relative risk each species-vector combination would pose to the island.



Correlation between risk evaluation sections and the invasion process

|   |        |             |             |             |
|---|--------|-------------|-------------|-------------|
| C<br>o<br>n<br>s<br>e<br>q<br>u<br>e<br>n<br>c<br>e | High   | Medium      | Medium-High | High        |
|   | Medium | Medium-Low  | Medium      | Medium-High |
|   | Low    | Low         | Medium-Low  | Medium      |
|   |        | Low         | Medium      | High        |
|   |        | Probability |             |             |

Risk categories as seen on a probability by consequence matrix

### 3. Protocol Evaluation

Prevention protocols are management actions that reduce the risk of introduction of an invasive species. Prevention protocols were gathered from existing biosecurity plans and evaluated on three criteria: the degree of risk from the species being prevented, the effectiveness, and the cost. Effectiveness was determined through consultation with island resource managers who currently implement these strategies. As a result, protocols were categorized as: recommended, ineffective, infeasible, or no information. Cost estimates are based on labor requirements and market value of the necessary equipment.

### 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. Generally, prevention is considered to be more effective and less costly. However, managers can choose to wait to control when the vectors for introduction cannot be fully addressed through protocols or when the cost of effective control or eradication is lower than the cost of prevention.

## Framework Outcomes

The decision framework was used to create a draft biosecurity plan based on the evaluation an initial list of potentially invasive species, supplied by TNC. We evaluated the risk associated with all relevant species-vector combinations, selected a set of recommended protocols to effectively reduce high risks at the lowest cost, and identified species for which reducing consequences of invasion is more appropriate than reducing the probability of introduction.

This process is applicable for use with any set of priority species, budgetary requirements, or risk preferences and should be repeated when managers are presented with new information or new risks. A biennial review process is recommended including an internal audit of stakeholder compliance and a passive adaptive management process that reduces uncertainty through monitoring and the incorporation of new information.

### High Risk

- Cape Ivy:** Aircraft, animals, bulk soil, miscellaneous 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, miscellaneous equipment and supplies, and vehicles
- Raccoon:** Dumpster
- Rats:** Aircraft, container, dinghy, dumpster, IPCo boat, NPS boat, personal gear, and private boat



Vectors, from top: Dumpsters, Footwear, Island Packers Co boats

Risk Evaluation Results: High risk species-vector combinations to Santa Cruz Island. \*IPCo - Island Packers Company, a concessionaire that transports visitors to the island.

## Project 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

## 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 managers 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.



Website: <http://fiesta.bren.ucsb.edu/~santaacruz>

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