MAB-UNESCO
Status Report

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ESTABLISHING THE BASES FOR A LONG TERM STUDY ABOUT ENDEMIC BIODIVERSITY IN JUAN FERNÁNDEZ ARCHIPELAGO, CHILE.

Report from a preliminary visit and Fundamentals for a restoration and conservation project in Juan Fernandez Archipelago, Chile.

November, 2009

1. Introduction

The Juan Fernandez (JF) Archipelago is located 650 km west of the Chilean Pacific coast and it is made up of three islands: Robinson Crusoe (48 km^2), Alejandro Selkirk (50 km^2), and Santa Clara (2.2 km^2). In 1935, the Chilean Government declared these islands a National Park and in 1977 they became a UNESCO-approved Biosphere Reserve. Due to the extraordinary biotic endemism that characterizes these small volcanic islands, they are considered to be one of two of the world's mini-hotspots (along with the Galapagos) (Mitterier *et al.* 1999). The JF Archipelago presents the highest plant species richness in the smallest area on the planet (Arroyo *et al.* 1999) and is considered by WWF/IUCN as a Center of Plant Biodiversity.

Additionally, these islands have been classified as a highly threatened ecosystem and Bird Life International regards the conservation of its avifauna as a critical priority. For these reasons, the JF Archipelago has one of the highest priorities for biodiversity conservation in the world. The highly endemic flora (63%) and fauna (55% terrestrial birds) of the JF Archipelago have survived the devastating effects of numerous invasive species so far (Marticorena *et al*. 1998). Repeated burning, overexploitation of species, and the introduction of animal and plant plagues have 75% of the endemic vascular flora to the verge of extinction (Cuevas & Van Leersum, 2001). Goats, now numbering 3000-5000 and other animal herbivores such a rabbits (5000), and predators such as rats and feral cats have caused serious damage to native plants and animals (Arroyo *et al.* 1999), especially bird nests. Additionally, the introduction of exotic plants, which now number 195 species, is a serious problem due to the expansion rates of some species. The major threaten are, for one side, the reduction of the forest cover by the combined action of invasive species, and for the other side, the remoteness of the area that have limited many efforts to rescue species to prevent their extinction in their natural habitats.

Two important issues for the conservation of these island biodiversity need high attention. First, the problems caused by invasive species need urgent solutions. For instance the exotics *Rubus ulmifolius*, *Aristotelia chilensis,* and *Ugni molinae* have covered extensive areas of the Robinson Crusoe Island, and are displacing and reducing the area covered by the native forest. The rate of invasion, the magnitude of the forest displacement and the specific location where the invasion is heavier remains controversial or unknown. Second, the effect of exotic mammals, such as rabbits, rodents, feral cats, and coatis are affecting the vegetation and the fauna, but few studies quantified these effects despite the diary experience showed damage by mammals in both native birds and plants, by destroying regeneration, predating on seeds and on growing leaves.

Pioneering efforts have been done by the local park-rangers rescuing the last endangered plants to cultivate them into greenhouse, and in restoring the population of several of them. Local park rangers have conducted restoration assays and have controlled several invasive species in small areas, being the most remarkable the eradication of the European rabbit (*Oryctolagus cuniculus*) from the

Santa Clara Island. Another example such as the removal of large extensions of *R. ulmifolius* but after a couple of years the area was covered again. Despite the large number of studies conducted in these islands, most of them do not test management measures to promote the conservation of the biodiversity.

Finally, local knowledge, particularly the large efforts from park-rangers in protecting biodiversity, rescuing endangered species, growing them, restoring and controlling exotics remains in the anonymity, as results of the little valuation of their efforts, and the lack of training in monitoring methods, data analysis and in the stimulus to publish this knowledge. As result, local efforts are many times unconsidered in the analysis and planning of the conservation actions, and conservation efforts risk to be replicated.

In this project, we propose a plan to develop conservation actions in collaboration with local actors to:

i) Enhance the rescue and conservation of the highly endangered species
ii) Reduce and control the negative effects of invasive species
iii) Enhance local capacities and promote the valuation, synthesis, and publication of the knowledge obtained by the park rangers. The main goal is that park rangers were the main authors of their papers in collaboration with researchers

2. Activities conducted during the time project since March 2009.

1. 7 – 13 July, 2009. First Fieldwork in JF National Park.
We delimited the project objectives and their main activities in collaboration with the Park-rangers:

2. Data analysis and article develop Workshop. The JF Park-rangers have much knowledge about the endemic biodiversity, different findings like the presence of two new species and the extinction of one in the islands. In collaboration with them we will organize a workshop for to develop a first manuscript with their authority for one national magazine like Revista Gayana or Revista Chilena de Historia Natural. The workshop will be developing during the next fieldwork during January-February, 2010 by Dr. Iván Díaz.

3. We defined the priority investigations conducted to enhance the biodiversity conservation in JF National Park. Under several conversations (6 month), meetings, emails, telephone contact with the lieder of the park rangers in JF National park (Don Iván Leiva), with several scientists how have work in the islands, and also with Biodiversa Fundation, we delimited the aims project in terms to help the park ranger's necessities to reduce and control the negative effects of invasive species. We will analyze in collaboration with them the capacity of invasive species, like *Aristotelia chilensis* and *Rubus constrictus*, to colonize the gap forests under different environments in JF National Park (Robinson Crusoe Island).

4. We selected two new students for develop their thesis work under this project.

5. Participation in the International Meeting: Biodiversity Conservation in JF Archipelago organized by Biodiversa Fundation, November 2009. (http://biodiversa.cl/taller-internacional/introduction-workshop-purpose).

6. January – February, 2010. Second fieldwork in JF National Park. During one month field work in the Robinson Crusoe Island 6 persons will conduct two main activities in collaboration with the park rangers. First we will develop the Workshop to start to write an article with the data from park rangers, and second we will start with the field measurements to conduct our long term biodiversity study.

We propose the following hypothetical models of the major forces driving the lack of forest, and we will develop several experiments with actions to stop invasion, all of them testable and modifiable in function of the results obtained.

First, the major forces that drive the lack of native vegetation are herbivory and expansion of exotic invasive vegetation. In many areas, herbivory by large animals have been excluded by over 20 years. Hebivory by rabbits and rodents can vary depending of the type of environment. Rabbits usually avoid forest cover,

concentrating their activity in grasslands. From the information obtained by park rangers and aerial photograph comparisons between 1980 and 2006 (Iván Leiva comm. pers.), the major driver in the change of native vegetation is the expansion of invasive species, in particular the association between *Rubus* and *Aristotelia*, also *Ugni molinae*. All these species are fast growing species, which require open areas for germination and establishment, and for them, roads, trails, disturber areas, canopy gaps and grasslands represent suitable areas for colonization.

Then, the success in the invasion of the forest by exotics could be a function of:

Invasion = Edge + Distance + Bird dispersion + Gap + Trails + e

Where "Edge" represents the probability that in the edge between native vegetation and exotics, exotics overwhelm the native at some rate. "Distance" represents the intensity of the seed rain by gravity from the nearest source; "bird dispersion" represents the seed rain caused by birds; "Opening" represents the habitat where seeds are deposited; if its an open area the seed will germinate and invade, if it is under closed canopy the seed will not succeed; and "e" represents an error term.

1. Edge effect: In the edge between native vegetation and exotics, three processes could be happening: exotics overwhelm native displacing native vegetation; native vegetation could be overwhelming exotics, or the edge could stay static. To evaluate this process, we will establish plots counting the number of seedlings, saplings and adults of dominant woody species at the edge and at both sides. With this information we will model the movement of the edge along the time. If exotics overwhelm natives or if the edge stays without movement, we propose to increase the shade of the exotics by removing an area of at least 20 m wide of exotics and there planting fast growing trees, such as pines (that are already introduced in the island) all of the same sex to create an extra-edge between native forest and exotics. Managing this plantation with different treatments we will evaluate which conditions of plantation will more probably succeed in stop the advance of exotics on native forest.

2. Distance: The seed shadow will determine the probability of invasion from a source plant. In the plots defined in the point 1, we will evaluate the seed rain locating seed collectors, to analyze the shape and intensity of the seed rain into the forest. If the seed rain is heavy, the plantation along the edge proposed in (1) will have to consider this distance for defining the width of the tree plantation.

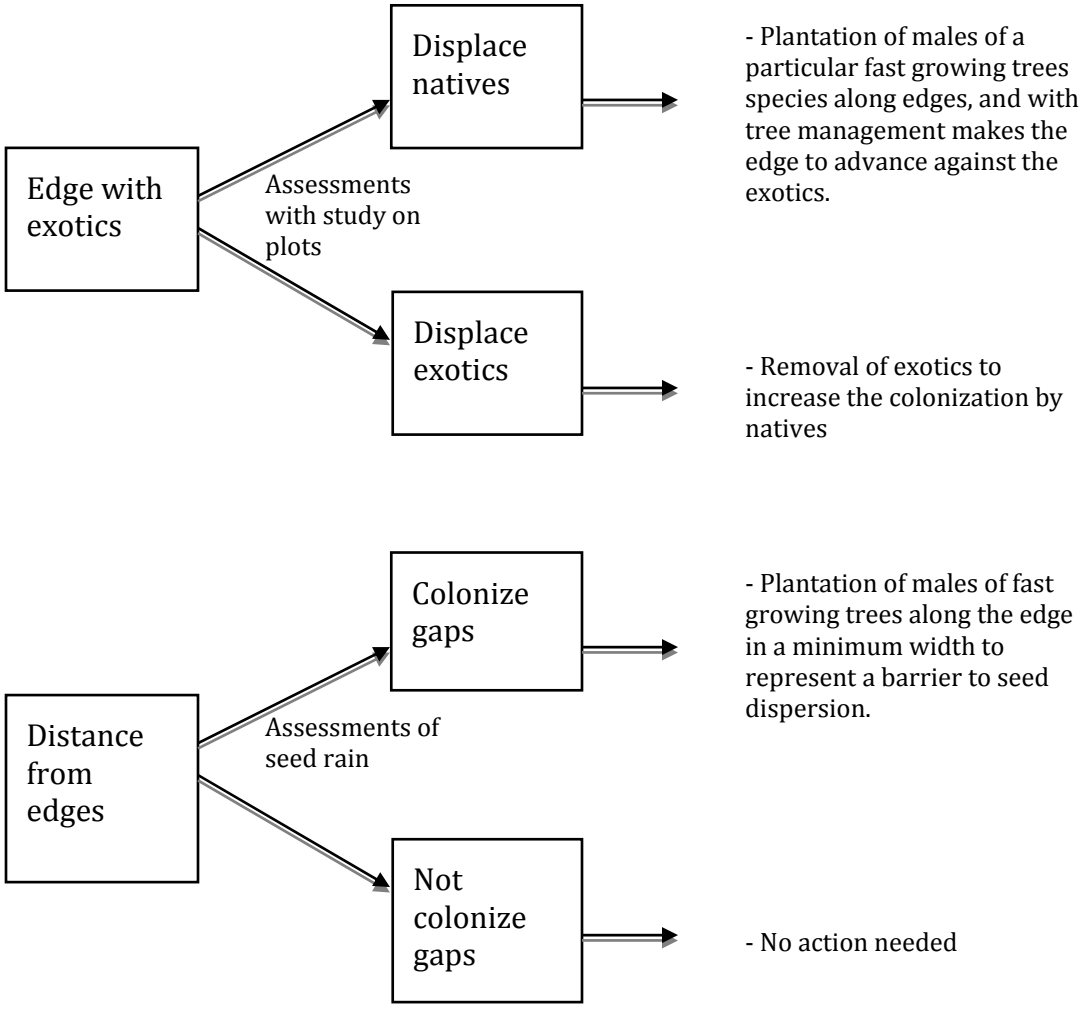
3. Bird dispersion: The Zorzal (*Turdus falcklandii*) is the only frugivorous bird present in the island, and is the only animal vector for both, native and exotic plant species. Then, if this species successfully disperse seeds into forest gaps, these seeds will successfully establish. However, this action could be a problem is in (1) the

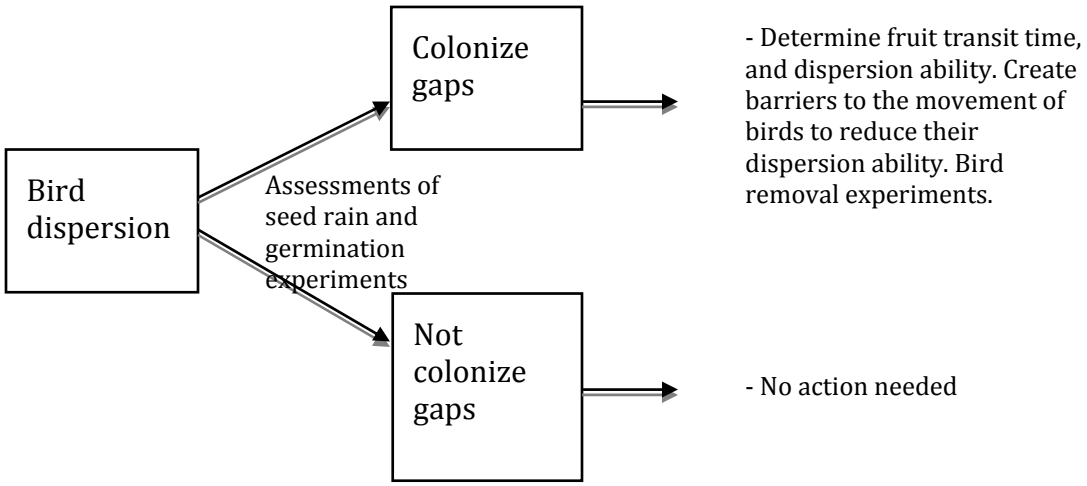
exotics overwhelm the native. Gaps are small areas, then if native forest overwhelm exotics in the gaps, no major management is needed

4. Gap: If seeds are deposited in openings, seed will germinate and establish. This could be a problem in forest gaps, but also in areas where vegetation is naturally low, such as in highlands, and in the top of the hills.

5. Trails: Many exotic plant species are spread by humans along the human trails. The main action is the permanent removal of exotics from the trails.

The terms of this model can vary depending on the location along the altitudinal gradient and along the climatic gradient present in the island, from the semiarid areas near the aerodrome, to the hyper-humid areas at middle altitude. The following model summarizes the questions and experiments to be conducted in this restoration project:





This simple model followed by studies, experiments and restoration actions will allow us to:

- Define priority areas for conservation actions

- Focalize the actions in the most important drivers in each site in particular, and combine actions for all sites.

- Developing adaptive management and restoration actions in the long term, with emphasis in invasive plants but completely compatible with other conservation actions such as removal of exotic mammals, combination of exotic and native plantations, and providing infrastructure to continue recruiting the most endangered species for their cultivation in the greenhouse and the establishment of new populations on new sites.

Annexes

Figure 1. Rabbit and Goal distribution in Robinson Crusoe Island (from Biodiversa Fundation)

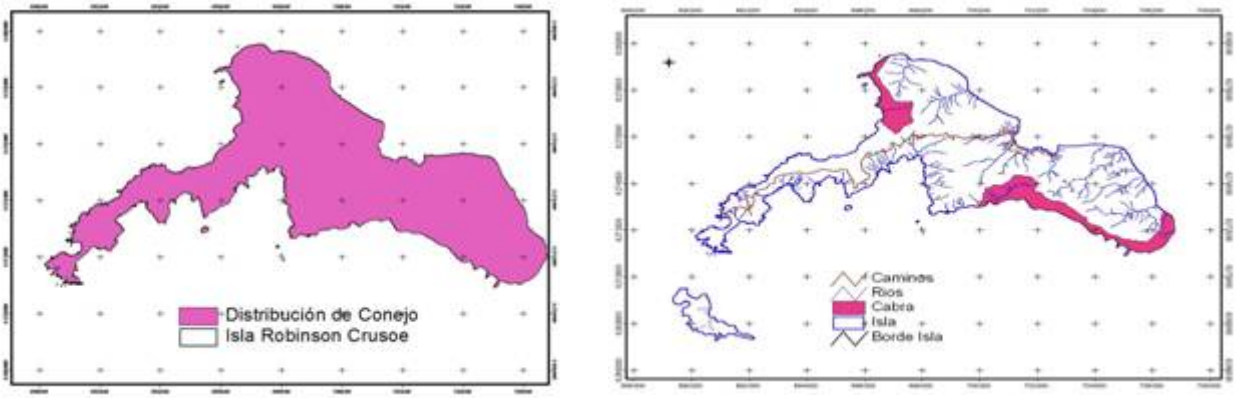
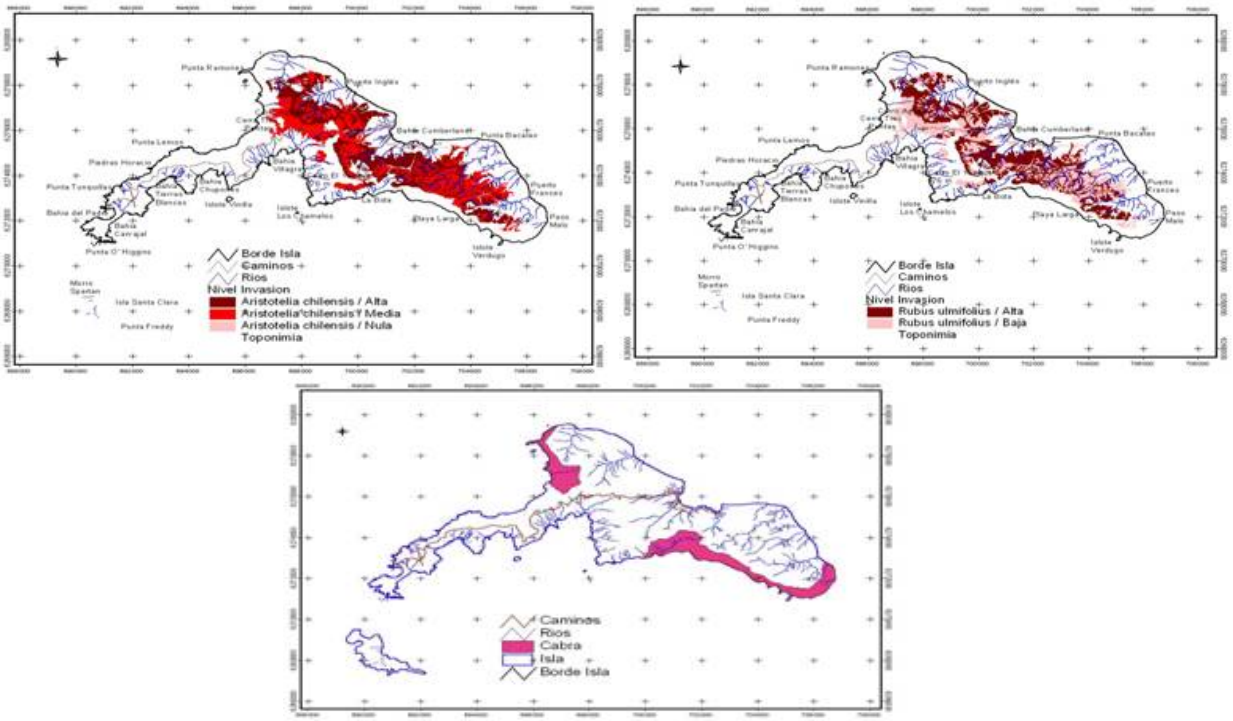


Figure 2. Aristotelia chilensis, Rubus ulmifolius, and Ugni molinae distribution in Robinson Crusoe Island (from Biodiversa Fundation)



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