ECUADOR CONSERVATION-MANAGEMENT PLAN 2014

With partners:

October 2013

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Section 1: Executive Summary

Projects Abroad is on the verge of signing a “convenio” (agreement) with the National Park office on San Cristobal formalising and cementing our working relationship for the foreseeable future. We are actively helping the government in many projects in order to assure that conservation management plans are made with a solid foundation. Data and its interpretation are fundamental in any conservation strategy and no one, to date, has started to compile databases on species numbers and population dynamics on the island. Our work is dedicated to improve conservation efforts and help the government draw up valid management strategies justified by visible data.

The ecosystems found on the Galapagos Islands are unique and the increased pressure of human encroachment is having a detrimental effect on individual species, many of which are only found on the islands. Whole ecosystems are under threat from alien species and feral animals. In conjunction with the National Parks Agency and the Ministry for Agriculture and Fishing, Projects Abroad has joined the battle to preserve the island’s ecosystem and is leading the way with new conservation initiatives and data processing.

Section 2: Background Information

Ecuador is divided into three continental regions: the Costa (coast), Sierra (mountains), and Oriente (east), and one insular region, the Galapagos Islands (officially Archipelago de Colon). The continental regions extend the length of the country from north to south and are separated by the Andes Mountains.

The Galapagos Islands are situated 1,000 km west of the Ecuadorian coast with a location of 1°40'N–1°36'S, 89°16'–92°01'W. They are famous for their association with Charles Darwin, whose observation of animals here during the voyage of the Beagle led to his formation of the theory of natural selection as a means of evolution. The islands are isolated from the mainland and rely heavily on revenues from tourism as visitors flock from all over the world to experience the unique ecosystems and endemic wildlife.

Section 2.1: Study Area

San Cristobal is the oldest yet smallest of the inhabited islands in the archipelago and 97% of the island is covered by the Galapagos National Park. Local agriculture and tourism cohabit but the pressures of conservation are not always understood and embraced by farmers struggling to survive on tough island terrain.

Projects Abroad is based out of the island's largest town, Puerto Baquerizo Moreno, where volunteers are immersed in local culture staying with host families.

Section 2.2: Weather and Climate

The Galapagos Islands experience a subtropical climate with two seasons dictated by the warm El Niño current and the cold Humboldt current. This produces a dry and wet season with annual temperatures ranging from a low of 15°C to a high of 32°C.

Section 2.4: Habitat

Flora

The volcanic history of the islands means that the landscape is covered by rocks and moving away from the beaches the topography starts to rise and dry forested areas dominate the landscape. On San Cristobal the main forest ecosystems were historically dominated by native species including *Calandrinia galapagosa*, *Lecocarpus darwinii*, and trees such as *Lignum vitae*. Introduced species are now taking over and plants such as guava (*Psidium guajava*), avocado (*Persea americana*), cascarilla (*Cinchona pubescens*), balsa (*Ochroma pyramidale*), hill raspberry (*Rubus niveus*), and the elephant grass (*Pennisetum purpureum*) are displacing the naturally occurring species. The Galapagos now hosts 700 invasive species of plant which outnumber the endemic and native species by 200. This is the cause of such concern and the need to restore the balance is imperative to any conservation effort on the islands.

Fauna

The Galapagos Islands host a wide number of endemic species which include the giant tortoise, sea lion, marine iguana and a host of birds. Darwin's finches (actually tanagers), number 13 species and are found only on the islands. Four species of mocking bird, the Galapagos hawk, Galapagos penguin and the flightless cormorant are some of the archipelago's other unique creatures. As a result of introduced species their numbers are declining and our work on the islands is dedicated to studying population dynamics. In other words, we know what is here but not how each species is adapting to the impact caused by human encroachment.

Section 3: Threats to the Area

The biodiversity of the islands is under threat from many sources. Human populations are growing at an unsustainable rate of 8% per year (1995) and the result of such growth is the necessity for more living space, more roads and increased demands for fresh water. Necessity from over population has increased pressure on the island's farmers who expand their ranches hoping to cash in on the added demands for poultry and beef. Feral cats and dogs abound on the islands and with no natural predators native species are becoming prey to their ever increasing numbers.

In 2007 Galapagos was placed on the List of World Heritage in Danger by UNESCO and whilst the actions of the Ecuadorian government has since led to its removal in July 2010 many issues still abound.

Increased tourism has led to more pressure on the islands' resources and the arrival of more ships to the archipelago has facilitated the introduction of new invasive species which threaten to overrun the islands and out-compete the native ones.

The marine ecosystems are suffering from climatic changes and El Niño is warming up the ocean. In 1997-1998 the average water temperature rose by 5°C and this caused huge damage as corals suffered, hammerheads moved on

looking for colder waters and the marine iguanas died in their hundreds as red algae blossomed and eliminated the green algae, their food source!

Over-fishing, to cater for the increased human population, is draining the ocean of its resources and increased boat activity is chasing fish away from their breeding sites.

Section 4: Overall Aim

The Galapagos Islands are under threat and whilst we cannot control factors such as global warming we can help on the ground and the agreement with the National Parks is fundamental in allowing us to implement our ideas and help mould conservation programs based on our experience and expertise. On San Cristobal we aim to aid in the removal of alien species, reforest areas with historically occurring plants and monitor the populations of the island's unique fauna. Comprehensive studies will allow us to better understand what is actually occurring in the ecosystem and better place us to advise on and implement further action in the national park.

The data we collect will enable us to design and suggest environmental awareness schemes directed at both local residents and visiting tourists.

Section 5: Research Projects and Ecological Monitoring

General Aim

All of the projects outlined below are designed to gather information and address environmental issues. If we work in an area to eliminate invasive species we must have a means to investigate the success of such endeavours. We must prove ideas and answer many questions- for example- does reforestation of endemic plant species have an immediate effect on populations of native animals?

Throughout our research and work we must quantitatively demonstrate that the projects are efficient and have the desired effect. Data collection and analysis is the only way to achieve this and Projects Abroad will be the first to actively couple data processing with established conservation practices here

on San Cristobal. In short, we are not just going to go ahead and do what everyone thinks is right but actually prove this to be the case. If some techniques are not very effective then this data will lead to modifications that can improve the efficiency of the work. This will benefit us, Projects Abroad, and, perhaps more importantly, the national parks agency. However, the ultimate beneficiary will be San Cristobal and its unique ecosystems!

Section 6: Galapaguera- Tortoise Breeding Centre

6.1: Aims

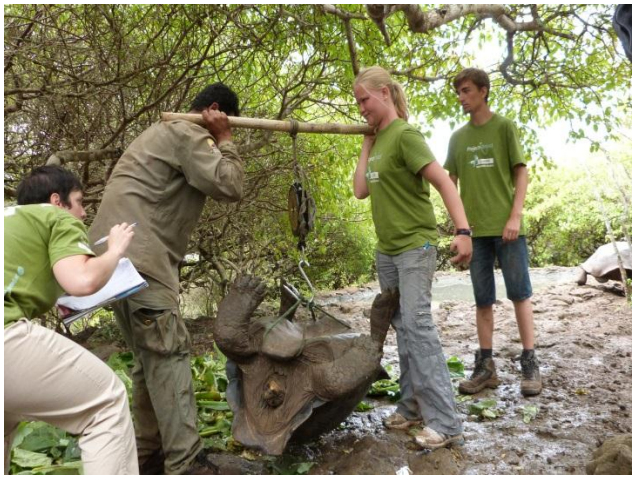
The icon for conservation in the Galapagos is the endemic giant tortoise (*Geochelone nigra spp.*) and on San Cristobal they can only be found in the wild in a protected area far from human contact. The Galapaguera is a breeding centre run by the National Park closer to Puerto Baquerizo Moreno and they require help. The centre maintains captive-bred hatchlings until five years old before transferring them to the wild site. The centre maintains a breeding population of 40-50 adult tortoises.

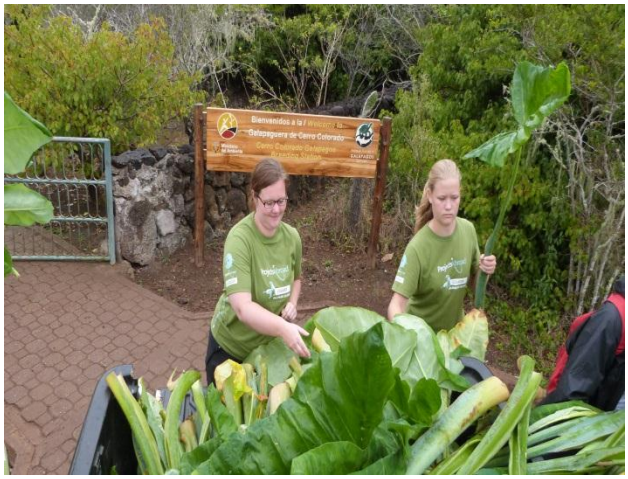
Volunteers participate in feeding the tortoises, cleaning the 2 hectare enclosure, taking biometric data and relocating the eggs to incubators.

6.2: Methods

At least once a week we take “otoi” plants to feed the animals and then clean their bathing pools. Raised walkways are maintained and alien plants removed. We perform censuses regularly to monitor the captive population and every three months biometric data is taken from the adults. In addition we actively help in the care of the baby tortoises; cleaning their pens, weighing the individuals and controlling the temperature of the egg incubators.

This project is a constant that we have committed to long term and has helped achieve better relations and trust with the National Parks authority. Activities can be performed by small numbers when volunteer numbers drop and volunteers enjoy learning about the species and its natural history.





Section 7: Alien Plant Removal/Native Plant Reforestation

7.1: Aims

The Galapagos Islands host over 500 endemic/native species of plant, all of which form an integral part of a very delicate ecosystem. Darwin's finches, 13 in total, have evolved to co-exist with these plants to the point of evolving specific bill shapes capable of feeding on certain seeds and fruits. Other native bird species also rely heavily on these endemic species and the presence of over 700 species of introduced plants is having a catastrophic effect on the islands' ecosystem. Projects Abroad is dedicated to help restore the ancestral balance by removing alien species and reforesting with endemic ones.

7.2: Method

Currently we are working on a large bluff known as Cerro Colorado and we are systematically clearing away invasive species. The bluff is separated into plots which are worked on systematically thus enabling us to reforest the whole area by stages. The government has set up a plant nursery about 500m from the site and volunteers work in the cultivating of saplings for future planting.

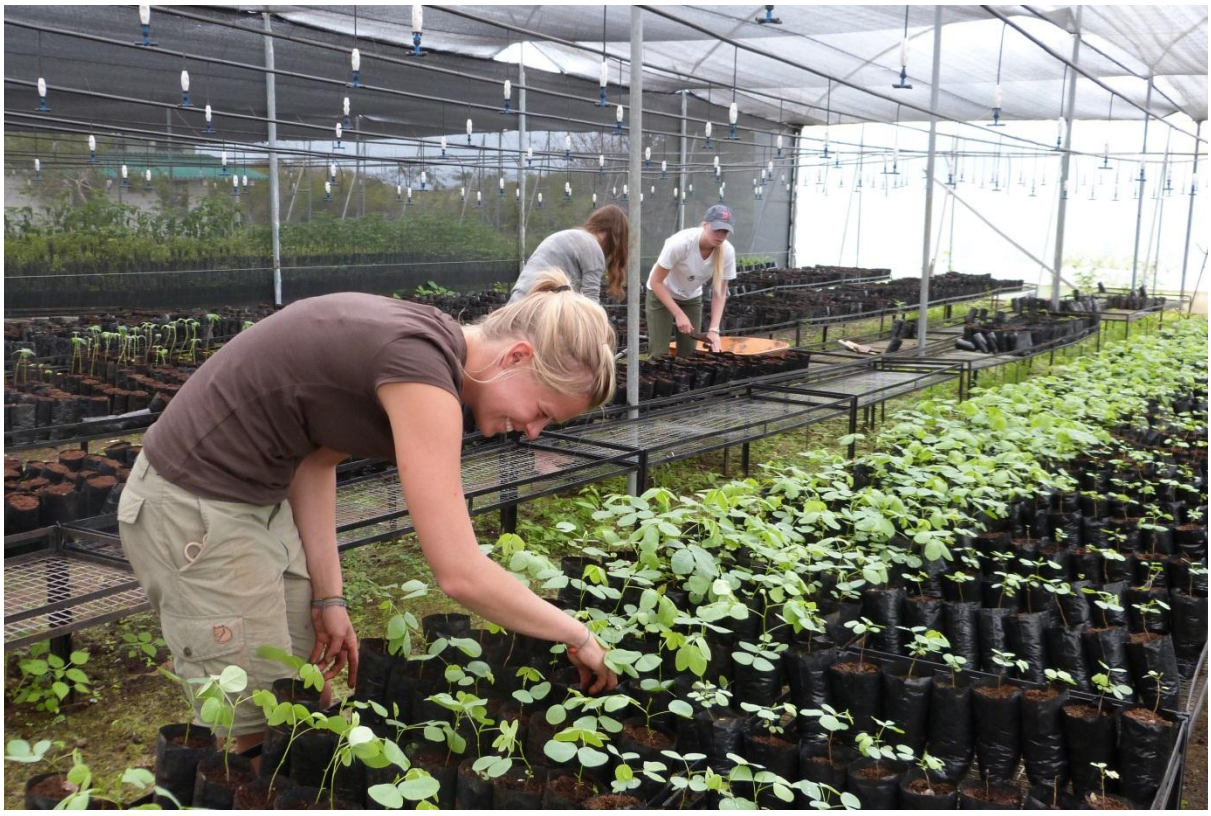
These endemic species include:

- Galapagos Rock Purslane- *Calandrinia galapagosa*
- Darwin's Cotton- *Gossypium darwinii*
- Thread-leafed Chaff Flower- *Alternanthera filifolia ssp. Filifolia*
- Guayabillo- *Psidium galapageium*

- Galapagos Miconia- *Miconia robinsoniana*
- Glorybower- *Clerodendrum molle*
- Black Mangrove- *Avicennia germinans*
- Matazarno- *Piscidia carthagenensis*
- Flat-fruited Senna- *Senna pistaciifolia var picta*
- *Legocarpus darwinii*

In addition we have our own plant nursery located about 10 minutes from Puerto Baquerizo where we grow our own plants for reforestation in and around the town- schools, parks etc…..

The re-introduction of all these plant species in greater densities should encourage the bird populations to return to the area and re-establish the balances and dynamics of the ecosystem before man's influence.



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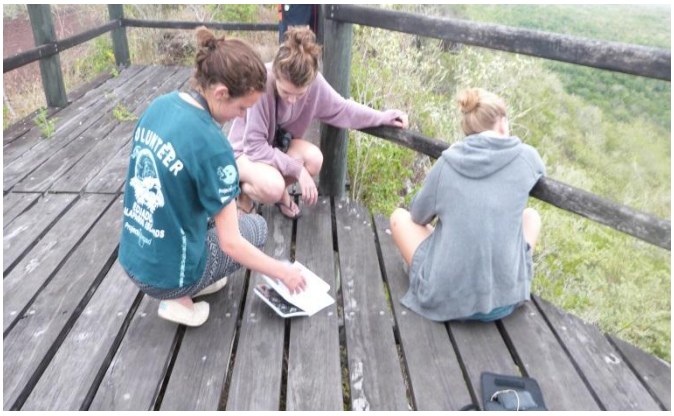


Nobody to date, even within the National Park Agency, has actually proved that such clearing and reforestation is having the desired effect and so we will be starting a new project effective immediately. We shall be monitoring the birds on Cerro Colorado. As the reforestation work is just beginning we still have time to canvas and record the birds currently residing/feeding on the bluff. A fixed platform on the bluff's summit provides a wide ranging observation post. We shall be collecting data from fixed point observations recording data parameters such as species, number, behavior, weather and temperature.

With a solid database of species numbers and diversity we can identify if and when certain bird species return to the area or if numbers of certain species increase/decline. This population model will enable us to conclusively measure the success of the project. If successful, we can publish the findings as the first researchers to prove that the invasive plants have had a detrimental effect on the island's ecosystem, and, more importantly, that reforestation of endemic flora can help address the problem.

7.3: Future Plans

Upon completion the national park will allocate a new area to continue with the same work, Cerro Chemado (Burnt Mountain).

Section 8: Invasive Species Removal

8.1: Aims

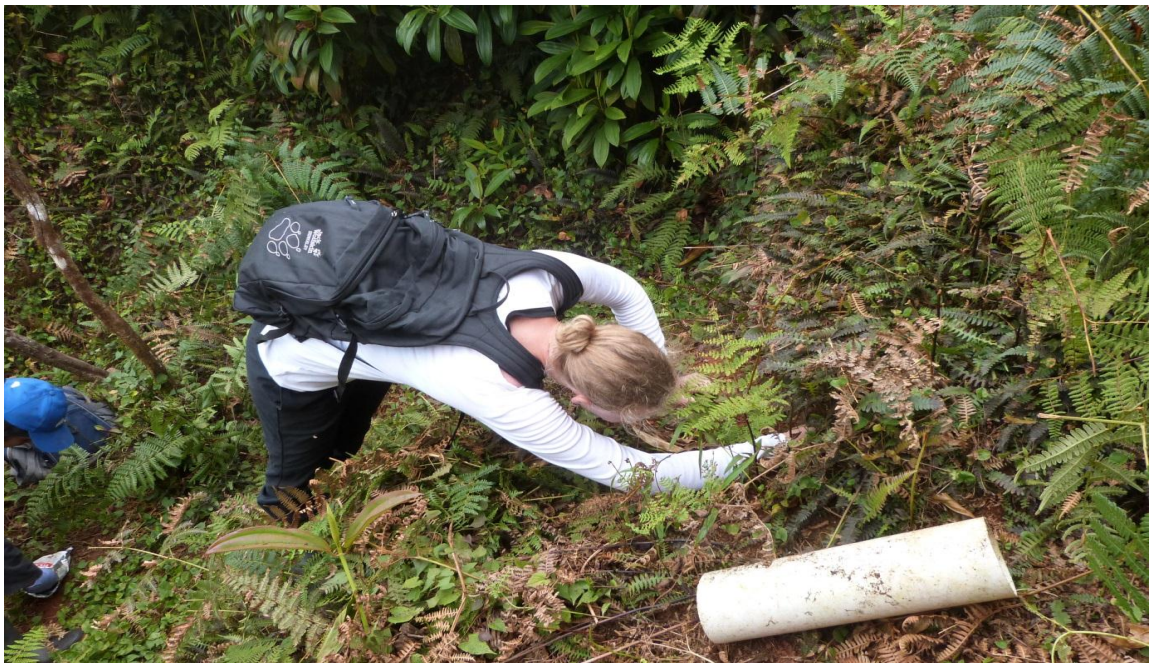
The Galapagos ecosystem is not just suffering from changes in plant compositions but also from introduced animals which prey on the islands' residents. The Galapagos was a unique ecosystem with no natural predators, with the exception of a small non-venomous snake, but human invasion has brought domesticated animals which in turn attract rats! Feral dogs and cats coupled with an exploding population of the black rat (*Rattus rattus*) means

that iguanas, lizards, birds and their nests are all easy pickings for the scavengers. Projects Abroad and the National Park have procured a special poison created to attack the rat's immune system but not to affect other animals (for example birds of prey that might catch the debilitated individuals). The first stage is to protect the breeding grounds of the dark-rumped petrel (*Pterodroma pheopygia*). These sea birds lay their eggs in hollows dug in open ground with soft substrates and so are very prone to attack from rats.

8.2: Methods

Volunteers search the breeding grounds of the petrel looking for holes with birds nesting in them. GPS coordinates are then taken to establish exact location and to enable us to verify if birds return to the same nesting sites each year. Once an active nest is identified volunteers place tubes around the entrance with poison inside. The tubes encourage the rats to enter, as if it were a bird hollow, and as soon as they eat the poison the effects are almost immediate.

If the project is successful then we should be mapping progressively more nests each year as young birds are hatching and surviving in the absence of rats.



8.3: Future Plans

The rat infestation will be an ongoing problem for many years to come and their quick reproduction coupled with constant dockings from the mainland means that a concerted effort will be need to assure complete eradication. Success on the petrel's breeding ground will set a precedent to expand the project to the breeding sites of other birds and other areas of the national park

We must aim also to raise awareness of the petrel's plight as the need for loose soil often leads them to nest in cattle pastures. The cattle destroy many nests by trampling them and we must educate farmers in the hope that they will allow us to fence off small areas where active nests are located.

Section 9: Marine Iguana Censuses

9.1: Aims

The marine iguana (*Amblyrhynchus cristatus*) is endemic to the Galapagos archipelago. The only aquatic reptile of its kind the iguanas feed on blooms of green algae. Environmental change can cause the blooms of these algae to fail and as recently as 1998 El Niño caused the ocean's temperature to rise by 5°C. This dramatic increase led to an explosion of red algae which replaced the green variety all along the coast. Hundreds of iguanas died as a result of starvation and until now no-one has investigated the state of the current population on San Cristobal. How many remain? Where do they congregate? Are the populations recovering?

We aim to monitor several different rocky stretches around the island to count numbers of individuals, the composition of the population (males, females and juveniles) and identify their breeding sites.

9.2: Methods

Transects of 1km are plotted with GPS along stretches of rocky shore.

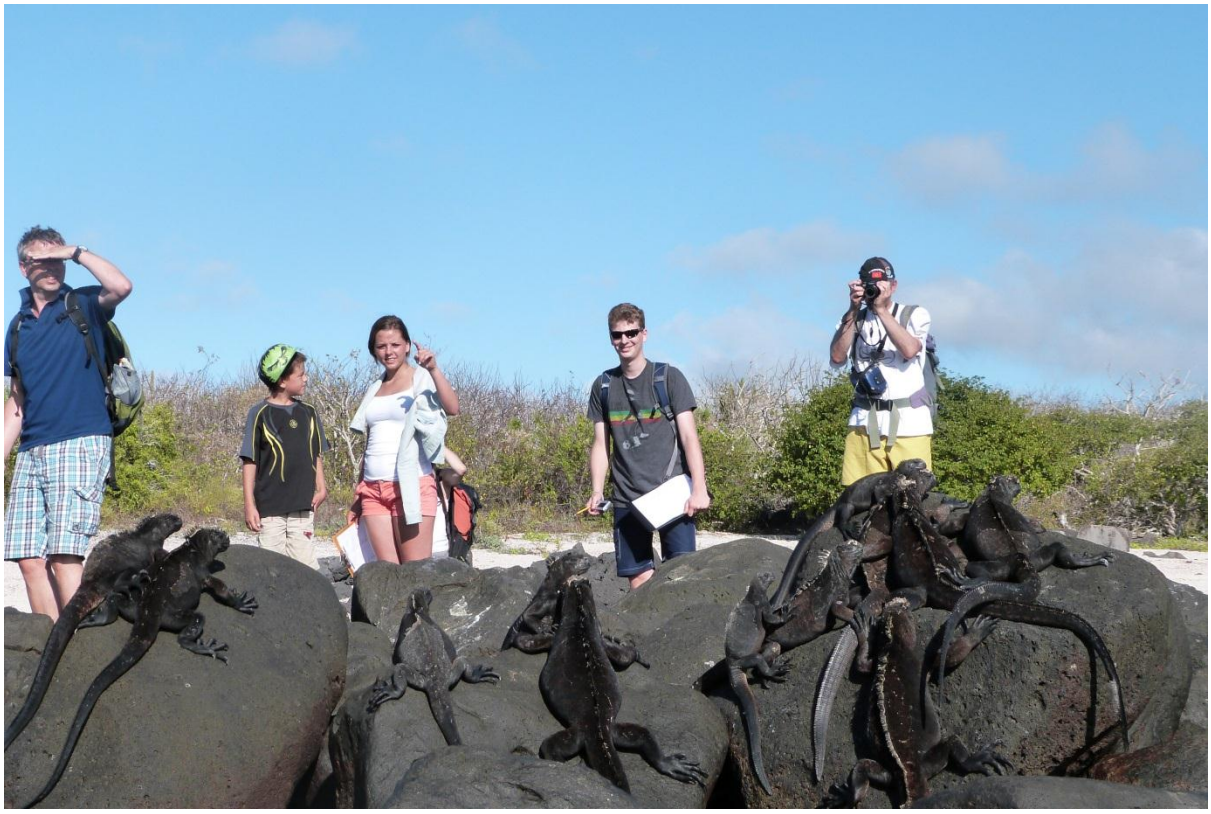
Volunteers and staff then walk these transects recording data on number of individuals sighted, sex (males have dorsal "spikes", whereas females only on the neck) and age (adult/juvenile). Behaviour is also recorded- feeding, mating,

basking, nesting…In addition; we record climatological data- temperature and weather (sunny, cloudy, precipitation) as well as the active tides. All these factors can affect iguana behaviour and must be correlated with the data.

9.3: Future Plans

We aim to discover which areas host the greatest density of numbers so as to propose protective zones. Breeding sites are of special interest.

Over time we will be able to investigate whether populations on the islands are territorial or if they seasonally move around different stretches of beach. The arrival of the cold currents from the south could cause the iguanas to seek out the cooler water for the higher densities of green algae. The arrival of the warm currents could cause the iguanas to move to the opposing side of the island to avoid the warmer conditions. There is no data to support any of these theories and an on-going data base will enable us to investigate this.



Section 10: Sea Lion Monitoring

10.1: Aims

San Cristobal, along with the other inhabited islands of the Galapagos, encounters a unique situation where Galapagos sea lions (*Zalophus wollebacki*) and humans live in close proximity. All along the sea front of Puerto Baquerizo sea lions are found resting on benches, sleeping under trucks and lounging in the middle of the road! Most residents have learnt to co-habit with these noisy neighbours but with any human-animal conflict there is always friction. The beaches around the town are smelly and covered in faeces, fishermen complain of sea lions stealing their catches and aggressive males patrolling their harem have been known to charge at people. Most people will not go as far as to hurt the sea lions but there have been cases of human caused injuries and also those by dogs.

The National Park has a sea lion management plan implemented but they need help and data to improve their strategies.

10.2: Methods

Sea lions tend to come ashore in fixed territories and so we have established two fixed locations to collect data- “El Malecon” (seafront area of town) and “La Loberia” (large beach north of the town). GPS transects of 1km are plotted and volunteers walk these lines at low tide recording all individuals within 5m of the transect line. The volunteers will split into two groups as one group will walk the transect close to the water’s edge, carefully managing the slippery rocks. Another group walks further up the beach and records the data shouted out. After 500m the groups switch and the same is done for the second half of the transect. Each transect will be walked twice a week in the afternoons when most sea lions return to shore having fed at sea during the morning.

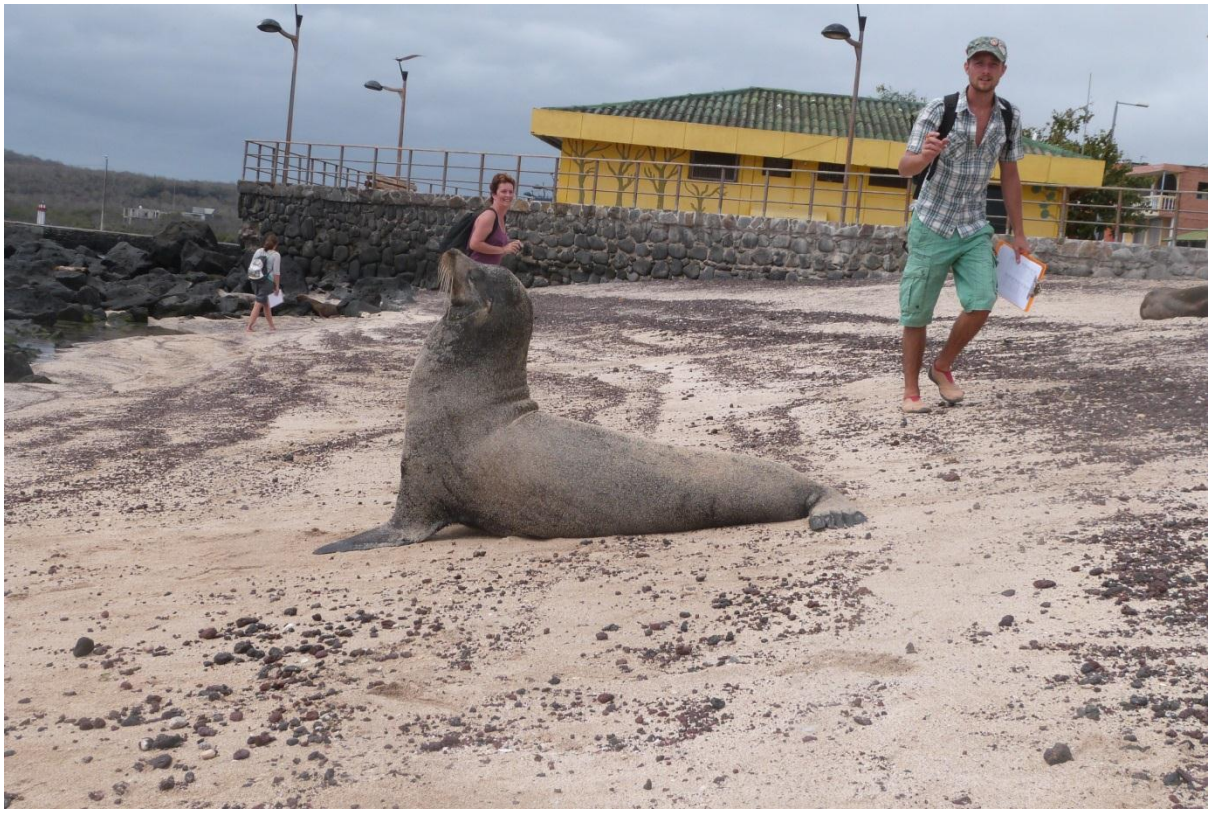
Data on age and sex is recorded to allow us to determine the composition of each population. This data will provide conclusive data on population numbers over time and will establish whether the sea lions always return to the same area or if they move locally around the island.

During the transects we also record data on invasive species such as wild dogs and cats as these prey on young pups and must be removed from the sea lion breeding grounds.

To help the National Park with their management plan volunteers will also help in the cleaning of the beaches close to town. Shovels are provided and volunteers will help the park officers turn the sand thus burying the faeces and removing the strong odours so unpleasant to visitors to the beaches.

10.3: Future Actions

As more data is collected and volunteer numbers increase we shall start to expand our census sites and collect information on more sea lion colonies. Education and environmental awareness of our work in schools is vital so that the next generation on the island learn to live with the sea lions and human-related fatalities become an anomaly.



Section 11: Beach Controls

11.1: Aims

A large percentage of San Cristobal's fauna depends on the ocean and its coastline. Sea lions, iguanas, turtles, sea birds and many invertebrates are just some of the animals dependent on the beaches and shallows. Increased tourist activity leads to more rubbish. Large fishing fleets produce abandoned nets. Oil cans and discarded bottles wash up onto the beaches.

All of the above are hazardous to the islands animals. Sea lions and turtles have been known to drown after becoming entangled. Animals can swallow plastic and cut themselves on broken glass. Projects Abroad is committed to help keeping the island's beaches clean and safe and this involves getting our hands dirty and actively combing the beaches and shoreline collecting rubbish.

11.2: Methods

Volunteers and staff systematically comb the beaches closest to the town of Puerto Baquerizo where most rubbish is found. Gloves are worn and all items are placed in plastic sacks. GPS co-ordinates will be taken at the start and finish of every transect and the total weight of rubbish recorded. The rubbish is then transferred to a recycling site to be disposed of.

The weight of rubbish collected will be recorded in a spread sheet so that we can identify which areas appear to accumulate most rubbish as a result of the tides. Over time we can graphically represent how much rubbish has been collected and if there is an increase or decrease in the amounts washed up.

11.3: Future Actions

The beaches around Puerto Baquerizo do not have rubbish bins much less recycling containers and with the data we collect we hope to force the national parks into allowing us to install bins where necessary.

Signs in English and Spanish should be placed at entry points to the beaches as a lot of the rubbish is left by people visiting the beaches; not washed up by the sea.

Section 12.0: Bird Surveys

12.1: Aims

Whilst the biodiversity of the Galapagos is well documented no one is actively performing bird surveys to ascertain the relative abundance of certain species. This project is designed to investigate the bird populations in three fixed areas of the island and to record active nests in the area as well.

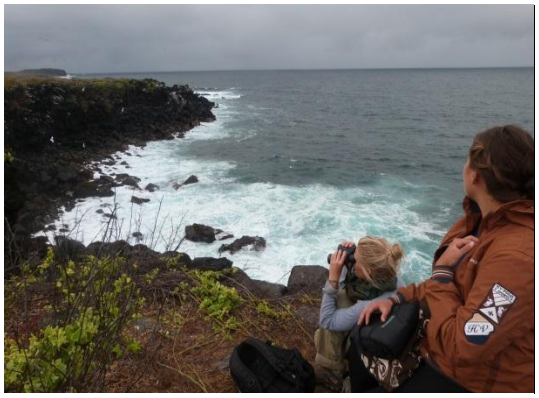
12.2: Methods

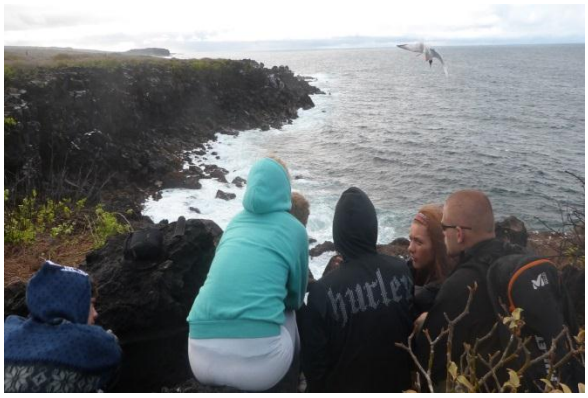
The National Park has cleared many hiking trails which snake along the borders of the beaches where sand meets vegetation. We have identified three such sites to perform this research.

1) Cerro Tijeretas
2) La Loberia
3) El Junco

At each location volunteers walk a transect of 1.5km following the trails. Birds are recorded that are spotted within 50m towards the open sea and 20m into the forests (this distance represents the limit of good visibility). Species type, sex, where possible, and behaviour are recorded.

In parallel we record any nests found and take GPS references.





12.3: Future Plans

By building a database on the species encountered and numbers of each we can determine the health of the island's bird populations and establish fixed breeding seasons and sites. This data will help the National Park protect the

areas and implement the invasive species control which we currently operate at the dark-rumped petrel breeding sites.

Section 13: Other Projects for Development

13.1: Shark/Turtle Nurseries

The majority of open water fish species head to coastal areas to lay their eggs. The sanctuary offered by shallow waters and rock formations protects the babies from predation. Marine turtles lay their eggs on beaches and the young hatchlings remain close to shore until strong enough to head into the open seas. San Cristobal has many areas where historically fish would come to lay their eggs but increased boating activity is impacting these bays and lagoons. We wish to perform shark/turtle censuses in these areas to determine whether human impact is seriously affecting the populations. Volunteers will snorkel around these sites recording data on shark/turtle species and numbers. Areas that no longer host these species in large numbers must be protected and boating activity limited.

Future studies could expand to other large pelagic fish species but we must first concentrate on sharks and turtles as these are the species killed frequently by fishermen either consciously or, in the case of turtles, drowning in nets or hit by propellers.

13.2: Lobster Fishing Control

The fishing industry around the globe is coming under increased pressure. As fish populations decrease and human demand increases fishermen are forced to catch and sell whatever is available. Before such supply and demand issues became so severe fishermen would return small sized individuals back to the seas knowing that they would grow and breed thus replenishing the populations. Many countries around the world have passed legislations forcing fishermen to return under-sized fish back into the wild and whilst some may do so this law is very hard to enforce. On the Galapagos crab populations still flourish but the lobster populations are suffering. The National Park- marine branch- is keen to implement such controls on San Cristobal. As lobsters are brought to land still alive it is easier to monitor the catches as they must be brought to dock near town. We would help the authorities by measuring and

weighing the lobster catches enabling us to return under-sized individuals back to the ocean.

Section 14: Implementing the Plan

The imminent contract to be signed with the Galapagos National Park agency is a huge boost to our work on San Cristobal. Projects Abroad has the funding and man power through volunteers to make a real difference to the conservation of the island's ecosystems.

An in-country conservation manager ensures the correct use of our resources and maximises the efficiency of our efforts on the island. This management plan is a guide to help manage existing projects and to set up new ones. The key to our success on San Cristobal is the collection and processing of valid data. The Galapagos Islands and are globally recognised icon for conservation and whilst everybody is aware that we must help conserve the unique wildlife found here there is no solid evidence confirming the best way to do this.

Section 15: Reporting on Research

The data collected on this project will be processed into scientific reports which must be sent every 3 months to the Projects Abroad UK office where it will be reviewed by our conservation team. These quarterly reports will contribute to an annual scientific report which will be made available to the public. Over time these data sets will be peer reviewed by leading experts and published in scientific journals.

The project will also produce an annual report outlining progress and recommendations. This will also feature in Projects Abroad Conservation Annual Report, made available to the public through a wide range of media.