# Conservation Management Plan

## Peru

With Partners:

# Contents

# 1. Executive Summary

Projects Abroad has been successfully operating in the Taricaya Ecological Reserve since November 2001. Deep in the Amazon rainforest the 476 hectare reserve is located in South-east Peru in the Madre de Dios Province and hosts a wide range of projects designed to research and conserve the most diverse ecosystem on the planet. In conjunction with INRENA and other branches of the Peruvian government we are pioneering new initiatives in bio-diversity research, agroforestry programs, animal rehabilitation, environmental awareness and much more. The Taricaya Reserve borders the Tambopata Candamo National Park which occupies 40% of the Madre de Dios department with an area of 274,690 hectares.

Since the project's conception in 2001 Taricaya has received over 2200 volunteers and our reputation for serious hands-on conservation has grown both nationally and internationally with publications in scientific journals, presentations in international conferences and the filming of many documentaries on our work. With this reputation established we work hard to improve and evolve our existing projects whilst simultaneously striving for new ways to raise awareness and promote the conservation of tropical rainforests.

# 2. Background Information

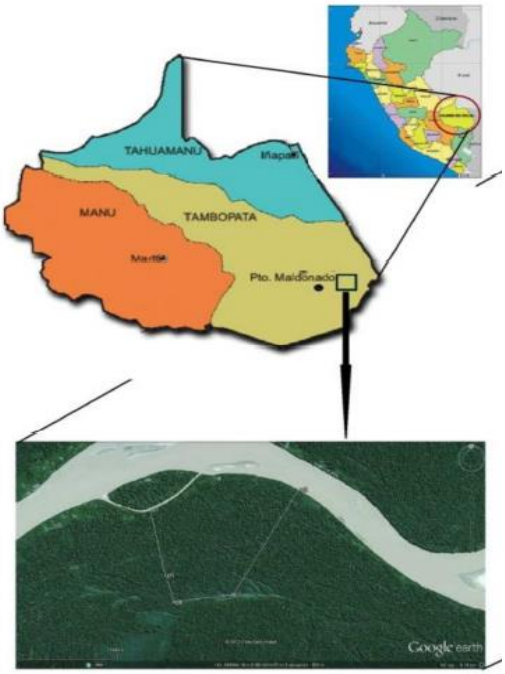
## 2.1 Geography of Peru

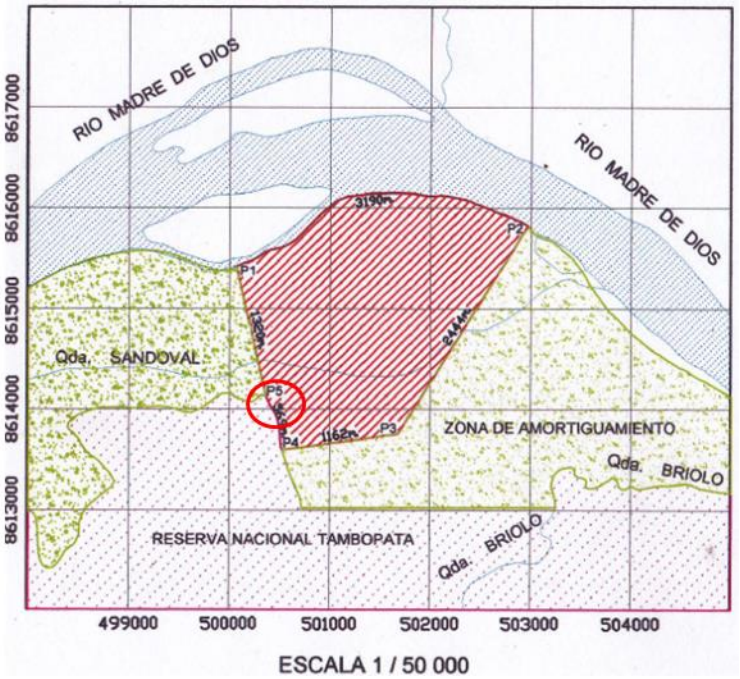
Peru's total land area is 1.28 million square kilometres (nearly 500,000 square miles), which contains three main regions, Coastal, Highland and Jungle. Of the 104 recognised ecosystems on earth Peru boasts 84, a staggering 81%. Peru's narrow strip of desert coast runs 2,500km (1,550 miles) from the borders of Ecuador and Chile. In the extreme south of Peru, the coast forms part of the Atacama Desert (Arequipa), one of the driest places on earth. The Andes represent the highest mountain chain on earth next to the Himalayan, and Huascaran, and contains Peru's highest peak at 6,768M (22,204Ft), which is the second-largest mountain in South America. Between these mountain ranges lie fertile valleys and grasslands between 2,300 and 4,000M – which is where the majority of its indigenous highlanders live and produce about half the country's food supply.

Eventually the Andes Mountains peter out into a series of ecosystems that cascade into the Amazon basin. Near the top of the eastern edge of the Andes is the cloud forest, a mist-drenched, inhospitable place that is one of Peru's most bio-diverse habitats. Here live hundreds of types of birds, orchids and butterflies. Clear mountain streams cascade down these slopes; eventually merging to form the broad, muddy rivers of the lowland rainforest. This carpet of green is the largest jungle on the planet and stretches thousands of miles through present-day Brazil to the Atlantic Ocean.

The Amazon rainforest is the most diverse ecosystem on the planet and is home to more species of bird, mammal, insect and plant than anywhere else. Every year new species are discovered and these findings continue to amaze the scientific community dedicated to unravelling the mysteries of such a complex ecosystem.

## 2.2 Map showing the country of Peru and the location of the Taricaya Ecological Reserve




## 2.3 Climate

Peru's weather is just as diverse as its geography with patterns caused by the Humboldt Current, the Andes, and the jet stream, which blows west (not east as in the Northern Hemisphere) and picks up the Amazon's moisture as it travels. On the coast, the south-westerly trade winds that blow toward Peru are chilled as they pass over the frigid waters of the Humboldt Current. When these cold winds hit Peru's sun-baked coast, they gradually warm and rarely release rain because their ability to hold water increases. Clouds form only when the air begins to rise over the Andes, dropping rain over Peru's mountain valleys and high grasslands, which affect the counties river levels more than local rain.

The jet stream heads west over the Amazon basin toward the Andes, picking up transpiration from the Amazon basin. As this warm, humid air rises over the Andes it also condenses into a fine mist that keeps the cloud forest moist. As it rises even higher over

the mountain plains it falls as rain. The heaviest periods of rain in the Peruvian Amazon and Andes occur between December and April, a time that Peruvians refer to as the *epoca de lluvia* (the rainy season). The first rains, however, begin in October, which is the beginning of the highland-planting season. Soon after, rain from the Andes begins to cascade down to the coast and into the Amazon, where rivers become swollen and muddy.

In the rainforest temperatures remain consistently high all year round with midday highs of over 30°C and a humidity that rarely falls below 80%. Nights are hot and humid in the rainy season but cooler during the drier period. The only exception to the tropical heat are the sporadic “friajes” where colder winds blow up from Patagonia and cause temperatures to drop as low as 10°C. These spells can last 24 hours to a week and occur during the dry season.

## 3. Major threats to the area

### Agriculture:

Rainforests all over the world are being cut down at alarming rates. In Brazil alone thousands of hectares are cleared every day to create pasture for cattle. In Peru, farming and agriculture are also major threats. Rudimentary farming techniques mean that small scale farmers clear new land every year. An inability to manage their land means that after a couple of years the soil becomes infertile and so more forest is cleared out of necessity. These abandoned plots slowly regenerate but the rate of recovery is much slower than that of deforestation.

### Logging:

Timber extraction is another major threat to the Amazon rainforest. Hardwoods such as mahogany (*Swietenia macrophylla*) and cedar (*Cedrela odorata*) are virtually extinct outside protected areas and private plantations with the former being the first high value tree to be listed as vulnerable on CITES (Convention on International Trade in Endangered Species) in 2003. This CITES II status could soon become “endangered” (CITES I) and with the cedar now also listed as “vulnerable” loggers have switched focus to other tree species. Millions of cubic feet of wood are extracted from the Peruvian rainforests every year and the impact is devastating.

### Gold mining:

Fluctuations in the global price of gold have meant that historically gold mining has been a frequent if not constant threat to the Amazon rainforest. However, the price has gradually increased over the past 40 years and this encourages illegal artisanal miners as well as the larger companies. Huge areas of forest are destroyed every year as the Amazon basin has rich deposits of gold dust in almost all the river systems. Miners clear huge areas of land to reach the fluvial layers deposited thousands of years ago under the existing forest.

Deforestation is not the only threat from gold miners as the Amazon's rivers have high concentrations of mercury as a result of the pollution caused by the gold extraction.

### Hunting:

Whilst deforestation for whatever reason is the largest threat to the Amazon rainforest the hunting of wild animals for food and the illegal pet trade is causing many species to become locally extinct. Certain species are the first to disappear when humans settle in an area. Tapirs (*Tapirus terrestris*), peccaries (*Pecari tajacu, Tayassu pecari*), large primates and deer are the first to disappear as they provide large quantities of "bush" meat. The illegal pet trade also accounts for the disappearance of certain animals such as parrots, macaws and small monkeys. All these animals form an integral part of the ecosystem and their loss inevitably causes an imbalance which affects all the other wildlife.

### Fishing:

The rivers of the Amazon basin are home to thousands of species of fish and over-fishing and pollution are causing major imbalances in the river ecosystem. Some of the largest freshwater species in the world are found in the Amazon with the majority belonging to the order of catfish (Suleriformes). Such fish are prize catches and vast drag nets are used to sweep up any fish large or small. The extraction of these large fish reduces the breeding populations in the rivers and causes a scarcity of food for many species of animal such as caimans, otters and numerous species of bird.

## 4. Overall Aim

Conservation is a very broad term used in many contexts. However, to effectively implement any conservation plans one must first understand the area and the ecosystems involved. Land management plans and environmental awareness campaigns are excellent tools for successful conservation but only when based on sound knowledge and effective research.

At Taricaya we are actively studying the ecosystem so that the research and data allows us to design effective conservation strategies. Our bio-diversity research is thorough and encompasses birds, mammals, amphibians, reptiles, insects and plants. In addition to learning about the ecosystem one must understand the pressures it faces and the dependence of people on the area to survive. Only when the two elements are successfully combined can we plan for the future working with local communities and scientists alike.

With 13 years of study and a dedicated effort to working with local people we are confident that our conservation efforts are effective. The Peruvian government supports our efforts and over time we have gained their confidence and trust and this good work must continue as we adapt to new research and increased knowledge of the area.

# 5. Animal Rescue Centre

## 5.1 Aims

- Rescue pets from captivity

- Treat and cure sick animals

- Prepare animals for rehabilitation into the wild

- Captive breeding program

- Perform behavioural studies on animals in captivity

- Repopulate the area with animals that have become locally extinct

- Monitor the released animals using telemetry equipment to assess their adjustment to rehabilitation to life in the wild

- Write protocols and scientific papers based on our findings to facilitate other entities copying our work in other areas

## 5.2 Summary to date

The concept of releasing captive animals into a safe environment is a popular concept for conservationists worldwide. Taricaya was the first official centre of its kind in Peru and was officially recognised in 2008. All the animals belong to the Peruvian government and we are their custodians for as long as they remain in our care. Laws did not exist for such

centres in Peru and we pioneered the concept amidst an on-going battle for rights to sanction the release of confiscated animals. Now we host many enclosures that allow animals to recover their health before releasing them back into their natural habitat.

To date we have released over 40 species of animal back into the wild.

In the past four years we have released five groups of Peruvian spider monkeys (*Ateles chamek*) and one mixed troop of capuchin monkeys (*Cebus apella* and *Cebus albifrons*) back into the reserve and adjoining national park. These animals have been extinct in the area for over 30 years and we have been monitoring their progress using radio collars and telemetry equipment and have recorded three wild births in the case of the spider monkeys. Staff and volunteers camp out in the forest and track the released animals for several months after the release until we are confident that they have established a fixed territory and are healthy and well-nourished after the stressful release process.

Since the official creation of the rescue centre in 2008 we have also started captive breeding programs with the goal to maintain reproductive pairs in the centre and release the offspring back into the wild. We have had success with three species thus far: Lowland tapir (*Tapirus terrestris*), Red howler monkey (*Alouatta seniculus*) and Razor-billed curassow (*Mitu tuberosa*). For any animal to breed in captivity the conditions must be ideal and these successes are a testimony to our management of these animals. We provide them with stimuli in their enclosures; well-balanced diets precisely administered every day and the avoidance of human contact as much as possible.

Our latest project started in 2015 has been the rescue of spectacled bears (*Tremarctos ornatus*). We currently have 1 male and 2 females at the rescue centre and the aim is to captive breed the adults with a view to releasing the offspring back into the wild. This

program has been the culmination of many months of preparation and strong relations forged with the government of Peru and in 2017 we will receive a third rescued female.

### 5.3 Methods

Illegal pets are confiscated in Puerto Maldonado either by us directly or, if the owner is unwilling, by the ecological police. They are turned over to us for a sanitary evaluation and are placed in quarantine as almost all new residents have been living in Puerto Maldonado and have been in contact with humans and domestic animals. After the quarantine period has been completed we then evaluate each animal and decide whether they are suitable candidates for release. Unfortunately not all animals that enter the centre can be put back into the wild. Around 80% of the animals we receive are eligible for release and the rest will remain in comfort at the centre, well fed and candidates for the captive breeding program.

After the necessary health checks the animals are placed in general population and begin the rehabilitation process. Volunteers are involved in studying the captive animals and recording data essential for their eventual release. In the case of animals common to the area they can be assessed on an individual basis as they will encounter many of their species in the wild. Those species not common in the area must be managed as a group in captivity to be released together.

The resident vet will inoculate all animals with the necessary vaccines before release and control their diets based on a program used globally to balance the diets of exotic animals in captivity. This dietary element is essential as all animals have a preferred diet in the wild and we must replicate this as best as possible analysing the vitamins, fats and proteins the animals consume. Failure to do so can result in illness and maybe death from liver failure and stomach infections.

### 5.4 Future Plans

The animal rescue centre is constantly being improved with new enclosures designed to better cater for specific types of animal. The new cages are safer, stronger and will not need maintenance like the older wooden ones. Our behavioural studies will continue and as our data base grows we are gathering more invaluable information for the better management of the animals and their preparation for release.

The captive breeding program will flourish as we learn from our own experiences and the aim is to encourage other species to breed also. The animals we have released will continue to be monitored and we shall continue to repopulate the area with healthy animals processed through the centre.

## 6. Remote Sensor Camera Survey

### 6.1 Aims

- Compile a complete species list of mammals found in the area

-Study population numbers and distributions for species that are elusive and seldom seen by humans

- Target “colpas” where many animals come to feed on clay to aid in the digestion of toxic plants and fruits

- Compile a database of certain indicator species such as jaguars, tapirs and pumas based on distinctive markings and colour patterns

### 6.2 Summary to Date

We have been monitoring the area with sensor cameras for 5 years and have captured on film most of the mammal species one would expect to find the Taricaya reserve. We have a comprehensive list of mammals, excluding bats, where we have identified 64 species of 9 orders and 27 families. The presence of top predators such as jaguars and pumas indicates a healthy ecosystem and reflects on our efforts to conserve the area.

Targeting known areas of animal traffic can provide good population data especially in the dry season. When the rains stop and the forest dries out; streams and colpas become very important focal points in the behaviour of many animals in the rainforest. When the dry season starts fruits are very scarce and must be eaten unripe, casual water disappears and we can take advantage of these sites to capture animals on film.

## 6.3 Methods

A line transect is a standard sampling technique used to study species distribution. To conduct a line transect, an imaginary line is drawn to dissect the study area at predetermined places. The use of transects allow for the study area to be monitored in a uniform and systematic way. The extensive trail system in the Taricaya reserve provides a perfect set of transects and cameras are placed at fixed intervals along the trails. The cameras are placed in pairs, one either side of the trail so that we might capture on film the animal regardless of which direction it is walking.

Every recording (photo/film) has the date, time and weather conditions and GPS co-ordinates are taken at every camera location.

With indicator species we separate different individuals through their colour patterns and distinctive markings and record their movements around the reserve as they are captured on film in different sites.

### 6.4 Future Plans

As our database continues to grow we hope to monitor species populations and register increased presence in the reserve. The fact that population numbers increase reflects on a positive impact of our conservation strategies.

## 7. Freshwater Turtle Repopulation Project

### 7.1 Aims

- Monitor the river island Playa Alta and collect nests of the Yellow-spotted river turtle

- Transfer the eggs back to artificial beaches at Taricaya

- Monitor the eggs and control against parasites and infection during incubation period

- Mark and release the baby turtles back into the rivers

- Perform censuses on the river to monitor fluctuations in population numbers and dynamics (male/female ratio, adult/juvenile ratio etc.) and check for sightings of marked individuals from previous years

### 7.2 Summary to Date

The Yellow-spotted river turtle (*Podocnemis unifilis*) is rapidly disappearing from the rivers of the Amazon Basin. The eggs are a delicacy and during the dry season when local tribes and communities are looking to supplement their income the eggs are sold as delicacies in local markets. The adult turtles are also poached and eaten when caught in fishing nets or on the beaches when laying their eggs. The result is that population numbers have decreased dramatically over recent years. We have been involved in a repopulation project at Taricaya since 2005 and to date we have released over 10000 baby turtles back into the wild.

Apart from operating our own project we have also been working in conjunction with the native Eseja tribes in the area. The communities of Palma Real and Bahuaja Sonene have slowly begun to understand the importance of protecting their natural resources and the children from the community schools have participated in competitions in environmental awareness and have managed their own artificial beach within the community. In the form of materials for the school we have given the communities incentives to work with us and there has been some level of success over the years.

In 2013 we reached a new level working directly with the government and the national parks authorities. A field trip was taken to the Heath River on the Peru-Bolivia border and over 70 nests were collected and brought to Taricaya. By working with the park rangers and the government employees we hope to raise awareness of the plight of the species

and help their protection in the future with the correct enforcement of laws prohibiting the illegal collection of eggs.

## 7.3 Methods

Every year we are awarded custody of a large river island about 1.5km from Taricaya. The government authorises us to monitor and protect the beaches of Playa Alta and every night for two months (July/August) volunteers and staff camp on the island deterring poachers and collecting the eggs from every nest laid. Fishermen and local farmers are a constant threat to steal the eggs and we employ the help of an Eseja guide to help us beat the poachers to the nests.

Once a nest is located GPS co-ordinates are taken and the eggs are removed carefully and placed in sand in buckets. Data is collected from the nest including depth, number of eggs, sand temperature and weather conditions. This is important as we must recreate the individual conditions of each nest in the artificial beaches at Taricaya. The female turtles lay their eggs at a fixed depth on purpose as the sex of the baby turtles can be determined by the temperature of the sand during incubation. Cooler eggs are more likely to become males and warmer ones females. This is an evolutionary tool that has enabled turtles to address any imbalances in their populations over time and no doubt has contributed to the longevity of the Chelonians in general. If we bury the eggs in our beaches at different depths to that of the mother then we are changing the sex ration of the population.

There have been reports that eggs hatched in artificial beaches can tend to be dominated by just one sex as the conditions do not reflect those of nature. To this end we have sent 20 still-born babies from different nests to Lima for sexing and were very satisfied to discover that we are producing both males and females. This reinforces that our methodology is sound and we are replicating natural conditions to the best of our ability.

After an incubation period of 70-90 days the baby turtles hatch and they are measured, weighed and marked with a small cut on their shell. Every year the location of the insertion

changes so that when we see adult turtles in the wild we can ascertain which year they were released. When all the babies are hatched we calculate the success rate for the occlusion of the eggs (number of live babies from the total number of eggs) and take them back to Playa Alta for release. This step is important as the baby turtles remember their first walk down to the river and should return as adults to the same beach to lay their eggs. This way we can ensure the safety of future generations.

During the laying season we also perform censuses of wild turtles in the river. We patrol from Taricaya down to the island and then a further 1.5km downriver. All turtle sightings are recorded and where possible age and sex of the turtles found. This way we can assess the population of wild turtles and record the increase in numbers resulting from our annual releases. Encouragingly we have sighted adult turtles with cuts on their shells and in 2016 we found to marked turtles actually laying eggs on the beach. Whilst the survival rates of the young babies in the rivers is low due to predation and fishing we are already seeing success from years past and to see our released females laying eggs on the beach is the final vindication and sign of success.

## 7.4 Future Plans

After nearly ten years of working on this project we are confident that our methodology is efficient and confirmation of marked adult turtles in the rivers confirms this. We are constantly looking to improve the survival rate of our eggs and a success of over 80% in 2014 is a fantastic achievement and one we must look to improve even further. After the success of local competitions in Puerto Maldonado we hope to work on raising awareness further of the plight of the species and the new links with the government are encouraging. We must press on and look to get more people involved in the project thus expanding our area of influence further afield from Taricaya.

# 8. Bio-diversity Research

## 8.1 Ornithology

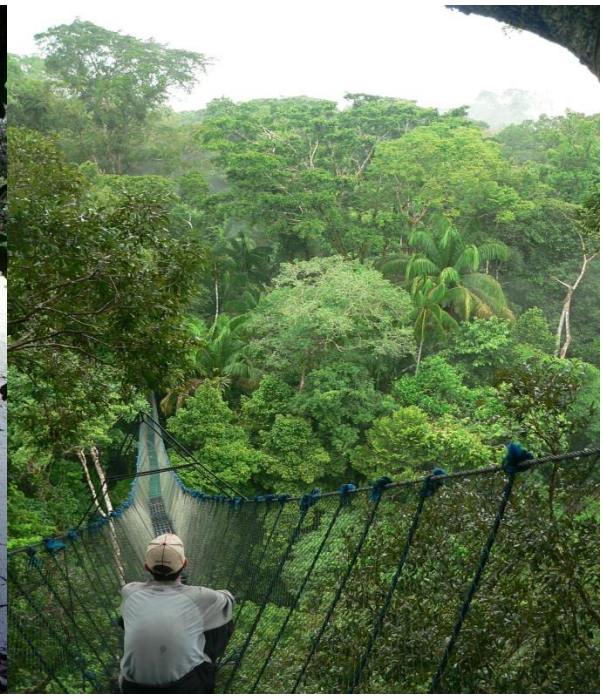
Summary:

Since the conservation project's conception in 2001 we have been studying the birds of the reserve. Through a combination of data collection techniques we have compiled a list of 485 species of bird for the reserve. This is close to the world record for an area of less than 500 hectares and is a reflection of thousands of hours in the field. To date we have published several scientific papers on our research and have visited several international conferences all over South America.

Methods:

Our extensive species list has been collected using three different methods. Fixed point observations, mist netting and opportunistic sightings. The fixed point observations are performed at different stations around the reserve and include a 42m canopy platform, the highest in South America, a 12m platform and a blind. Each station gives us access to

different habitats and canopy levels with different species of bird resident in each. Data is collected on bird behaviour, numbers and climate. With a huge database we have been able to identify which birds are common in certain types of forest and also recognise migrant species and the time of year they pass through the reserve.



The second research technique is the use of mist nets. With two trained staff on the project and a third consultant from the University of Arequipa we have been banding birds and studying their behaviour since 2004. In an initial study of 12 weeks over 6 months we caught and banded 512 birds and the data collected lead to several publications. Since then we have joined forces with Corvidi, an international organisation, and using their coded bands we have now caught and released close to 2000 birds and biometric data, GPS co-ordinates, habitat type and age has been recorded for every individual captured. In total we have logged over 20,000 mist netting hours and such is our success with mist netting and bird diversity we have hosted three international bird banding courses at the reserve with international experts arriving from all over the world. Taricaya was the first internationally recognised bird banding site in Peru. Many areas of Peru had been studied in independent projects but our on-going research in one fixed location is unique.

Based on local migrations around the reserve and the relative abundance of the bird species in the area we have been able to study population dynamics, impact and seasonality of migrants, behavioural traits and much more. Our data base is colossal and there are many more scientific papers in process as we study all the information available to us.

The third method for registering new species is opportunistic sightings. We spend most of the day out and about in the reserve and inevitably we come across many bird species

whilst working on other things. If specialist staff is not on site then volunteers will take photos and bring them back for us to identify in camp.

In short, we have learned a huge amount about the birds of the reserve and we have registered species not thought to be found in the area. Birds previously only associated with cloud forest (higher altitudes) or Pampas grasslands have been captured and recorded at Taricaya and we have contributed to the editing of species ranges in the definitive guide to the birds of Peru.

Future Plans:

The wealth of information we possess must be analysed and processed to design sound conservation strategies. For example the presence of certain species of bird in mixed flocks is a good indicator that the ecosystem is healthy. These species follow huge colonies of army ants or peccaries around the forest feeding on the insects chased up by the animals below. High numbers of these species indicates high numbers of peccaries and army ants which in turn indicates a healthy ecosystem. This is just one link between bird populations and indicators of how an ecosystem is functioning. There are hundreds of specific relationships between birds and other animals and plants and the presence or absence of these bird species reflects directly on the ecosystem.

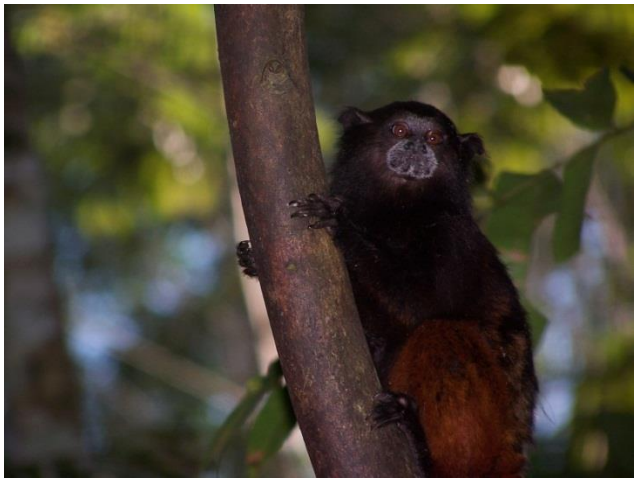
We must continue to monitor the reserve and check the health and stability of our bird populations as they can tell us a lot about everything else happening in the forest.

## 8.2 Mammalogy

Summary:

This research concerns all species of non-flying mammals in the reserve. We have recorded 64 species including 5 feline species, 8 primate species and 21 species of rodent. Whilst it is important to record the presence of these species in the reserve it is in fact the populations that give us a better idea if our conservation strategies are working. Top predators such as jaguars (*Panthera onca*) and pumas (*Puma concolor*), if present in high numbers, indicate an abundance of prey species which is only possible in a healthy

ecosystem. Other indicator species, such as tapirs (*Tapirus terrestris*) and red howler monkeys (*Alouatta seniculus*), reflect an absence of hunting and represent a balanced ecosystem.



Methods:

Data is collected using sensor cameras (see above), walks looking for tracks/scats, traps and opportunistic sightings. The identification of colpas, where mammals feed on clay to help digest unripe food, is an excellent way to monitor the mammals of the reserve. Since the reserve was created we have systematically identified several such locations and in the larger ones have installed platforms to observe the wildlife.

In the case of rodents and marsupials we have performed several studies using Sherman, Tomahawk and pitfall traps. These are placed along transects and are used at different levels of the forest. Tomahawk high in the trees, Sherman lower down and pitfall on the ground. Many species of rodent and marsupial are very elusive and nocturnal. These traps allow us to catch them and study them closely as many species appear almost identical at first glance. All animals are released after photos are taken and biometric data recorded.

Future Plans:

In addition to monitoring the existing populations of mammals in the reserve we must also consider the impact our released animals are having on numbers. When the reserve was created and we began protecting the area it was uncommon to encounter many of the mammal species now abundant in the area. Hunting had caused animals to seek refuge in the adjoining national park and their return reinforces our conservation effort in the area. The reserve is not at capacity in that the wild populations are still recovering but we must continue to monitor numbers over the coming years to avoid creating direct competition between released animals and the residents. Should this situation ever arise we must have a release strategy in place for different areas of the rainforest where the animals will be safe and can repopulate different zones.

## 8.3 Herpetology

Summary:

Herpetology is the study of amphibians and reptiles. Amphibians are often the first animals to disappear in an area that has been severely impacted and so monitoring their populations and diversity is essential when designing any conservation strategies. Tropical rainforests provide ideal living conditions for amphibians and as reptiles are the main predators of the frogs and toads their presence should be expected also. Unsurprisingly we have accumulated a fantastic data base over the last ten years and have registered 51 species of amphibian and 63 species of reptile: a total of 114 species.

Methods:

Data is collected by using pitfall traps, night walks and opportunistic encounters. Pitfall traps are a standard technique for studying amphibians. Long strips of plastic are staked in the ground along an imaginary line of 30 metres creating a wall about 40cm high. Every 5 metres a hole is dug and a bucket placed. Frogs and toads walk into this unnatural barrier and follow it sideways looking for a way around. Whilst following the wall they fall into the buckets and can be collected and studied the following day. Many species of frog and toad

are only possible to identify in the hand and even then complex identification keys must be used to reach a positive identification at species level.

Night walks are excellent for studying and capturing both amphibians and reptiles as strong flashlights can be used to search for the reflective shine from their eyes. Most of the rainforests animals are nocturnal and reptiles and amphibians are no exception. Membranes covering the retina shine brightly in direct light and enable us to capture them more easily.

The tropical rainforests support more forms of life than anywhere else on the planet and as such a walk in the jungle will undoubtedly present you with many encounters of both reptiles and amphibians. Volunteers and staff always carry plastic bags when covering the reserve's extensive trail system and animals are brought back to the lodge for identification before being released in the same area. This is very important as amphibians and reptiles, especially snakes, are very territorial and any animal collected must be returned to the same location.

Future Plans:

Currently the herpetology project is on standby but we continue to monitor the species of the reserve in opportunistic encounters. After ten years of research we have a very extensive species list but we must continue to register a high diversity of amphibians to ensure that the ecosystem is healthy.

## 8.4 Bats (Chiropterology)

Summary:

There are an estimated 1,100 species of bat in the world. The class Chiroptera represents mammals with the ability to power flight and bats make up almost 20% of all known mammal species in the world. In Taricaya we have recorded 67 species of bat, 6% of all known species on the planet. The land area of the Earth is 149,000,000 $km^2$ and yet in 476 hectares (4.76 $km^2$) we have a disproportionate number of bats. These figures coupled with our other biodiversity research highlights Taricaya as a bio-diversity hotspot. Bats have an essential role to play in the ecosystem of the tropical rainforest as predators,

pollinators and seed dispersers. When designing any conservation strategies the study of bats is essential and their presence and population numbers can provide us with an excellent indicator of the health of the ecosystem.

Methods:

With the aid of a local expert from the University of Arequipa we have been studying the bats of the reserve using mist nets. At first we performed a general census in areas around the reserve but once our species list began to grow, we targeted different habitat types in search of specific types of bat. The mist nets are 12m long and are hung either simply or in rows of two or three. Sampling has been performed from the ground level up to a height of 6m and every individual is photographed and bio-metric data taken. During the day we also walk the trails looking for bat roosting sites and nests as these are logical places to open nets at night. Very little is known about the life history of many tropical bat species and we are investigating factors such as preferred tree species for nesting, feeding habits and seasonal variations and population dynamics.

Bats are very resourceful animals and we have large fruit eating species, agile insect predators and even two species of fishing bat (*Noctilio leporinus* and *albiventris*). In the case of the latter we are working with a local biologist to study the levels of mercury in captured individuals as part of general programing researching the contamination from increased gold mining activity. Animals that feed primarily on fish are excellent indicators of the mercury levels in the environment and reflect levels of pollution.

Future Plans:

With an extensive species list our sampling techniques have been effective. However we have very little knowledge of canopy dwelling species. Bats are important pollinators and dispersers of many species of orchid which are bromeliads found high in the trees. Very little is known about the symbiotic relationship between bats and orchids in that some species are completely co-dependent on the other. We are keen to design pioneering

methods to get our mist nets high up into the mid-canopy and tree tops and sample these elusive species. We also plan to work more on bio-acoustics as many species of bat are very difficult to catch in nets but analysis of their vocalisations with the correct software can help in identification.

We will also continue to study the areas where we have set up our transects previously so that we can monitor population numbers and relative abundance as an indicator of the health of the reserve's ecosystem.

### 8.5 Entomology

Summary:

Over 55% of all species on the planet are insects and 80% of all animals. Their success is due to small size, a hard exoskeleton, the ability to fly and metamorphosis. Metamorphosis allows the same species of animal to utilise two completely different body designs- one for feeding and growth (larva) and the second for reproduction and colonisation (adult). The classic examples are Lepidoptera. Butterflies and moths feed voraciously as caterpillars before changing into attractively coloured adults ideal for reproduction and dispersal. The tropical rainforest is home to hundreds of thousands of insect species, if not millions, and biologists discover and record new insect species daily. Effective conservation strategies should consider the importance of insects and at Taricaya we have spent the last eighteen months investigating the most abundant group of animals on the planet.

To date we have been able to identify 508 species from 12 different orders and 96 families. This includes butterflies of which we have 281 registered species and dung beetles of which we have identified 34 species. These two orders of insects have higher identification rates as we have performed specific studies on these types with the help of local entomologists from the University of Arequipa.

Methods:

Volunteers and staff walk the trails performing manual captures using plastic containers and nets. These animals are brought back to the laboratory where they are identified using classification keys and one of each species is mounted using entomological pins for future reference. This methodology is essential as the classification of insects is incredibly difficult. One can open a book on butterflies and see photos of hundreds of species that appear identical to the naked eye. By producing a collection of individuals that have been successfully identified we can speed up the classification process with recaptures. A further advantage to preserving individual specimens is that we can study them at leisure. An average “insect walk”, as we name the project, could produce 20 or 30 individuals that we cannot recognise straight away and hours must be spent in the laboratory trying to get a positive identification at species level.

Other techniques involve the use of pitfall traps. These are simply designed with small containers buried in the ground to catch terrestrial insects. At night we connect a battery to a bright bulb placed in front of a white sheet. This light attracts nocturnal insects that we can collect easily from the hanging fabric.

Future Plans:

The importance of insects to the rainforest ecosystem dictates that we must continue to research this incredibly diverse order of animals. Insects are prey, pollinators, disease vectors (important natural biological controls) and predators within the forest ecosystem and birds, amphibians, reptiles, plants and mammals all rely on insects in some way. The more we can understand about the most successful group of animals on the planet the better. This project is now a seasonal one as we invite entomologists to the reserve when possible to continue our research.

## 8.6 Botany

Summary:

The plant diversity in the Amazon rainforest is overwhelming. Estimates claim that one hectare of jungle can be home to over 3,000 different species of plant, yet strangely there

are very few botanists in Peru that specialise in this richness. We were able to hire one such specialist for a year of research and the results were exciting yet discouraging. For every tree or shrub we positively identified there seemed to be 4 or 5 we could not. However, we have a sound base with 257 species identified- 185 angiosperms (flowering plants), 24 pteridophytes (ferns) and 48 mycophytes (ferns).


Methods:

Periodically specimens were collected from different habitats located within the reserve (sterile samples, flowers, fruits and seeds). This material was duly returned to the laboratory for processing and identification. Secondly, several tree samples were marked around the reserve. These were evaluated on a monthly basis to discover the phenological state (life cycle) of the species that in time will demonstrate a pattern for flowering and fruiting respectively. The assimilation of this data will help us understand the seasonal movements of the resident fauna.

Finally, we wanted to study the productivity of the forest and its structure and composition. This data will allow the exact calculation of the amount of vegetable matter (biomass) the forest is producing as a resource for the animal species found in the area. Leaf-litter traps have been placed strategically in different habitats. The future results will generate an accurate measure of the productive cycles of the Amazon rainforest and the inherent seasonal variation (wet and dry seasons).

Future Plans;

The collation of all this data will generate a complete evaluation of plant diversity within the reserve, coupled with the uses, importance and ecology of the plant species present. In addition, the project will allow us to evaluate, analyze and understand patterns of forest behaviour, productivity and processes of regeneration; in turn, we can apply forest management techniques designed for long-term conservation of the rainforest. We hope to continue this research in the future.

# 9 Pilot Farm Project

## 9.1 Aims

The concept of the pilot farm is to help the locals manage their land efficiently and hence reduce their impact on the surrounding forest. Hunting, fishing, timber extraction, charcoal burning and palm leaf collection are time-consuming and labour intensive activities which they would gladly rescind given the opportunity. We, at Taricaya, are fortunate enough to be able to perform various experiments with crops and productivity that local farmers do not have the luxury of testing. We are now in a position at Taricaya where we have created a self-sufficient module for local families. With this model established we have been helping local communities in the management of their land.

The second phase is an agroforestry project designed to help farmers recover abandoned farm plots with timber and plants that will provide high income from lands already left fallow. The soil in such plots is infertile and cannot support high density crops such as maize, rice and bananas. However with careful management and natural fertilisers they can be turned into productive wood plantations or fruit farms.

## 9.2 Summary to Date

Taricaya now has two plots of land where we work. The original farm plot which was started in 2004 is now being maintained and used as a base for the production of saplings for transplantation to other areas. The second is a newly acquired area that had been abandoned by its former owners and we are trying to make the land productive again to demonstrate that it is, indeed, possible. Whilst working with traditional crops we have also been working with tropical flowers, mostly from the Heliconia family, that are being produced and sold both locally and elsewhere in Peru.

## 9.3 Methods

In Peru, and indeed most developing countries, monocultures are recognised as the standard farming technique. Huge areas of land are cleared for the planting of one major crop such as corn or rice. Not only does this require a lot of area but maintenance is high and the risk involved is great. Disease, drought or flooding can wipe out a farmers entire

production and he is forced to start over, often without the financial means to do so. At Taricaya we have been working hard on polycultures whereby we plant many different crops in the same farm plot and so the farmer can produce more at less risk. For example, one can plant bananas and cocoa initially, these trees grow quickly and the shade can be used to plant coffee, chillis and pineapples. This is a very basic example but already the farmer has five cash crops in the same area producing at different times of year.

This model is one we have worked hard on and have achieved not just with plants but also livestock (goats, chickens, sheep and even guinea pigs- a delicacy in Peru). Volunteers now help in the maintenance of the first pilot farm and help us work with the local communities when necessary.

The second plot was an abandoned farm and we have begun work by trying to recover the land with bananas and corn (for the animals in the rescue centre, and us!). These crops will produce short term but simultaneously we have planted saplings of timber species of tree that will grow whilst we harvest the other crops. The idea is to demonstrate that reforestation is not independent of working the land and can be done in parallel until the trees are big and the other crops out-competed.

### 9.4 Future Plans

We hope to confirm that the recovery of abandoned lands is both possible but also profitable to the owners. By making reforestation economically advantageous we hope to convince more people to become involved in our work, either independently or with our help. Education and project awareness are vital in communicating our success and whilst local television and radio shows have taken an interest already we hope to expand our area of influence.

## 10 Reserve Monitoring and Investigation

### 10.1 Aims

- Effectively monitor our 476 hectare reserve against poachers and loggers

- Create and map (with GPS) a complete trail system within the reserve

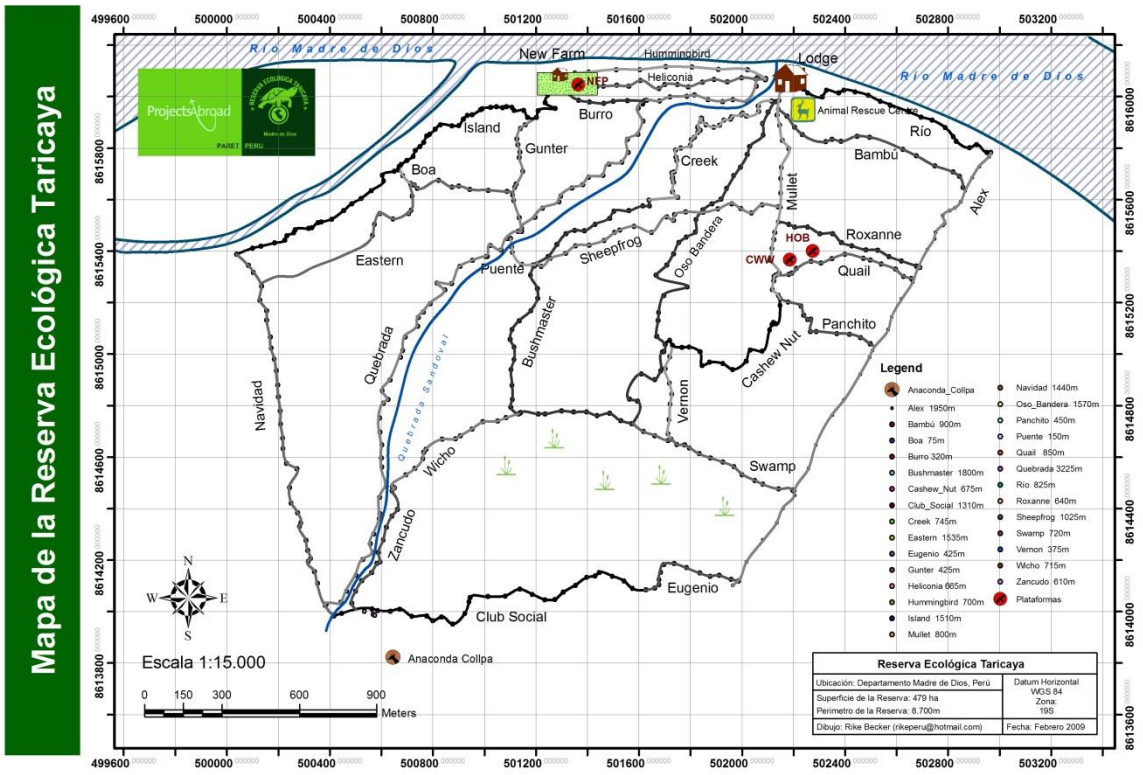
- Identify and connect micro-habitats and points of interest such as bamboo thickets, mammal colpas and emergent trees

- Allow complete access to all parts of the reserve for investigation

- Mark all trails with name signs and distances every 25m to make our research easier- this data can then be cross-referenced with the complete GPS map

## 10.2 Summary to Date

We have opened a system of trails that totals in excess of 57km. We have GPS mapped the whole area and have created a border limit trail that circumvents the entire reserve. Points of interest such as the canopy walkway and mammal colpas have been accessed and all trails are signed and marked every 25m.




## 10.3 Methods

Points of interest in the reserve were located by the use of indistinct temporary trails marked by staff and volunteers when canvassing the area. Such trails may use animal paths, such as those created by tapirs and peccaries, as they invariably lead to water or food and other routes opened up by tree falls or natural depressions. Routes are mapped with GPS to avoid getting lost and once points of interest such as swamps, colpas and streams were located we then cleared direct permanent trails that were marked and mapped.

## 10.4 Future Plans

We must now continue to maintain this trail system open. Heavy rains and storms cause trees to fall frequently and we must either clear these obstructions or divert the trail which must then be re-plotted. Whilst we have an excellent knowledge of the reserve we are always looking for new points of interest and signs and distance markers must be continually repaired and updated.

# 11. Butterfly House Project

## 11.1 Aims

- Build a butterfly house at Taricaya

- Study the reproductive behaviour and breeding rates of the owl butterfly (*Caligo oedipus*)

- Investigate the diversity of butterflies in the reserve

## 11.2 Summary to Date

The construction of a large enclosure and adjoining laboratory has enabled us to successfully breed and study our main species of interest- the owl butterfly. Its distinctive markings make it a favourite choice all over Peru for people making souvenirs for tourists. Whilst illegal, the mounting and sale of these butterflies is profitable and so the trade continues. We are not just focussing on this one species as the family of Nymphalidae butterflies also has another genus of great interest- *Morpho*. These large butterflies are found all over tropical America and there may be as many as 147 subspecies. These species are also captured for sale as they all have a bright blue colouring on the tops of their wings which disappears when closed. We are starting to identify the different species in the reserve and observing their behaviour in the butterfly house.

## 11.3 Methods

To capture the butterflies we use two techniques- hanging traps and manually with nets. The former requires the preparation of a sugar rich “bait” which can be rotten bananas, fruits left to ferment in alcohol or sugary water. This is then placed on a hanging dish with a net attached above it. There is a small gap between the net and the plate so that the butterflies can reach the food. However, butterflies always take of vertically and so fly straight upwards and become trapped inside the net. This technique is very efficient and the butterflies are completely unharmed. The second technique using nets is more straightforward but can be more effective especially in open areas.

Once in the butterfly house the numbers are controlled and food provided for the residents. Once they start to breed we separate the caterpillars and provide them with food in separate containers in the laboratory. This means that we avoid competition between the larva and their growth is quicker. Once the larva chrysalises, the pupae are hung in dry conditions to facilitate the birth of the adult butterflies.

### 11.4 Future Plans

We must continue to study the diversity of Lepidoptera (butterflies and moths) of the reserve and try our success at breeding the owl butterfly with other species of the *Morpho* genus. The butterfly house requires constant upkeep and the tending to plants known to provide food for the butterflies we are studying.

## 12. Mahogany Project (*Swietenia macrophylla*)

### 12.1 Aims

- Demonstrate that mahogany trees can be grown in high densities in open areas

- Monitor germination success, growth rates and the effects of attack by the *Hypsiphyla grandella*

- Teach the management of mahogany plantations and the uses for the wood of younger trees

### 12.2 Summary to date

Mahogany trees and indeed many other species of commercial timber are almost extinct outside protected areas. This means that loggers are now focussing on other tree species and the threat to the rainforest is becoming ever greater. If we could prove that commercial plantations of high-quality timber are not only possible, but profitable, then we would reduce the pressure on the forest. People would happily manage their lands and trees if

the benefits were high enough as logging is hard work and the price of timber from low quality trees is poor.

Germination beds of 1.5m by 15m were built and mahogany seeds were carefully prepared and planted in sawdust compost. Over 80% of the seeds germinated and after 30 days these saplings were transferred to a second area with greater space between plants. Each plant was carefully extracted to ensure no damage to the roots and then planted in earth that had been loosened and fertilised with compost. After a further 3 months these plants were then planted at the pilot farm in lines 2 metres apart and with a space of 3m between each plant.

During the whole process we had to combat the attacks of an aggressive parasitic wasp, *Hysiphlya granella*. This insect lays its eggs on the young trees and the larva hatch and attack the tree. The moth lays at the tips of the trunk and can cause the tree to send out branches as it is unable to grow upwards. This stunts the growth of the tree and causes the trunks to distort. The life cycle of this moth means that it will only fly to a height of about 3m above the ground and so we had to fumigate the trees until the forks passed that height.

Growth rates and survival percentages were monitored and we sent the wood from a 5 year tree to the University of Lima for tests. The results were encouraging as that the young wood has the same properties as that of an adult tree in that it has the same density, resistance to fungus, and characteristic graining. The only difference is that the younger wood lacks the red colouration of mature mahogany. These findings were very important as it meant that younger wood can be worked and farmers wanting to get involved in the project would have an income before the tress reach full adulthood.

## 12.3 Methods

With the mahogany plantation now established we continue to measure growth rates by taking data such as tree diameter at 1m above the ground, tree height and evidence of attack from insects. Our work now lies in managing the plantation. As the trees continue to grow they compete with each other for light and nutrients and so we must cut down some trees to leave space for others. This is the key to the success of the project. Farmers have never wanted to reforest land as the wait for productivity is too long. By logging trees after

just 5 years we make the project more attractive and financially viable to people needing to make money from their farms.

The young wood is taken back to Taricaya where we have a carpentry workshop. Lathes and other tools allow us to work the wood and create products for potential sale. The problem of the red colouration is solved by slow-boiling the bark of the trees in water and after three or four hours the essence is reduced and the red dye mimics that of older wood. The whole process is natural and we aim to produce bits of furniture, lamp stands etc. with the wood of young trees to demonstrate that the plantation is profitable whilst waiting for the big pay out of fully grown mahogany trees.

### 12.4 Future Plans

We have proven that high density plantations of mahogany are possible. Previous conceptions that young saplings only flourish in shade or that high densities make the attacks of *Hypsiphyla* uncontrollable and other such theories have been disproved. Our job now is improve awareness of our work by producing high quality products at Taricaya and even more importantly our 8 year old trees will soon start to produce their own priceless seeds and we must carefully evaluate what to do with them. Should we rebuild our own nursery to ensure the production of more saplings to be given away or try and encourage locals to try it themselves? Each case must be assessed separately to make the most of this precious resource that can reduce the destructive impact logging is having on the rainforest.

## 13. Other Projects

### 13.1 Environmental Awareness Campaigns

Our conservation work at Taricaya is innovative and showing positive results. However, it is our responsibility to raise awareness of conservation issues and we have taken huge strides with our research in attending conferences and publishing scientific papers. This international recognition has led to multiple documentaries and articles on our work and this publicity makes people aware of what we are trying to achieve. In Peru we have been featured on both local and national television stations and radio and our reputation is for honest work and creative projects. That said we can always do more and we have thus far organised drawing competitions in local schools and a recycling project with prizes presented in the main square by the local mayor. We shall continue to work on getting children interested in the conservation of their natural resources as they are the future generation that must help if we are to save the rainforest.

### 13.2 Data Input and Analysis

With so much research performed at Taricaya we have hundreds of data collection sheets that need processing and analysing. Volunteers help us input this data to produce species lists, project results and government reports. This activity is usually undertaken on rainy

days when we cannot venture outside but is invaluable nonetheless as we have many publications and more to follow. Other goals include producing field guides to the animals of the reserve- birds, bats, frogs etc.

### 13.3 Animal Behaviour Studies

Part of the animal rescue centre's work revolves around studying our captive animals and analysing their behaviour to ascertain their suitability for release. For example, in the case of the larger primates we must establish troops prior to release and so we must study all the residents and watch how they interact with each other. A dominant male and female (alphas) should be identified in the group designated for release as they will lead the monkeys once back in the wild. Some individuals are unsuitable for release as too much time in captivity before reaching us has modified their behaviour and dampened their natural instincts. These animals must be singled out as release would lead to certain death. Such animals can be used in captive breeding programs or will just live out the rest of their lives in comfort at the centre. Many other experiments and studies are performed such as cage enrichment where we provide our resident animals with as many stimuli as possible and try to shape their behaviour to resemble that of a wild animal thus improving their survival chances upon release. Volunteers will work on all aspects of this including taking data and working in the animal enclosure.

## 14. Implementing the Plan

As Projects Abroad places volunteers, interns and professionals into hundreds of projects worldwide, it is vital that these resources are deployed in a way that utilizes their strengths and coincides with the aims and objectives of the project.

To ensure all resources available to the project are being used correctly Projects Abroad employs nine staff on site directing the daily activities and ensuring research is being carried in accordance with this plan. Further back up is provided in Puerto Maldonado with two more staff members. Projects Abroad also has a conservation programme director ensuring constant consultation with experts and correct management of the project.

## 15. Reporting on Research

Data collected at the project will be sent to Projects Abroad head office in the U.K. to be reviewed by the Conservation Programme Director. Internal reports will be written using these data sets and made available to the public through a public domain.

When data sets are sufficient, reports will be peer reviewed by leading experts with the aim of publication in scientific journals.

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