# Project Tambopata:

## A report for the James Rennie Bequest Fund

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# TReeS - RAMOS Project Tambopata

## The Impact of tourism activities on Amazonian wildlife populations in the Tambopata-Candamo Reserved Zone, south-eastern Peru.

### Introduction:

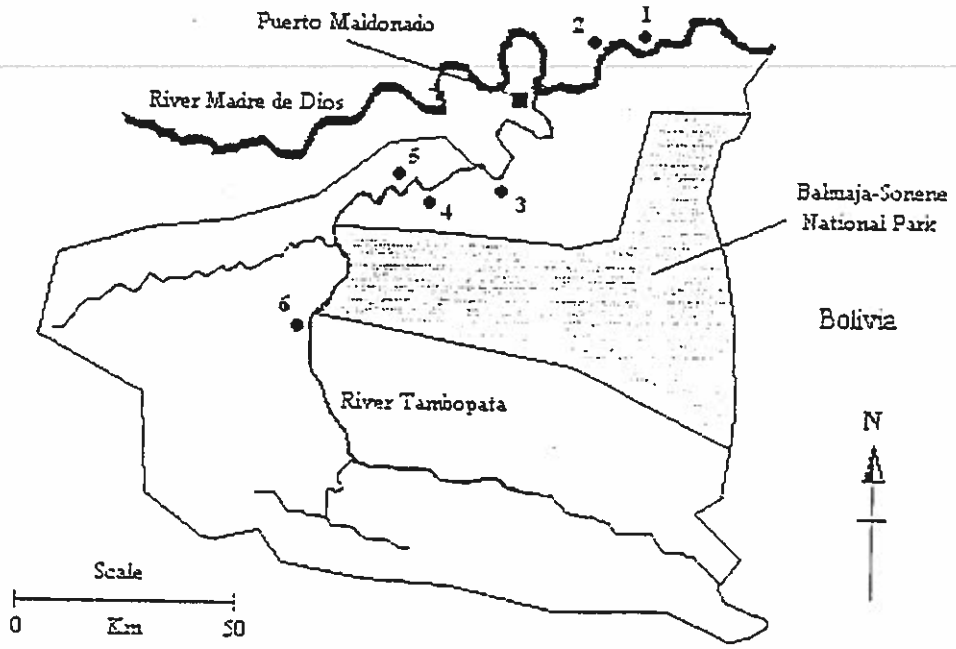
The increase in global tourism over the course of the last 3 decades has brought with it a shower of mixed blessings. As the rate of habitat loss has grown, and wild areas have become more and more elusive, people have been prepared to pay increasing amounts of money to see it. This brings in capital to those areas, which is especially vital for the developing nations, but the increased access this brings lowers the barriers that have kept it wild for so long. This problem can be found around the world, and the socio-economic aspects are well studied and understood. What is less well known is the impact that tourism can have on the wildlife itself, and on its habitat. TReeS-RAMOS Project Tambopata, which I was lucky enough to be involved with, was initiated to examine the effect of increasing tourism in one of the natural worlds great wonders, the rainforest.

The eastern end of the Amazon basin, where it approaches the Andes, has long been known as one of the most biologically diverse areas in the world, along with areas in Indonesia (Whitmore, 1991) and the *Protea* scrub of South Africa (Di Castri *et al.* 1981). There are many ideas over why this great concentration of species exists here, but we do not need to know exactly how it came to be to be able to conserve it. The Tambopata-Candamo Reserve Zone or (TCRZ) lies within this belt at the foot of the Andes(13 ° S, 69 ° W), in the south eastern corner of Peru (see Figure 1). It covers some 14,000 $km^2$, encapsulating within it a continuum from lowland (250m above sea level) to montane forest, 3500m up in the Andes. Since 1996, 3,300 $km^2$ of this area has been placed in the strictly protected Bajuaha Sonene National Park, mainly because most of it is inaccessible, thus ensuring its survival for the next generation.

The reader will be familiar with the ability of tropical biologists to wax lyrical about how diverse and how many red data book species are present in their reserve, so I leave it to your imagination. See Terborgh (1990) for a general impression of the biology of the region. Land use in the TRCZ is controlled by the National Institute for Natural Resources (INRENA), who allow small scale farms along the rivers (chakras), which grow bananas and other fruit for market and subsistence grains for themselves. The farmers also gather brazil nuts and hunt in the forest behind. Some timber extraction is permitted under strict license, but illegal logging is a threat, especially near the road to Cusco (in the Andes). The Tourist lodges are, with a few exceptions, found within this area, and more are planned for the near future.

The tourism industry is on the rebound after a long depression during the days of the Shining Path, who did much to discredit Peru on the international scene. Before 1990, there were only two lodges, and the number has risen since then to eight. The number of visitors has also risen accordingly, from 200,000 in 1992 to a predicted 1 million in 2000.

Figure 1. Diagram of the Tambopata-Candamo Reserved Zone showing location of lodges to be investigated, (1) Eco-Amazonia, (2) Cuzco Amazonico, (3) Explorer's Inn, (4) Sachavacayoc Centre (CEDCON), (5) Tambopata Jungle Lodge, (6) Tambopata Research Center.




Project Aims:

The principle aim of the project is to obtain data on how the number of tourists in a lodge (and hence walking on its trails) affects the local wildlife. There is a dearth of information of this kind for rainforests generally, but other ecosystems are well covered in the literature (e.g. African savannahs, see Sinclair & Arcese, 1995). The relative novelty of 'ecotourism' as a viable venture has meant that the impacts of excessive tourism are only now starting to be felt, and thus scientific interest has begun in earnest. The complexity of the rainforest ecosystem has meant that more rigorous techniques must be used to get valid data, as well as a longer term approach.

The project is thus a two year study (from January 1997), and it focuses on the 'charismatic vertebrates', as these are the most important for the lodges. The methods for each of the four taxa (mammals, birds, amphibians and reptiles) are based year-round survey of the relative abundance of species on and away from the walking trails, as this provides a figure for the differential diversity between disturbed and undisturbed sites. The official project aims are:

1. To map tourist trail use on lodge trail systems,
2. to identify and record patterns in the distribution, abundance, diversity and behaviour of four taxa in forest dominated by tourist trails and tourist installations (lodges) and to compare these patterns with those identified at the control sites,
3. to determine the degree to which tourism disturbance alone can explain why any variation observed in (2),
4. to identify and record indicator species for tourism related disturbance in each of the four taxa concerned,

5.to collect systematic data on rare species to augment the knowledge base of the population status of these taxa within the TRCZ,

6.to provide data on which to base appropriate trail and tourism management decisions, for instance the identification of optimal trail use intensities,

7.to provide training (and an equipment base) for Peruvian scientists to build the national capacity to conduct similar work elsewhere in the country and to continue monitoring activities beyond the end of the project.

(from Kirkby & Lloyd, 1996)

Personnel:

Each of the two years is divided into quarters, which is the length of stay for the volunteers, half of which are Peruvian, half from the UK and North America. There were two co-ordinators for each of the three groups (mammals, birds and herps), one Peruvian, one foreign. I myself was on the third phase of 1997, from 3rd July to 25th September, on the amphibians and reptiles team (herps). There are, on average, four volunteers in each of the teams. The project also had a charismatic chef, 'Peaches' and an amorous boat driver, Victor. The volunteers contribution part paid for a house in Puerto Maldonado (see Figure 1), where the project was based.

Methods used:

Due to the wide range of vegetation types found in the rainforest, and the obvious differences in species composition between them, it was decided to concentrate on a forest type that was present at all lodges. The only type that was present in abundance was terra firme and old flood-plain forest, which is infrequently flooded. The other types were too scarce, too likely to be underwater in the rains or not present at all sites. At each of the six sites the teams undertake intensive sampling of their previously designated survey areas. I will only summarise the herp methodology here, purely because it is the one I am familiar with, but see Appendix 1 for a brief summary of all the methods (taken from Kirkby & Lloyd 1996). The actual methods used differ slightly from those given in the appendix.

The herp methodology was based around those given in the 'Standard Methods for Assessing Biodiversity: Amphibians' book, the like of which are invaluable for this type of research. Our remit covers three main groups: frogs and toads, lizards and snakes, and these obviously require different scales of sampling to get an adequate sample for each. For the smaller and less obvious frogs and toads, a system of intensively searched quadrats was devised. The more thinly spread reptiles were sampled on visual encounter surveys along transects.

*Quadrat sampling:*

Two pairs of 70 x 80 m plots, two on the tourist trails (treatment), and two at least 200 m away from them (control) were laid out at each site. Within these, 64 8x8m quadrats were marked out. At each visit to the site, 30 were sampled, 14 during the day and 16 at night. They were intensively sampled up to a height of 2m by four people for around 17 minutes. All anurans, lizards and snakes found inside were captured and taken to a recorder at the edge. The anurans and lizards were marked using a toe-

clipping scheme (it's the best way to do it, and they don't mind), and released back into the quadrat. The aim of marking the anurans and lizards is too allow a mark- recapture scheme to be run, giving population estimates when that quadrat is resurveyed in 3 months time. The snakes were taken home for scale counting and photography. The number and girth of all the trees with a dbh>10cm within the quadrat was taken, along with 16 leaf litter depth readings. The weather conditions (cloud cover) and temperature were also recorded.

*Transects:*

Two hectare plots were marked out, one treatment, one control, and within each 24 transects were cut, to allow easy passage. 16 were sampled at night, 8 during the day. Two people walked slowly (for 30 minutes) along the 100m searching the two metres on either side, and catching all the anurans, lizards and snakes that were seen. The mark recapture regime was the same as for the quadrats, but no habitat data was collected. Once again the cloud cover and temperature were recorded. This method covers a larger area (~600m), but not in such detail as the quadrats.

All individuals caught were weighed and measured where possible (you try getting a 1.5m bushmaster (*Lachesis muta*) into a weighing bag). Any individuals who posed a taxonomic problem were 'collected' for speciation later. The herp team are trying new sampling methods to focus on specific problems encountered, such as the dorsal patterns of *Bufo typhonius* (a cute purplish toad), and the fascinating *Chiasmocleis ventrimaculata*, which lives symbiotically with tarantulas.

Discussion:

I am unable to present any form of results here, mainly as they are not yet fully collected, but also because I don't have them. This is not an ideal vehicle for their full presentation and analysis in any case. In this section I would rather talk about the new perspectives and ideas that have come to me through the project, and hopefully somebody somewhere may find it useful.

A large moan of mine about the sort of data collection described above is that it is all survey data, and it does not address any one hypothesis satisfactorily. Thus, at the end of the project, the data may point in a direction, but will not demonstrate anything. In defence of Project Tambopata, the data will give invaluable help on the development of management strategies, which may be more important at this stage.

It strikes me that short term survey work, which is often done by default in these ultra-diverse biomes contributes very little to knowledge of the area, or scientific understanding as a whole. This is usually due to a lack of density data in the first instance, and the lack of applied hypothesis testing in the second. The rainforests mysteries can only be unravelled by careful examination of its components and how they interact, and not through species list compilation. What is more, in this biome, progress can be made through simple, well thought out experiments of the sort that were done long ago in the northern hemisphere. This means that there is potential for student projects visting the area to really contribute to local and international understanding of the area. I also feel that it is vitally important to involve the local population in any

scientific work, as Project Tambopata does. Without this, none of the experience from the project will filter down to the people who really need it.

The data being collected on the dorsal patterning in *Bufo typhonius* is mainly my idea, as I want to see if there is an environmental or taxonomic reason for their different forms. The data encompasses the sex, size, dorsal pattern, two subspecific markers (the presence of crests above the eyes and protruding bones at the jaw articulation) and when and where the individual was caught. I hope to analyse the data using a form of principle component analysis and cluster analysis. This should show up any co-occurrence of pattern and morphological features.

## Conclusion:

Project Tambopata has given me a marvellous insight into the tropical rainforest, for which I am profoundly grateful. It has also refired my childhood interest in frogs, and I am now hoping to be able to do further research with them after I graduate. I have also picked up a working knowledge of Spanish and a little Quechuan swearing, which is more useful than it sounds. The money provided by the Rennie Bequest was instrumental in funding this trip, as well as the generous offer of employment by Prof. Jarvis. I sincerely hope that others will be able to follow in my footsteps to this astounding place.

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Appendix 1

**Bird Surveys**

*Point Counts* : A grid system of 15 permanent census stations (see Figure 2) will be positioned near to a trail with a known tourism-use level. The design is such that sampling can be undertaken in forest progressively further away from this trail. A further three census stations will be situated at a distance of 600 meters from the trail in floristically similar forest and will act as a Control. The distance between neighbouring point count stations will be 150 meters and each station will sample an area of forest equal to 1,258 $m^2$ (i.e. a circular area of radius 20 m). Fifteen of the eighteen census stations will be visited daily at random between 0530hrs and 0930hrs for 10 minutes each (this census period being divided into five two-minute intervals). The following data will be collected on bird-contacts, i.e. any bird that enters the area of the point count station; species, number of individuals, observer-bird distance (m), type of contact (vocal, visual), height of bird contact (either ground; low, 1-5m; mid, 5-15m; high >15m), time of contact. Two observers will undertake this data collection simultaneously at each census station. The position of bird flocks observed while walking between census stations will also be noted.

*Mist-Netting* : Due to the difficulties in detecting cryptic species using the aforementioned method and to provide for comparative analysis of methods, direct capture of birds using mist-nets will be implemented. Mist-nets will be assigned to the same areas delimited by the census stations. Leg rings will also be used to permanently mark captured individuals and will allow for long-term recapture studies as well an aid to the investigation of the behavioural response of birds to tourism disturbance.

The method will involve the allocation of mist-nets to three census stations, chosen at random on a daily basis (see Figure 2). In each case three mist-nets (each 2 m tall, 12 m long and 36mm mesh-size) will be placed in series across the centrepoint of the census station. Nets will be opened at 0600hrs and closed at 1500hrs. Visits will be made at intervals of 45 minutes. The following data on captured individuals will be collected after ringing has been completed: Species, Time, Net Number, Level in Net, Weight, Sex, Age, Culmen Length, Tarsus Length and Wing Length. Note: point counts will not commence again until 48 hours after mist-nets have been taken down.

*Sound Recordings* : Professional recording equipment will be used to record the dawn chorus at four census stations chosen at random. A knowledge of species specific songs will permit the identification of gross species diversity at each census station.

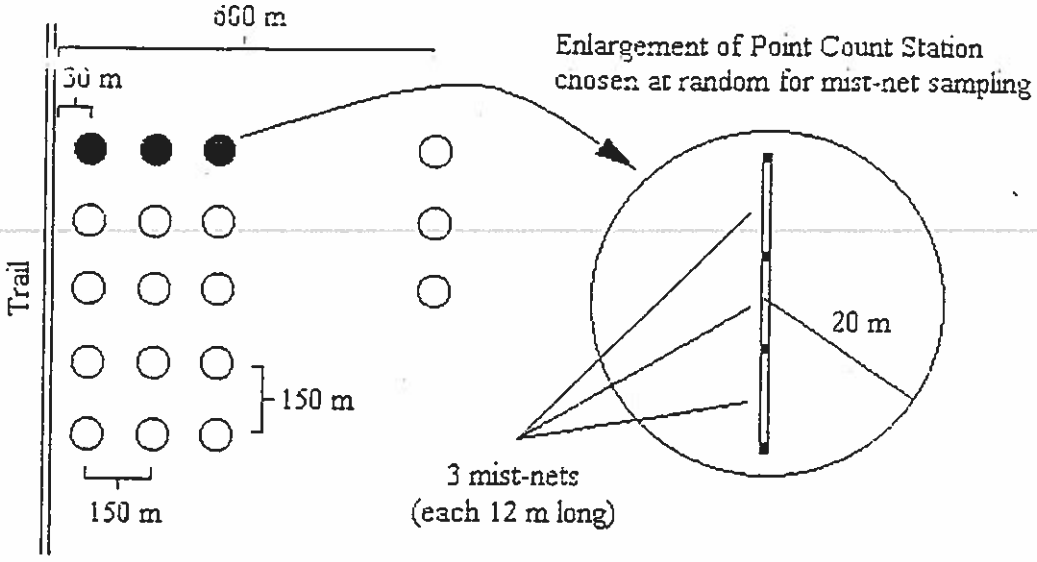


**Figure 2.** Schematic diagram of layout of point count stations and mist-net locations.

*Behavioural Studies* : Bird behaviour will be recorded at the census stations following the mist-netting and point count studies. The response of birds to different numbers of people, and the different noise levels created by varying numbers of people will be recorded and will be ranked into behaviour categories e.g. no effect, stop foraging, flee from observer, flee and call, etc. The different noise levels (e.g. x number of tourists talking, or shouting or silent) will be pre-recorded and standardized, and played back over a ten minute period at each census station.

*Habitat Survey* : Although all census stations will be placed within floristically similar forest it will still be necessary to investigate the major aspects of vegetation structure which characterize a station and will be important in comparative evaluations between stations and between lodges. Therefore, a systematic habitat survey will be undertaken at each census station. The survey will consist of determining percentage vegetation cover at varying heights; 0-1m; 0-2m and canopy. The ten nearest trees to the centre point, with dbh >20cm, will be identified to family/genus and their height determined with a clinometer. Physical and biological characteristics such as architecture, whether the trees are alive or dead, in flower or in fruit, deciduous or evergreen, will also be noted, as well as the slope of the site and the presence of nearby tree-fall gaps.

## Mammal Surveys

*Line transects* : This method will be performed along established trails used by tourists and control trails. Mammal sighting frequencies will be recorded by two observers as they move slowly and quietly along a transect line at a rate of 1-1.5km/h, stopping periodically to watch and listen for the presence of mammals. Upon detecting an individual or group up to ten minutes will be spent *in situ* recording data such as: detection method, time, height, behavior, distance along transect, observer-mammal distance, sighting angle, perpendicular distance from the transect to the individual, total number of individuals estimated to be present, presence of vocalizing but unseen individuals and general reaction of individuals to the presence of the observers. Individuals will be considered solitary if nearest neighbour distance is greater than the normal conspecific group width. Observer-mammal distances will be estimated by eye.

Transect surveys will be undertaken in the early morning and in the late afternoon only. A survey will be abandoned if rain falls continuously for 30 minutes. During short interruptions due to rain observers will remain stationary. Consecutive samples, along any one transect, will be initiated at least 24 hours apart and direction of travel will be reversed.

*Sweep sampling* : This will involve at least three observers walking parallel 500m-long transects in concert. Each transect is separated by a distance of 50m or the visual horizon, whichever is smaller. Sweep survey transects will be sited in forest alongside established trails and alongside control trails. Data to be collected will be similar to that associated with Line Transects (above).

**Amphibian and Reptile Surveys**

*Quadrat sampling* : Three one-hectare plots, each situated at varying distances from established trails, will be identified. Within these, numerous quadrats (each 64 $m^2$) will be systematically sited and searched for herpetofuana under the cover of darkness to a height of 2 m, for a period of 30 minutes each. All herpetofauna encountered will be identified by sight or captured for identification. Individuals captured will be weighed and measured. Plots will be searched over a number of nights until a total of 150 individuals have been identified.

*Artificial Ponds* : Three groups of three artificial ponds (water-filled plastic tubs) will be sited at varying distances from established trails. These will act as a magnet for local amphibian species who will converge on the ponds to breed. Daily surveys of amphibians within these ponds will be undertaken to build up a picture of relative diversity and relative population levels of particular amphibian families though their effectiveness will be restricted to the drier months of the year.

*Nocturnal and Diurnal Belt Transects* : Transects, measuring 100m long and 2m wide (1m either side of the transect line) will be sited along and parallel to established and Control trails. Transects will be searched for herpetofauna by day (early afternoon) and by night (late evening) with the aid of head torches and eye-shine.

*Habitat Surveys* : The following environmental and vegetative characteristics will be undertaken in herpetology plots and along transects; soil temperature, soil type, slope, litter depth, wet litter mass, number of herbs, saplings and trees greater than 10cm dbh, vegetation density, time of day and current weather condition, will be collected.