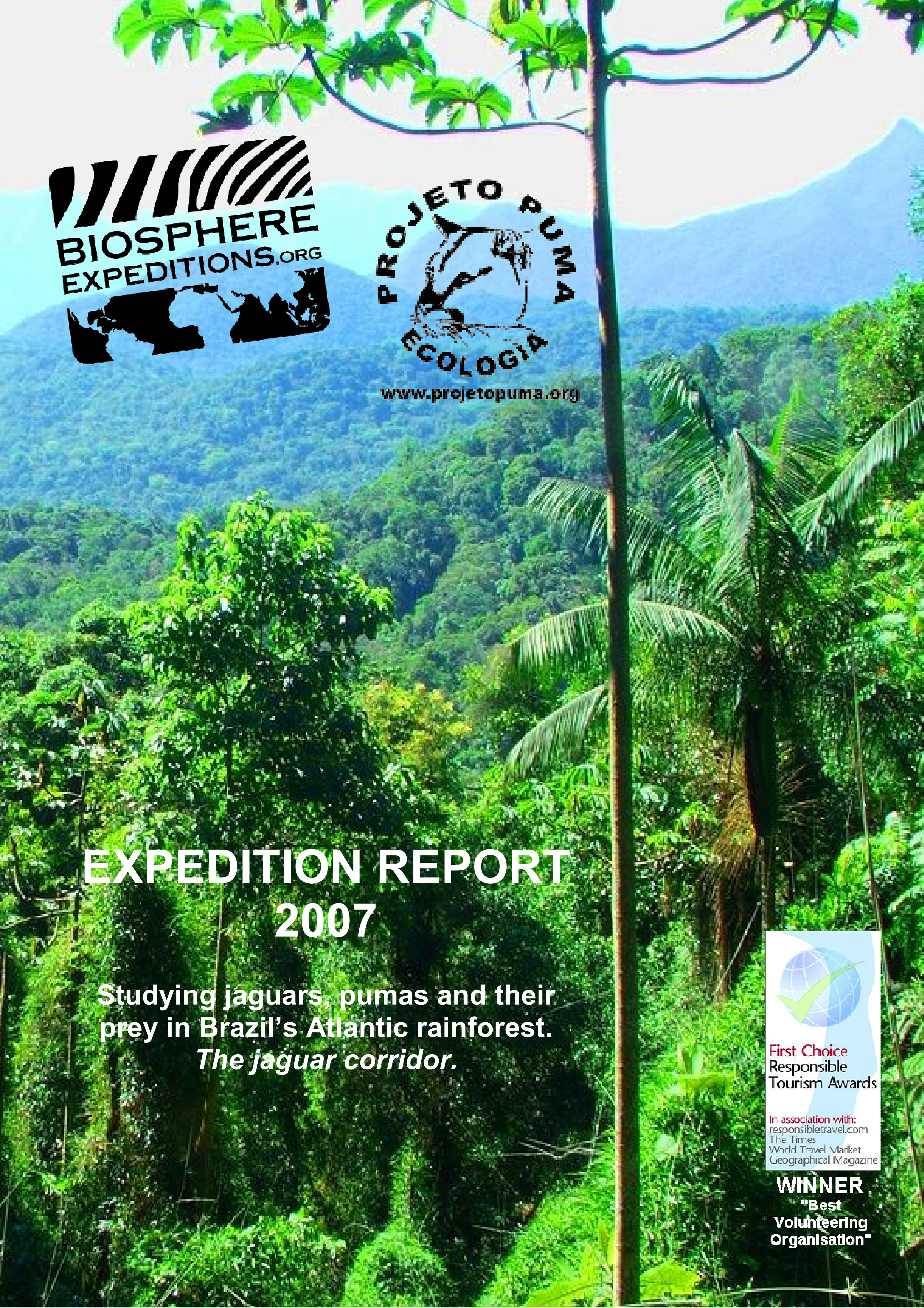

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EXPEDITION REPORT 2007

Studying jaguars, pumas and their prey in Brazil's Atlantic rainforest.
The jaguar corridor.

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EXPEDITION REPORT

Studying jaguars, pumas and their prey in Brazil's Atlantic rainforest. *The jaguar corridor.*

Expedition dates:
5 November – 1 December 2006

Report published:
May 2007

Authors:
Marcelo Mazzolli
Projeto Puma

Matthias Hammer (editor)
Biosphere Expeditions

Abstract

Expeditions to the southern Atlantic forest of Brazil were conducted with local students in August 2006 and Biosphere Expeditions in November 2006. They aimed to elucidate the current habitat conditions for jaguars and pumas, based on parameters collected from field sampling. Parameters collected were species richness for mammalian communities over 1 kg and proportion of area occupied (PAO) by jaguar and pumas (ocelot PAO was also calculated) in 8 quadrats 2 x 2 km over an area of 130 square kilometers. Species richness was estimated using CAPTURE software, and PAO was estimated using PRESENCE software.

Fourteen species of mammals were recorded (R) in total, and the same number of species was estimated ($\hat{N}$) by CAPTURE: Agouti *Dasyprocta azarae*, two species of brocket deer *Mazama* spp., capybara *Hidrochaerus hidrochaeris*, capuchin monkey *Cebus nigritus*, crab-eating fox *Cerdocyon thous*, howler monkey *Alouatta guariba*, jaguar *Panthera onca*, nine banded armadillo *Dasypus novemcinctus*, ocelot *Leopardus pardalis*, peccary (*inc. sp.*), puma *Puma concolor*, racoon *Procyon cancrivorous*, and tapir *Tapirus terrestris*.

Capture probabilities calculated from PAO were very high for puma (p=1) and very low for ocelot (p=0.15, SE=0.08) and for jaguar (p=0.1, SE=0.07), resulting in estimated PAOs of 25% for puma and 100% for both jaguar and ocelot. In other words, puma was easy to detect when present, so its PAO was the same as the 'naïve' PAO, i.e. the product of the number of quadrats where the species was found by the total number of quadrats sampled. Jaguar and ocelots were considered by PRESENCE, based on accumulated data, extremely difficult to detect even when present so that occupancy estimates presumed that they must be everywhere. Puma was recorded only by tracks, jaguar by vocalisation and tracks, and ocelot by tracks and camera traps.

It is argued here that jaguar were expected to have similar capture probabilities than puma, as they share the same habits of walking on open trails and being fairly easy to detect, provided the area is suitable for track imprinting. For this reason the high PAO was likely to be an artefact derived from the low area fidelity, and low density of jaguars in the area, rather than a product of its low detection probability. This conjecture is substantiated by the low frequency and non-detection of important prey species in many of the sampled quadrats. Only three species (deer, armadillo, and ocelot) were recorded during 351 camera trap nights, and frequency of tracks was equally low, including those of vulnerable prey that are generally easily detected when present such as peccaries and tapir. Species richness, presence of puma, and presence of vulnerable prey were higher further from human settlement. Low presence of vulnerable prey are certainly a product of human poaching and may be indirectly responsible for the reduced presence of jaguars in the area. The area is crossed by trails used for illegal extraction of palm heart resulting in extensive areas where adult palm stands are simply absent, and where poaching is likely to occur causing a reduction of wildlife populations. The problems connected with illegal palm heart extraction are also the ones connected to illegal (and mostly unrecorded) poaching.

It is important in this context to mention that this does not diminish the importance of the study site for jaguar conservation, as it is part of one of the few remaining blocks of connected jaguar habitat in the Atlantic evergreen forest. Instead, these observations identify management needs for these areas could be upgraded from corridors to full habitats if prey species were given opportunity to prosper.

Resumo

Expedições à Floresta Atlântica do sul do Brasil foram realizadas com estudantes locais em Agosto de 2006 e 'Biosphere Expeditions' em Novembro de 2006. Estas expedições tiveram como finalidade elucidar as condições atuais de habitat para a onça-pintada e o puma, baseando-se em parâmetros coletados durante amostragem de campo. Os parâmetros coletados foram riqueza de espécies de comunidades de mamíferos (>1kg) e proporção de área ocupada (PAO) por onça-pintada e puma (PAO de jaguatirica também foi calculada) em 8 quadrantes de 2 x 2 km na extensão de uma área de 130 quilômetros quadrados. A riqueza de espécies foi estimada usando o aplicativo CAPTURE, e PAO foi estimada usando o aplicativo PRESENCE.

No total, quatroze espécies de mamíferos foram registradas (R), e o mesmo número de espécies foi estimada ($\hat{N}$) pelo CAPTURE: Cutia *Dasyprocta azarae*, duas espécies de veado *Mazama* spp., capivara *Hidrochaerus hidrochaeris*, macaco-prego C*ebus nigritus*, graxaim *Cerdocyon thous*, bugio *Alouatta guariba*, onça-pintada *Panthera onca*, tatu-galinha *Dasypus novemcinctus*, jaguatirica *Leopardus pardalis*, porcos-do-mato (*inc. sp.*), puma *Puma concolor*, guaxinim *Procyon cancrivorous*, e anta *Tapirus terrestris*.

As probabilidades de captura calculadas a partir de PAO form muito altas para puma (p=1) e muito baixas para jaguatirica (p=0,15, SE=0,08) e onça-pintada (p=0,1, SE=0,07), resultando em PAOs estimadas de 25% para puma e 100% para a onça-pintada e a jaguatirica. Em outras palavras, puma foi facilmente detectado quando presente, de maneira que a PAO estimada para a espécie foi igual à PAO observada, i.e. o produto resultante do número de quadrantes onde a espécie foi encontrada pelo número total de quadrantes amostrados. Com base nos dados acumulados, a onça-pintada e a jaguatirica foram considerados pelos resultados de PRESENCE como sendo extremamente difíceis de detectar, mesmo quando presentes, de maneira que a ocupação estimada presume que estas duas espécies estão por toda parte. Pumas foram registrados apenas por rastros, onça-pintadas por rastros e vocalização, e jaguatiricas por rastros e armadilhas-fotograficas.

Argumenta-se aqui que o esperado seria a onça-pintada apresentar probabilidades de detecção similares ao puma, tendo em vista que ambas tem o hábito de caminhar por trilhas abertas e serem relativamente fáceis de detectar, desde que a área seja adequada para impressão de rastros. Por este motivo a alto PAO estimada para onça-pintada está mais para ser um artefato derivado de baixa fidelidade à área e baixa densidade da espécie, do que um produto de sua baixa probabilidade de detecção. Esta conjectura é substanciada pela baixa freqüência de mamíferos na área, incluindo as espécies-presa da onça-pintada e do puma. Apenas três espécies (veado, tatu-galinha, e jaguatirica) foram registrados durante 351 noites de armadilhamento fotográfico, e freqüência de rastros foram igualmente baixos, incluindo para as espécies vulneráveis de presas que geralmente são fáceis de detectar quando presentes, como os porcos-do-mato e a anta. Riqueza de espécies, presença de puma, e presença de presas vulneráveis foram maiores quando afastadas de ocupação humana. A baixa presença de presas vulneráveis foi certamente o produto da caça e pode ter sido indiretamente responsável pela reduzida presença de onça-pintada. A área é cruzada por trilhas para extração ilegal de palmito, resultando em áreas extensas onde palmiteiros adultos estão simplesmente ausentes, e onde a caça certamente ocorre, causando a redução das populações silvestres. Os problemas de cumprimento das leis ambientais conectadas com a extração ilegal do palmito são as mesmas conectadas com a caça ilegal (na sua maioria não registradas).

É importante neste contexto mencionar que isto não diminui a importância da área de estudo para a conservação da onça pintada, por ser parte de um dos poucos blocos remanescentes de habitat para onças na Floresta Atlântica costeira (Ombrófila Densa). Ao contrário, estas observações identificam necessidades de manejo, pois estas áreas poderiam ser promovidas da função de corredor de passagem para a função de habitat completo se as espécies presas tivessem a oportunidade de prosperar.

Contents

1. Expedition Review

Matthias Hammer
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Expeditions are open to all and there are no special skills (biological or otherwise) required to join. Expedition team members are people from all walks of life and of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This expedition report deals with an expedition to the Atlantic rainforest of Brazil, which aimed to initiate the first-ever concerted conservation project of Atlantic forest jaguar and puma populations and their prey in unstudied rainforest. The expedition's Hilaire/Lange National Park study site is known for its outstanding beauty, with densely forested mountain ranges and mangrove lowlands reaching the Atlantic ocean. It harbours one of the few jaguar populations surviving in broad-leaved Atlantic rainforest. Data collected by the expedition will form the basis for the management and protection of jaguars and pumas and their habitats within a highly threatened ecosystem.

Nobody knows how many jaguars and pumas there are in the Saint-Hilaire/Lange National Park and its surrounding areas (PNSH/L), an important refuge where these two cat species probably still survive in numbers. It is vital that this southernmost population of jaguars in the broad-leaved Atlantic rainforest is protected, as it contains the source population from which jaguar numbers could be re-established. Biosphere Expeditions assisted local conservation efforts by initiating research in this unstudied area of forest, gathering key information vital for the protection of this highly endangered habitat and its resident species.

1.2. Research Area

Brazil is located on the Atlantic coast of South America and is the largest country on the continent. Two thirds of Brazilian territory is located within the Amazon basin. In addition to the Amazon, the Atlantic rainforest extends for about 3,500 kilometres along the coast with an area of over one million square kilometres. The Atlantic forest ecosystem is recognised as one of the most unique habitats on Earth, with numerous endemic species. It is one of the so-called world "hotspots" of biodiversity, with over 400 vascular plants per hectare, 50% of which are endemic. Animal diversity is also high: 215 species of mammals have been recorded, 73 of which are endemic; and out of a total of 183 species of amphibians, 91.8 % are endemic. Although biodiversity is very high, the status of many individual species is precarious. A recent estimate showed that 171 out of 202 species of vulnerable animals from Brazil are from the Atlantic forest.

Flag and location of Brazil and study site.

The study area is situated on the edge of the PNSH/L in southern Brazil, comprising 25,000 hectares of protected Atlantic forest and named after the French naturalist Saint Hilaire, and the Brazilian environmentalist Roberto Ribas Lange. The name is expected to be changed to 'Serra da Prata' (Silver mountain range), as national parks in Brazil are no longer allowed to carry names of people or towns. Early settlers crossed the mountain range in search for silver mines, inspiring the new suggested name. The park was created quite recently (in 2001) and as such is not well known or studied.

The PNSH/L area is dominated by the Atlantic rainforest of Brazil, one of the most endangered ecosystems on Earth. It is hard to overstate the importance of this ecosystem in terms of conservation. Declared a UNESCO World Heritage Site in 1999, most scientists rank the Atlantic forest as one of the top three priorities for global conservation efforts. Very little of the Atlantic forest remains, and what does is highly fragmented. Despite this, it still maintains extremely high levels of diversity and endemism.

The forest, which once spread along the Atlantic coast and much of southern Brazil, is now reduced to fewer than 8% of its original extent because of intensive human occupation, beginning with sugar cane plantation in the 1500s and later coffee plantations.

To address this lack of information, the expedition's research work also assessed which human occupation strategies are most compatible with the concurrent survival of large mammals, with special emphasis on the habitat quality for the jaguar and puma. Few areas are left, which have remained untouched and these are of high importance for their intrinsic value as a source of species, and as a model for recovering disturbed areas.

Map of the Atlantic forest showing estimated extent around 1500 (grey) and extent in 1990 (black).

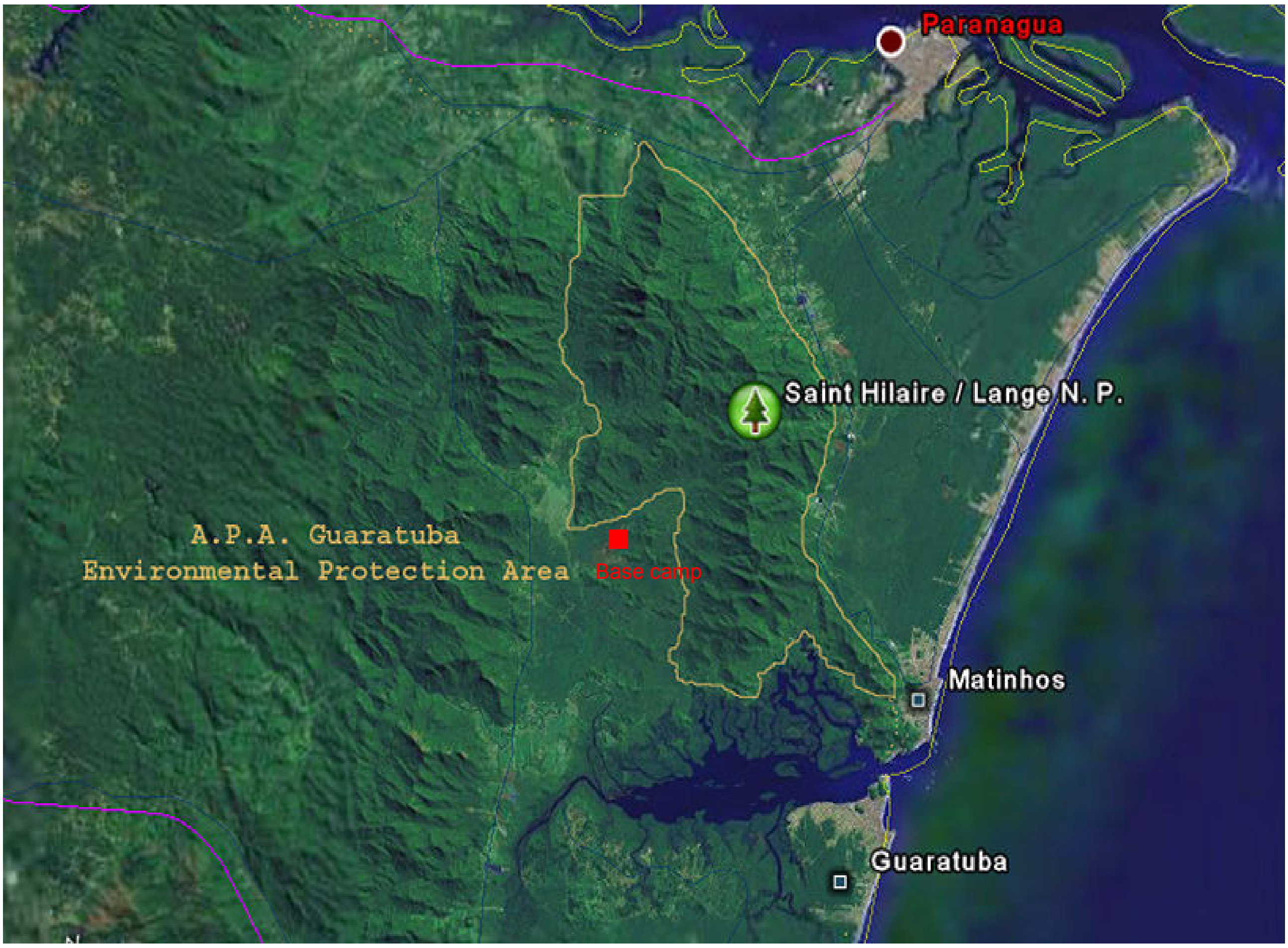
1.3. Dates

The expedition ran over a period of six weeks divided into two two-week slots, each composed of a team of international research assistants, guides, support personnel and an expedition leader. Expedition slot dates were

5 – 17 November 2006
19 November – 1 December 2006

1.4. Local Conditions & Support

Expedition base & transport



Map showing Saint Hilaire / Lange National Park encompassed by a larger, less restrictive protected area (APA) © Google Earth.

The expedition assembly point was Curitiba (see map of Brazil in section 1.2. above), where expedition team members were met by the expedition leader and scientists and taken to a harbour base in Matinhos (see map immediately above) by Land Rover and other vehicles.

Harbour base is owned by the NGO Ecoplan, which kindly provided the facility for the expedition. Located by the Guaratuba bay and with its own harbour, the facility gave the expedition team easy access to the river. One Land Rover Defender was kindly provided by Land Rover Brazil.

The harbour base, kindly provided by the NGO Ecoplan and the expedition Land Rover, kindly provided by Land Rover Brazil.

A large boat was used for transportation from the harbour base to base camp. Boats, especially large ones, can cross the bay area at high tide. Additional transportation used during the expedition was a speed boat and a canoe.

A speed boat, provided by NGO Ecoplan, motor provided by Mr. F. Mazzolli, was used to fetch supplies and for reaching islands and other places within the study area.

A small canoe, property of Mr. Ananias, was used to reach João's island (quadrat 3) after twenty minutes of paddling.

Base camp consisted of ten tents installed on wooden platforms and three hammocks, where the team slept, and a house where meals where served and other common activities where conducted.

Tents were installed on wooden platforms above the forest floor.

The base camp house and surrounding land for tents and hammocks was kindly provided by Mr. José Ananias dos Santos.

There was a dedicated cook to prepare main meals. Lunch often consisted of a snack taken to the field. There was limited generator electricity at base camp and the electricity supply was 220V.

The kitchen in base camp run by cook Olga.

Field communications

There was no telephone and mobile phones did not work at base. The nearest landline telephone was about two hours from base camp, but the expedition carried a satellite phone for emergency communication. However, this was found not to work well and a satellite connection could only be established very rarely.

Medical support & insurance

The expedition leader was a trained first aider, and the expedition carried a comprehensive medical kit. Further medical support was provided by hospitals in the towns of Matinhos, Guaratuba, Paranagua and Curitiba. All team members were required to be in possession of adequate travel insurance covering emergency medical evacuation and repatriation. Safety and emergency procedures were in place. There was one medical incident when an expedition team member broke their wrist and had to be evacuated by boat to Matinhos and from there by car to Paranagua, where the wrist was operated upon within a few hours of arrival at the local hospital. The total time from accident to dismissal from hospital was a remarkable ten hours only. The injured team member was advised by doctors not to return to base camp, decided to leave the expedition and continued holidaying in Brazil. There were also several cases of upset stomachs, a one one-day long bout of gastroenteritis, one incidence of an allergic reaction to mosquito bites (treated with the antihistamine tablets and cream), and a couple of cases of mild fever, which lasted a couple of days. All of these were dealt with at camp.

1.5. Expedition Scientist

The expedition's local biologist was Marcelo Mazzolli. Born in Brazil, he graduated in Biology in 1992, with a master's degree from the University of Durham, UK. His Ph.D. in ecology, obtained in Brazil, was on the effects of human occupation on the extinction of large mammals. He has devoted his career to the study of large mammals, particularly the puma and jaguar, but has had many other outdoors experiences. He was a professional jungle guide in the Amazon forest in 1986 at age 21. He has attended many national and international workshops, and published relevant articles. His studies have made his work well known, and early in his career he was invited to be a member of the International Union for Conservation of Nature (IUCN) Cat Specialist Group with one of his projects listed as a priority in the World Wide Cat Action Plan. He has travelled extensively, living in the United States and Peru, and has surveyed lions in Botswana.

1.6. Expedition Leader

David Moore was born and educated in England and now lives in the UK and France. He graduated in French and German and studied Japanese while working for two years in Tokyo. His expedition/group leading experience began with Japanese educational trips in Australia and he has since worked in the Caribbean and throughout Europe for companies such as P&O, Explorica and Alyson Adventures. David joined Biosphere Expeditions in 2003 and has led expeditions to the Azores, Namibia, Peru and Brazil. He is also active in running the Biosphere Expeditions operations in France.

1.7. Expedition Team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds.

5-17 November 2006

Hannah Bateman (UK), Marjorie Beebee (UK), Richard Claes (UK), Daisy Fretwell (UK), Alfred Grossmann (Germany), Alan & Janet Hoffberg (USA), Martyn Roberts (UK), Helmut Schneilinger (Austria), Ulrich & Karin Schubert (Germany), Clare Shanks (UK).

Also present: Daniel Contrucci of Biosfera Brasil, local partner travel agency and Matthias Hammer, Managing Director of Biosphere Expeditions.

19 November – 1 December 2006

Richard Claes (UK), Alice Gifra (Italy), Robin Glegg (UK), Brian Green (UK), Ali McQuade (USA), Tomas Sexton (Ireland), Georgina Treherne (UK).

Throughout the expedition:

Olga (cook), Quirera (Ananias farm foreman), Beto (boat driver).

1.8. Expedition Budget

Each team member paid towards expedition costs a contribution of £1150 per two week slot. The contribution covered accommodation and meals, supervision and induction, a permit to access and work in the area, all maps and special non-personal equipment, all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses like telephone bills, souvenirs, etc., as well as visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how these contributions were spent are given below.

Income	£
Expedition contributions	20.580
Expenditure	
Expedition set-up, base camp and food includes all monies spent setting up in Brazil, meals, camp equipment	2,390
Transport includes fuel, vehicle maintenance, boat hire	620
Equipment and hardware includes research materials, research gear, camera traps	4,581
Biosphere Expeditions staff includes salaries, travel and expenses to Brazli	3,077
Local staff includes salaries, travel and expenses, Biosphere Expedition tips, gifts	2,376
Administration & logistics includes admin costs, sundries, etc	789
Donation to Projeto Puma Payment to Marcelo Mazzolli's NGO	1,436
Team recruitment Brazil as estimated % of PR costs for Biosphere Expeditions	2,800
Income – Expenditure	2,511
Total percentage spent directly on project	88%

1.9. Acknowledgements

This study was conducted by Biosphere Expeditions which runs wildlife conservation expeditions all over the globe. Without our expedition team members, who are listed above and who provided an expedition contribution and gave up their spare time to work as research assistants, none of this research would have been possible. The support team and staff, also mentioned above, were central to making it all work on the ground. Thank you to all of you and the ones we have not managed to mention by name (you know who you are) for making it all come true. Biosphere Expeditions would also like to thank Land Rover, Motorola, Buff®, Cotswold Outdoor, Globetrotter Ausrüstung and Gerald Arnhold for their sponsorship.

Projeto Puma, Biosphere Expeditions' local partner for this project, and its founder Dr. Marcello Mazzolli were crucial to the success of the expedition. Thank you also to Daniel Contrucci of Biosfera Brasil who initiated the whole project by establishing contact between Projeto Puma and Biosphere Expeditions.

A large number of people and organisations in Brazil contributed to the project development. Ibama from Curitiba and Matinhos were always very helpful. Institutional support included the Center Research and Conservation of Wild Predators (Cenap-Ibama), Guaratuba's Secretariat of Environment, SOS Cultura, Center of Genomic and Molecular Biology (PUC University, RS), Community Association of Friends of Parati (AMAP), Society for Wildlife Research and Environmental Education (SPVS), and Jaguar Conservation Fund (JCF). Base camps were kindly provided by Instituto Ecoplan, Mr. José Ananias dos Santos, and Mr. Carlos Roberto Bilski. Scientists Arjun Gopalaswamy and Devcharan Jathanna from the Centre for Wildlife Studies, Bangalore, India and Ullas Karanth from the Wildlife Conservation Society (WCS) India Program helped interpret 'closure tests' and CAPTURE probabilities.

1.10. Further Information & Enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org.

Enquires should be addressed to Biosphere Expeditions at the address given below.

Please note: this report is primarily aimed to detail results obtained during the expedition. However, information gathered outside the Biosphere Expeditions project during a month long expedition with local students is also included for completeness. Data gathered during the Biosphere Expeditions project is treated separately when sufficient for analysis, but results are also combined for better characterisation of the entire study area and the understanding of species' occurrence.

2. Puma & Jaguar Survey

Marcelo Mazzolli
Projeto Puma

2.1. Introduction

The Atlantic rainforest of Brazil is one of the most threatened ecosystems on Earth, reduced to 8% of its original extent due to hundreds of years of intensive exploitation, especially where human populations are highest.

In a scenario like this, where human populations continue to encroach upon the remaining patches of forest, game species and those with large territory requirements are amongst the most vulnerable to extinction. Large felids such as the puma *Puma concolor* and jaguar *Panthera onca* face the problem of establishing their territory over several hundred square kilometers of areas with adequate prey populations. Prey of these large felids have also become scarce, as they are also game animals to humans.

Local extinctions of these felids and their prey have been recorded over vast areas of southern Brazil (Mazzolli 2006a). The jaguar, the tapir, and peccaries seem to be the most vulnerable large (>1 kg) mammalian species in the region (Mazzolli 2005, 2006a, 2006b).

The partnership with Biosphere Expeditions provided enough support to devise a project entitled '*Corredor do Tigre* – Tiger Corridor', aiming to increase the chances of jaguar survival in the Serra do Mar, an important extent of habitat of the Atlantic forest. The reason for using the word "Tiger" instead of "Jaguar" is because the jaguar is often called *tigre* by locals, a cultural inheritance from the first settlers and immigrants, which apparently considered that the jaguar resembled the Asian tiger. However, the title does not sound right in English, so it was decided that the English title would be 'jaguar corridor' instead. To guarantee that the jaguar has a better chance of survival the project aims are:

1. Perform ecological sampling on the presence/absence of jaguars and their prey in the APA de Guaratuba and later in the APA de Guaraqueçaba, as a means to identify which areas are the best habitats for jaguars and need most protection and in which areas jaguar still range, but need restoration.

2. Promote ecotourism to increase the value of fauna and flora for local people.

3. Promote the monitoring of jaguar records in its recent historic range through an information network including universities, environmental agencies and private stakeholders.

4. Build a rescue network for attending livestock depredation incidents and conditional compensation for losses.

5. Map the location of reserves, public and private, and contact its managers as a means to create a wildlife corridor.

While all objectives are in progress, this report will mainly detail ecological sampling and the GIS mapping of the corridor.

2.1.1. The jaguar

The extinction of the jaguar in the Atlantic forest seems to be imminent for three reasons. Firstly, the population is extremely reduced, estimated to be 200±85 individuals distributed in small and disconnected sub-populations (Leite and Galvão 2002) (Fig. 2.1a). Secondly, the population is isolated from other source populations, which are found hundreds of kilometers inland. And thirdly jaguars are being poached due to livestock depredation (Vidolin et al. 2004).

The short-term survival probabilities of the Atlantic forest jaguar were also agreed by specialists during a meeting where priorities for the conservation of the species were discussed (Sanderson et al. 2002). While such a large-scale overview is beneficial to provide basic information on jaguar distribution and conservation status, it may eventually produce a shortage of international funds for populations that have been considered as having short-term viability. Funding agencies may choose not to spend limited resources on a population, albeit rather too early, sentenced to extinction.

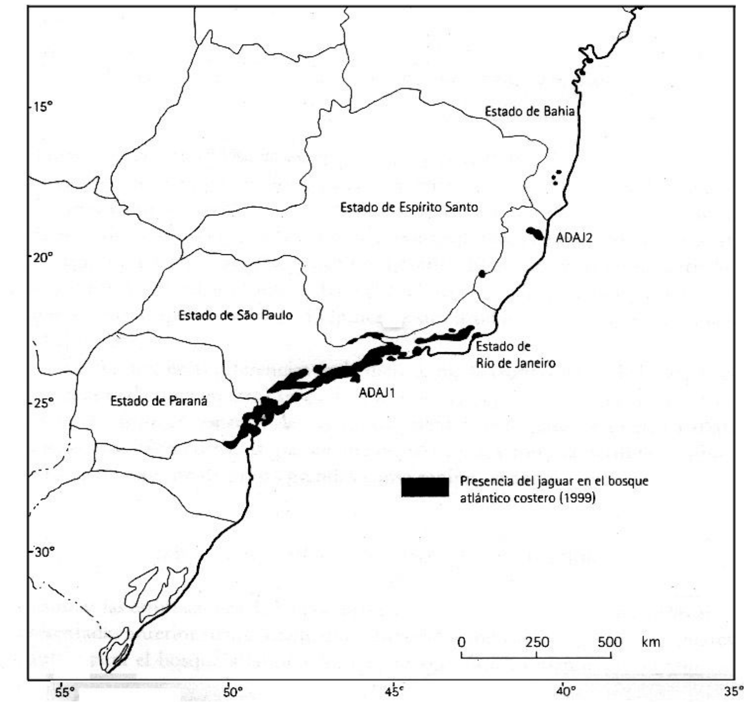


Figure 2.1a. Distribution of the jaguar in the Atlantic coast forest, distant from larger population found in the Amazon and Pantanal. The isolation and small population size renders it vulnerable to stochastic, random effects, with associated loss of genetic diversity and increase of homozigosis and inbreeding, and all associated effects (low reproductive rate, etc). Source: Leite and Galvão 2002.

The jaguar was once present throughout southern Brazil. Currently, however, the area encompassed by the Serra do Mar (coast mountain ranges) is the only stronghold of the jaguar in Atlantic evergreen forest in southern Brazil; in other words, it is the one of the most important refuges of the most threatened of all jaguar populations: the Atlantic forest jaguar.

Data obtained from records of last individuals poached show the ongoing process of extinction of the jaguar in its southern range on a high resolution scale. In 1960 the species disappeared from northeast Rio Grande do Sul, in 1970 from east-central Santa Catarina, and from 1982 to 1992 from northeast Santa Catarina (Fig. 2.1b). Because of this the southernmost extension limit of jaguar distribution in the Atlantic broadleaf forest had moved hundreds of kilometers north to the APA (Area of Environmental Protection) of Guaratuba by the turn of the millennium. The APA is 2 million square km in size, its classification as APA meaning that it has a 'flexible' protection status, its boundaries encompassing commercially productive areas.

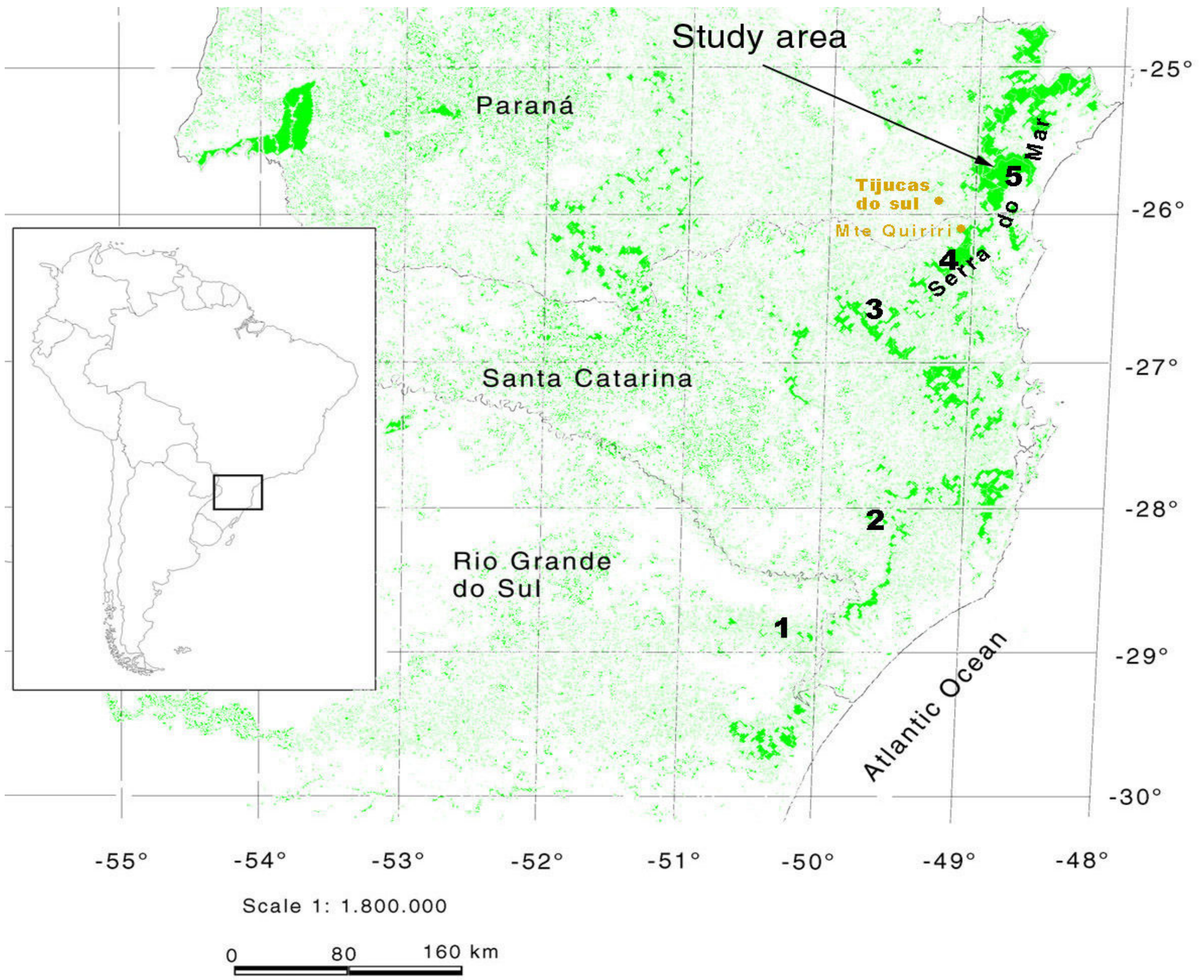


Figure 2.1b. Map of remaining fragments of Atlantic forest in southern Brazil (source: SOS Mata Atlântica, www.sosmatatlantica.org.br). Numbers 1 to 4 are records of last jaguar specimens in the area. Record dates show fast, northward loss of distribution. 1 - 1965 in the municipality of São José dos Ausentes (locality of Silveira) (RS); 2 –1970 in the municipality of Urubici (SC); 3 –1982 in the municipality of Cerro Azul, next to Reserva Biológica de Sassafrás, municipality of Rio Negrinho (SC); 4 –1992 approximate locality, yet to be confirmed with precision; 5 – southernmost present distribution of jaguar in coastal Atlantic rainforest, APA of Guaratuba and SHL NP area. Source: Mazzolli 2005.

2.1.2. The puma

The puma may still be considered widespread in southern Brazil, albeit confined to the most protected habitats. In spite of that persistence, pumas have become locally extinct from areas of higher human density such as the coastal lowlands of the two southernmost states of Brazil (except at an isolated spot at the north eastern tip of Santa Catarina) (Fig. 2.1c).

In spite of that persistence, pumas have become locally extinct from areas of higher human density such as the coastal lowlands of the two southernmost states of Brazil (except at an isolated spot at the northeastern tip of Santa Catarina) (Fig. 2.1c).

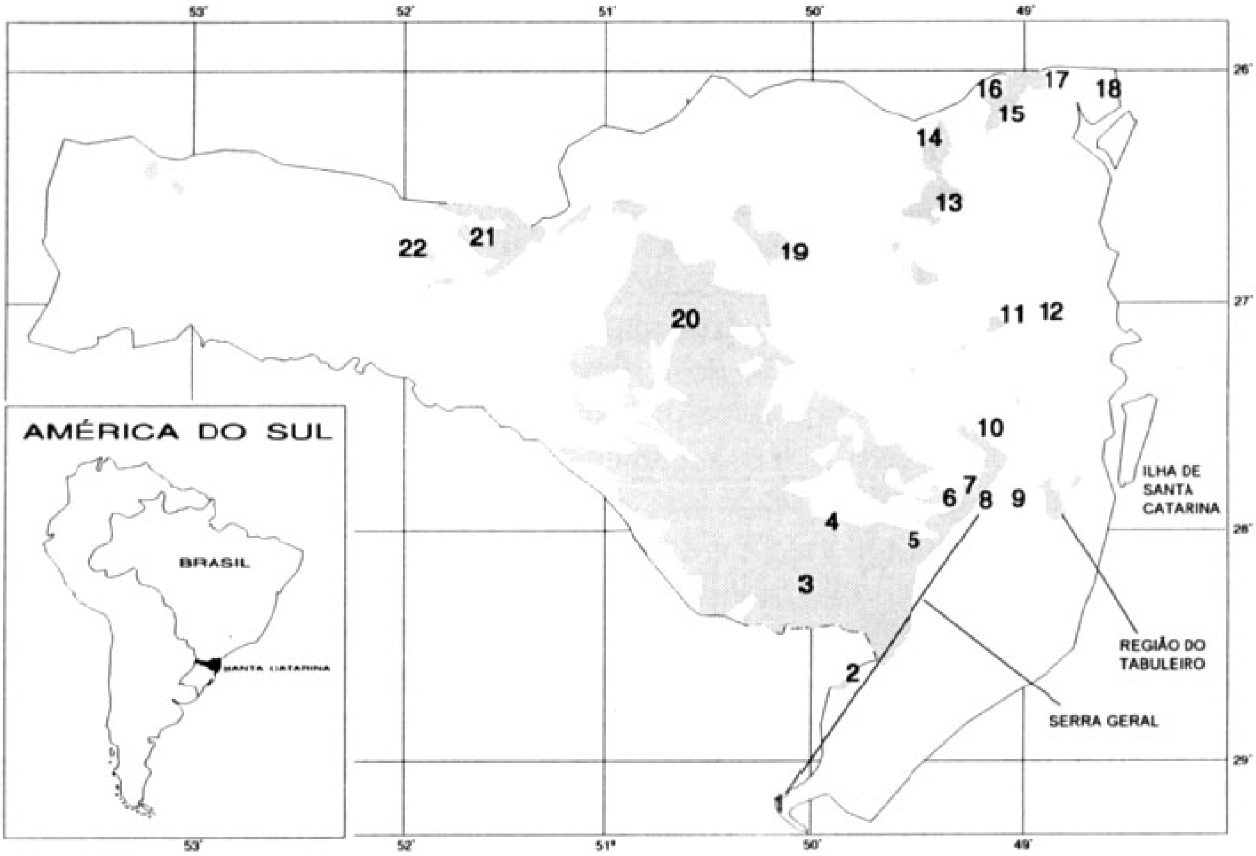


Figure 2.1c. The puma is still widespread in the state of Santa Catarina, where other large mammals with lower energetic requirements such as peccaries and tapir are more geographically restricted. In spite of that, it is more dependent on connectivity of habitats due to its larger home range. The puma has become locally extinct from populated areas of the coast. Source: Mazzolli 1993.

This report will detail the findings of the expedition conducted by Projeto Puma and Biosphere Expeditions between 5 November - 1 December 2006 in the APA de Guaratuba. Prior to that, however, some background information and results obtained with previous local expeditions are provided below.

2.2. Background & Complementary Information

A first survey was conducted in the states of Santa Catarina (SC) and Paraná (PR) on 30 and 31 July 2005 to investigate the possible occurrence of jaguars at its southernmost range at Serra do Mar.

Results of several enquiries in villages neighbouring the mountain ranges pointed to the presence of jaguars in the APA de Guaratuba, more precisely in the localities of Castelianos e Guaricana (PR). There were no reports on the presence of the species in the vicinities of Monte Quiriri (SC).

Chances are that the species is already extinct from the Serra do Mar within the boundaries of Santa Catarina, which would automatically give the APA de Guaratuba the status of the southernmost edge of the distribution of jaguar in coastal Atlantic forest, and the source population for the eventual restoration of the jaguar range further south.

A reserve of 250 square km maintained by the federal government, the Saint Hilaire/Lange National Park (PNSH/L), fully encompassed by the APA de Guaratuba, was chosen as the initial study area, despite of the fact that the localities of Castelianos and Guaricana, where inquiries initially pointed out the presence of jaguar, were located 20 km westward, near Guarapari Mountain (Fig. 2.2a). The decision was based on the fact that PNSH/L is an official reserve, with ongoing work of Ibama (Brazilian Institute of Environment – federal government), and other NGOs to effectively transform it into a protected area.The idea was that the current project would contribute to the area’s conservation by joining efforts with ongoing projects.

Figure 2.2a. Landscape, three dimensional view of the expedition area.

The fauna in the PNSH/L faces many threats. The park is situated in the Serra da Prata, a partially isolated mountain chain delineated in the east by a paved state road PR-508, in the north by the also paved federal road BR-277, in the south by the Guaratuba Bay, and in the west by a dust road (to Limeira). Curitiba, the capital of the state of Paraná, is situated in the highlands west of the Serra do Mar and harbours 1.7 million people. São José dos Pinhais, also to the west, has 252.470 people (IBGE 2006). During the summer, people from these and other towns perform a 'migration' down to the beach resorts of Matinhos and Guaratuba, located on the eastern side of the PNSH/L. The overall result is that the PNSH/L is very hemmed in by roads and thus isolated from the neighbouring mountain chains of the Serra do Mar.

Permits that allowed a local project team to research within PNSH/L were obtained from Ibama (number 02017,000269/06-36) and regardless of the nationality within APAs of Guaratuba and Guaraqueçaba from the Directory of Biodiversity and Protected Areas of the Institute of Environmental Protection – State of Paraná (DIBAP-IAP number 35/06).

In July 2006 a local expedition with students and lecturers from Brazilian universities was conducted to Salto Parati and vicinities, encompassing the eastern study site, for a period of one month (Fig. 2.2b). Salto Parati is a village of 40 families with limited land access. The road to it has been abandoned, so access to the village is mainly by bicycle and boat. Camp bases included a cabin in Parati village, and a harbour base at the Cabaraquara location, with road access (Fig. 2.2a).

Figure 2.2b. Local group of expeditioners consisting of students and professionals of biological and veterinary sciences (July 2006).

Two main trails three kilometres in length were established within PNSH/L from Salto Parati with six track traps in each (quadrat 8 - Q8). Five camera traps (Tigrinus www.tigrinus.com.br) were installed for a period of two weeks in each resulting in 150 camera trap nights. Sampling results also included other opportunistic records such as vocalisations, sightings and track observations. Parati village and its surroundings (quadrat 7 - Q7) were also sampled by track observations. Both quadrats encompassed an area of 10 square km. On one occasion a jaguar was heard and its tracks found in Q7 (Fig. 2.2c).

Figure 2.2c. Jaguar track found at Salto Parati in July 2006.
The jaguar was heard the night before the track was found.

Further records were obtained near the harbour base at the Cabaraquara location (Q5) where a puma track was found and in the road to Salto Parati (Q6), where crab-eating fox tracks were recorded. Additional exploratory walks three to five km in length but with no results were conducted at Rio do Henrique and towards the Parado Swamp from the Estrela Ranch, all with access from the dust road of Limeira (Fig. 2.2a). Track records were difficult to obtain during these fast surveys due to the amount of leaf litter on the trails, so the survey was not included in the analysis.

At the end of the expedition with the local groups, a base camp for the international expedition with Biosphere Expeditions was decided upon at the Ananias property by the Rio Preto river, near the Parado Swamp (western range of the study site). Information obtained from Salto Parati about this location was that the area was private but protected area where hunters were not allowed and wildlife abundant.

When the site of the future base camp for Biosphere Expeditions was surveyed during the first few days of August 2006, peccary and tapir (Fig. 2.2d) records, amongst others, were made. The presence of these vulnerable species in this location was an interesting finding as they had not been found in previous Salto Parati surveys. Based on this, it was expected that this area would harbour a better habitat for the jaguar.

Figure 2.2c. Tapir tracks near proposed base camp site at Rio Preto found in August 2006.

Conservation activities other than ecological sampling were conducted during the expedition with Biosphere Expeditions. Just before the beginning of the expedition, Projeto Puma had a meeting in Curitiba with Mr. Mauro Britto from the DIBAB-IAP to discuss compensation programmes and the rescue network for the Atlantic forest jaguar. After that a forum was held in the Rio da Onça State Park on 23 October in Matinhos, organised by SOS Cultura where the expedition scientist was invited to talk.

The expedition scientist was also invited by the Institute of Ecotourism of Paraná (IEPR) to give a talk on 17 November in the Rotary Club of Matinhos to instigate the participation of local NGOs in a training programme for ecotourism guides.

On 24 November Projeto Puma and team members from Biosphere Expeditions participated in a forum promoted by the community of Salto Parati. The community leader invited the expedition scientist to talk about the sustainable use of palm heart and on the value of wildlife as a resource that may yield revenues as ecotourism attractions.

2.2.1. Study area

The study area comprised 130 square km divided into an eastern and western range according to the geographic area and to the time of sampling.

The western range was located about 2.5 km west of the PNSH/L extending over an area of 22 square km, 16 square km of which is owned by Mr. Ananias and where the base camp was located. An area of two square km around base camp was under intensive management for palm heart (*Euterpe edulis*) (Fig. 2.2d). Palm heart seedlings were planted in rows requiring the forest underbrush to be cleared.

Figure 2.2d. Area managed for palm heart growth in the base camp area.

Access to base camp was possible only by boat via the Cubatão and Preto rivers, taking about one hour and a half in a speed boat and three hours with a larger boat from harbour base (Fig. 2.2a). The vegetation consisted mostly of lowland evergreen Atlantic forest partially subjected to flooding, although hills of up to a hundred meters were common. Although the area was influenced by the tide, the water's salinity was very low and no mangrove vegetation was present, as was the case in the bay area.

Palm heart stands were present at the Ananias property, mainly due to the presence of private rangers. Palm heart stands were uncommon outside his property, even within the PNSH/L, where evidence of palm heart illegal extraction was abundant (Fig. 2.2e).

Figure 2.2e. Palm heart was harvested illegally in the PNSH/L and wherever there were natural stands.

Particular landscape features that became familiar to the expedition were the Parado Swamp (Fig. 2.2d), with a predominance of herbaceous vegetation and 'caxeta' (*Tabebuia cassinoides*), "João's island", partially owned by Mr. Ananias, and "Peccary island", nicknamed after the presumed abundance of peccaries according to local sources.

Figure 2.2f. The Parado Swamp had to be crossed by boat to reach Peccary island.

2.3. Methods

2.3.1. Training and evaluation of team members

For the first two days of each expedition slot, team members were given talks (Fig. 2.3a) and practical lessons on how to navigate in the forest by using compass, GPS, and maps, on how to install camera and track traps, and on animal identification. During the third day team members were tested on the procedures learned before actual field work and data collection began.

The test was divided into two parts; one on animal identification, when printed cards of animal pictures and tracks were required to be identified, and the other on forest navigation and camera trap installation.

Performance in the test was evaluated based on 19 questions. As camera trap installation was one of the most crucial aspects of the project, 14 questions were about steps required for camera trap installation. Following the test a discussion was held to remove remaining doubts.

Figure 2.3a. Training given to team members during the first expedition days.
The talk in this photo was on geographic positioning and projection system.

2.3.2. Ecological sampling

Data on mammalian presence was collected from field surveys in eight different quadrats of approximately 4 square km each, over an area of 130 square km. The data on the western side were obtained by Biosphere Expeditions, those on the eastern by the local expedition.

Data collection procedures included camera trapping and recording of any mammal sign, vocalisation or sighting in the quadrats sampled. Sampling effort varied among quadrats, with more intensive camera trapping in the western and less in quadrats 4 and 5 of the eastern range of the study site.

Track records were obtained with the aid of six track traps (Fig. 2.3b) set on the main survey trails (3 km in length).

Figure 2.3b. Track trap installed on one of the trails by team members.

2.3.3. Camera trapping (Biosphere Expeditions, western range of the study site)

Eighteen analogue and four digital camera traps were placed in the study area. Total sampling effort in this area amounted to 351 camera trap nights (Table 2.3a). Films and batteries were first installed into the cameras in base camp under the supervision of the expedition leader and scientist (Fig. 2.3c).

Figure 2.3c. Team members setting up cameras and installing film and batteries at base camp.

Cameras were not set or removed all at once, so the period they stayed in the field varied. Twelve cameras where first installed in quadrat one, each set for a period varying from ten to twelve days, and nine cameras installed in quadrat two, each set for a period of 16 to 18 days.

Cameras were inspected after ten days, new batteries installed, and films replaced when necessary. After this period cameras from quadrat one were removed and installed on quadrat three, and on a fourth quadrat, nicknamed ‘Peccary island’. Cameras were then removed after a period of five to seven nights.

Table 2.3a. summarises the camera trapping effort.

Table 2.3a. Sampling history of individual cameras, including date of installation, re-installation, removal, quadrat installed and working period.

ID	Date installed	Date removed	Trap nights	Quadrat	Date installed	Date removed	Quadrat	Trap nights	**Total trap nights**
A2	08/11/06	20/11/06	11	1	22/11/06	28/11/06	4	05	**16**
A3	09/11/06	21/11/06	11	1	22/11/06	28/11/06	3	05	**16**
A4	11/11/06	–	–	–	–	28/11/06	2	16	**16**
A5	08/11/06	20/11/06	11	1	22/11/06	28/11/06	3	05	**16**
A6	09/11/06	21/11/06	11	1	22/11/06	28/11/06	4	05	**16**
A7	09/11/06	20/11/06	10	1	23/11/06	29/11/06	1	05	**15**
A8	11/11/06	–	–	–	–	29/11/06	2	17	**17**
A9	11/11/06	–	–	–	–	29/11/06	2	17	**17**
A10	10/11/06	–	–	–	–	29/11/06	2	18	**18**
A11	08/11/06	21/11/06	12	1	22/11/06	28/11/06	3	05	**17**
A12	10/11/06	–	–	–	–	28/11/06	2	17	**17**
A13	08/11/06	21/11/06	12	1	23/11/06	28/11/06	3	04	**16**
A14	10/11/06	–	–	–	–	28/11/06	2	17	**17**
A15	10/11/06	–	–	–	–	29/11/06	2	18	**18**
A16	08/11/06	20/11/06	11	1	22/11/06	28/11/06	4	05	**16**
A18	11/11/06	–	–	–	–	28/11/06	2	16	**16**
A20	09/11/06	20/11/06	10	1	22/11/06	28/11/06	4	05	**15**
A21	14/11/06	–	–	–	–	22/11/06	3	07	**07**
D2	09/11/06	20/11/06	10	1	22/11/06	28/11/06	3	05	**15**
D3	08/11/06	21/11/06	12	1	23/11/06	29/11/06	1	05	**17**
D4	11/11/06	–	–	–	–	29/11/06	2	17	**17**
D5	09/11/06	21/11/06	11	1	22/11/06	28/11/06	4	05	**16**
							Total trap nights		**351**

2.3.4. Data analysis

Analysis included the estimation of the proportion of area occupied (PAO) by jaguars, pumas, and ocelots over the entire study area, using the software PRESENCE[1]; and estimation of species richness (SR) calculated for the western and eastern ranges of the study site, first separately and then combined for the entire area, using the software CAPTURE[2] (Otis et al. 1978, Rexstad & Burnham 1991). The small sample size prevented partitioning of data for further spatial comparisons.

Both software packages attempt to estimate parameters (PAO and SR) using capture probabilities extracted from the data themselves, just like in capture-recapture models. The main concept behind these applications is that non-detection of a species at a site does not imply that the species is absent unless the probability of detection is 1.

[1] Available for download from http://www.proteus.co.nz
[2] Available for download from http://www.pwrc.usgs.gov

Indeed, in most situations, it is unlikely that sampling will produce a complete list of target species inhabiting an area or that a single species will be detected in every patch of the study area where it is present. Thus 'false absences' or imperfect detectability must be accounted for using capture probabilities to avoid underestimation of the true level of occupancy (PRESENCE) and species richness (CAPTURE). Habitat quality for the large felids is discussed in the light of these results.

A capture history with three sampling occasions was built for each species, based on their presence (1) or absence (0). Capture history occasions for the eastern range were built from data collected on three consecutive occasions during the local expedition lasting one month (July 2006). Occasions for the western range consisted of a single first occasion lasting four days (September 2006), and two additional consecutive occasions (Biosphere Expeditions) that lasted one month (November 2006).

2.4. Results

2.4.1. Training and performance

Training the expedition team on navigation through the forest was considered successful. After a week groups consisting of two to four team members went for long walks to perform their tasks by themselves. Some of the groups even explored trails that had not been visited before, handling a canoe when necessary. The fact that they were able to return in the scheduled time was proof that their navigation skills were excellent.

The results of formal, written tests on both identification of animal and track pictures, and on procedures during forest navigation, trail marking, and camera installation were meant to be applied twice for each of the two teams; once at the beginning of the expedition, and once at the end to verify if the expedition experience and training had improved performance. For team 2, due to last minute changes in schedule for the return journey, however, the test was applied only once at the beginning of the second team's expedition period.

Results for team 1 show an increased performance in both animal identification and on general procedures at every new application of the test (Fig. 2.4a).

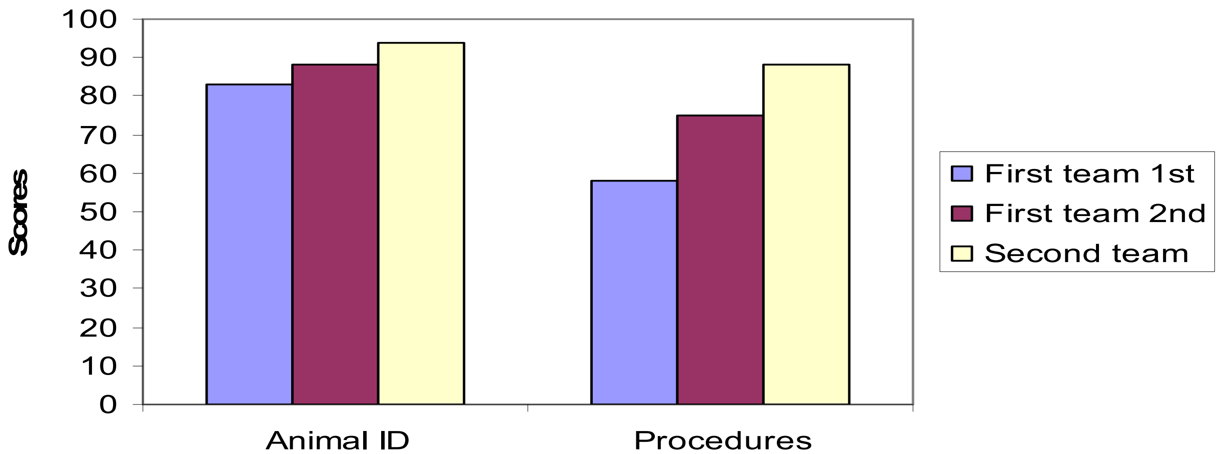


Figure 2.4a. Scores from written tests on animal and track identification (animal ID), and on navigation and camera trap installation procedures, applied twice for the first team, and once for the second team.

Both teams performed well on the animal identification test. Animal identification skills were of reduced importance for research results because the chances to see animals were very low, and the need to identify tracks could be replaced by taking good photographs of the prints for later identification at base camp.

Improvement was most noticeable in the answers regarding procedures. Teams were asked to mark trails and set and install camera traps. Thus it was important that these procedures were understood and applied. The progressively higher scores suggested that team performance could be related both to the skills acquired during field practice, noticeable in the improvement of team 1, and also to the improvements on the way information was transmitted to them as team 2 had a higher overall score for the test at the beginning of the expedition.

Low individual initial scores on procedures were partially compensated by the fact that individuals worked in collaborative teams. In contrast to animal sighting records, camera trap installation could be checked for errors.

2.4.2 Species occurrence

In total 14 species were recorded; ten on the eastern range and eleven on the western range of the study area (Table 2.4a). Track recording was the most efficient method of detection, responsible for recording representatives from all species sampled except monkeys, peccaries, and one species of brocket deer (which cannot be correctly distinguished by its tracks alone from other deer species anyway).

While areas in the western range consisted mostly of lowlands, the eastern range was sampled in both lowlands and highlands, providing a certain degree of heterogeneity that was reflected in the species composition. For example ocelot, howler and capuchin monkeys were only found in the highlands, whereas jaguar, capybara, racoon, and crab-eating fox were only found in the lowlands. Within the eastern range quadrats Q7 (lowland encompassing scattered houses of Parati village) and Q8 (highlands above Salto Parati) received a higher sampling effort than other quadrats and perhaps for this reason they contained all the species found in this range except puma (found only in Q5 near the harbour base).

Despite the human disturbance in lowland Q7 results indicate that it hosted more species (n=6) than Q8 (n=3). Species found in Q7 were, however, those relatively tolerant to proximity of human dwellings, except maybe the jaguar. The jaguar was recorded only once in the eastern range, from its vocalization and tracks at the end of the only (abandoned) road to the village after the few first scattered and frequently empty houses. Of all the quadrats, Q1 had the greatest number of species (n=9).

Table 2.4a. Species list of the Guaratuba Bay area with information on site recorded (W – western range, E – eastern range), quadrat number (Q), type of record (vestige, sighting, vocalisation, camera trap), characteristics of the land (lowland, highland, mangrove), and presence (1) or absence (0) during a given occasion.

Species	Latin name	Local name	Area	Q	Type of record	Obs.	Capture history occasions		
							1	2	3
Agouti	*Dasyprocta azarae*	Cutia	W	4	Track	Lowland	0	0	1
Brocket deer	*Mazama sp.* (likely *gouazoubira*)	Veado-virá	E	7	Track	Lowland	1	1	1
Brocket deer	*Mazama sp.* (likely *americana*)	Veado-mateiro	W	1	Camera trap	Lowland	0	1	0
Capybara	*Hidrochaerus hidrochaeris*	Capivara	E	7	Track	Mangrove	1	0	0
			W	2	Scat	Lowland	1	0	0
Capuchin monkey	*Cebus nigritus*	Macaco-prego	E	8	Sighting	Highland	0	1	1
Crab-eating fox	*Cerdocyon thous*	Graxaim	E	5,6, 7	Track	Lowland	1	1	0
			W	1	Track	Lowland	1	1	1
Howler monkey	*Alouatta guariba*	Bugio	E	8	Vocalisation	Highland	1	1	1
Jaguar	*Panthera onca*	Onça-pintada	E	7	Track Vocalisation	Lowland	1	0	0
			W	1	Vocalisation	Lowland	0	0	1
Nine banded armadillo	*Dasypus novemcinctus*	Tatu-galinha	E	7	Track	Lowland	1	1	0
			W	1, 2, 4	Track Camera trap	Lowland	1	1	1
Ocelot	*Leopardus pardalis*	Jagua-tirica	E	8	Track	Highland	1	0	0
			W	1,4	Camera-trap	Lowland	0	1	1
Peccary	*(inc. sp.)*	–	W	1	Depredation	Lowland	1	0	0
Puma	*Puma concolor*	Onça-vermelha	E	5	Track	Lowland	1	0	0
			W	1		Lowland	1	1	1
Racoon	*Procyon cancrivorous*	Mão-pelada	E	7	Track	Lowland	1	1	1
			W	1, 4	Sight, track	Lowland	1	0	1
Tapir	*Tapirus terrestris*	Anta	W	1	Track	Lowland	1	0	0

Camera-trapping yielded results below expectation, recording only three species: the nine-banded armadillo, the brocket deer, and the ocelot (Fig. 2.4b) (and possible reasons for this are examined in the Discussion section below).

Figure 2.4b. Species camera-trapped during the expedition. One ocelot (above) and one nine-banded armadillo (below), and the brocket deer (*Mazama americana* or *M. bororo*).

Cumulative species' curves produced in CAPTURE graphically display the number of 'new' species recorded for each sampling occasion. Curves were produced for each range, individually, and combined for the entire study site (Fig 2.4c).

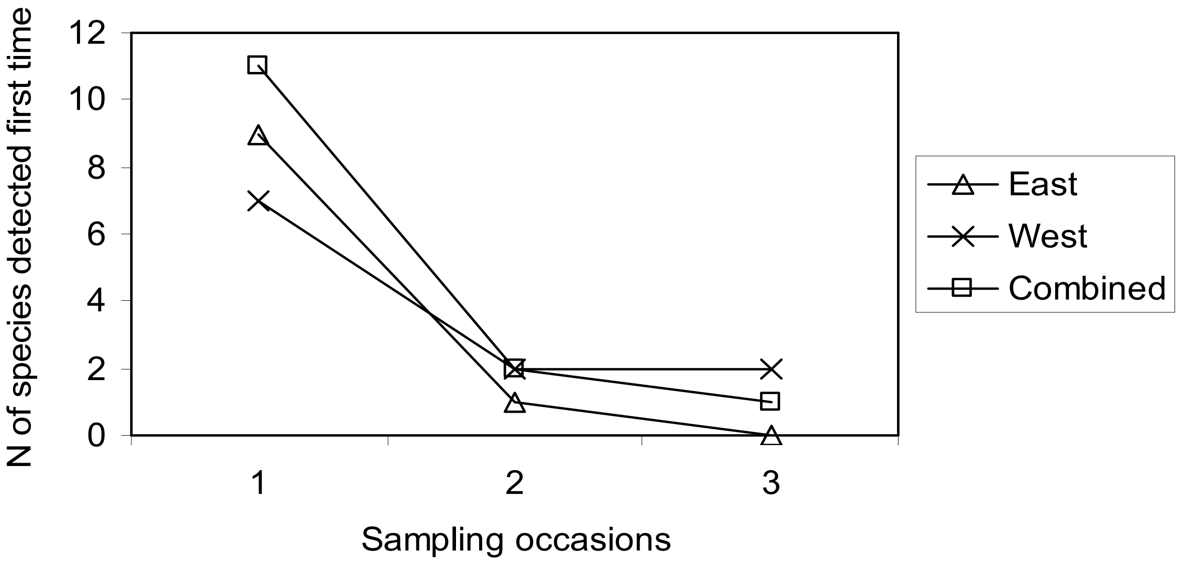


Figure 2.4c. Species cumulative curve for each range of the Guaratuba Bay and for the combined data.

Statistics of species' richness from the CAPTURE output indicate adequate sampling sufficiency (Table 2.4b), i.e. further sampling was unlikely to yield results with much greater detail or reduced error. Models selected by CAPTURE during the analysis were model Mo, indicating that capture probabilities were the same for every animal in every capture occasion; model Mbh, indicating behavioural response to first capture (model Mb), and varying capture probabilities by animal (model Mh); and model Mtbh, where time (model Mt) may be affecting capture probabilities (Otis et al. 1978, White et al. 1982). Estimates were more precise for the eastern and combined ranges (reduced error and reduced CI). The null hypothesis of population closure was not rejected (probability of a smaller value greater then 0.05).

Table 2.4b. Observed (R) and estimated ($\hat{N}$) species richness in Capture for three sampling events. Results are given separately for the eastern (E) and western (W) range of the study area and the entire study area (combined).

Site	Sampling occasions	R	Model selected	$\hat{N}$	SE ($\hat{N}$)	CI ($\hat{N}$)	$\hat{p}$	Closure test	
								z-value	Probability of a smaller value
E	3	10	Mbh Mtbh	10	0.09	10 to 10	0.73 (prob)	-1.225	0.11
W	3	11	Mo	12	1.38	12 to 19	0.55	0.500	0.69
Combined	3	14	Mo	14	0.64	14 to 14	0.71	0.500	0.69

SE ($\hat{N}$): standard error of estimate; CI ($\hat{N}$): confidence interval (95%) of estimate; $\hat{p}$: capture probability; Closure test: test for presence or absence of migration (population must be closed to meet CAPTURE assumptions).

Puma, jaguar, and ocelot capture histories were built for each quadrat to estimate proportion of area occupied (PAO) for the entire study area (Table 2.4c). Pumas were detected four times, jaguars twice and ocelot three times. Although ocelots were detected less frequently than pumas, they were found in more quadrats (n=3) than both puma and jaguar (n=2).

Table 2.4c. Capture history for large felids for three sampling occasions. Quadrats 1 to 4 are from the western range and those from 5 to 8 are from the eastern range.

Location (Quadrats)	Species								
	Puma			Jaguar			Ocelot		
Rio Preto (Q1)	1	1	1	0	1	0	0	0	1
Rio Preto Q2	0	0	0	0	0	0	0	0	0
Rio Preto - João's island (Q3)	---	0	0	---	0	0	---	0	0
Parado Swamp - Peccary Island (Q4)	---	0	0	---	0	0	---	0	1
Cabaraquara (Q5)	1	---	---	0	---	---	0	---	---
Road to Parati village (Q6)	0	0	0	0	0	0	0	0	0
Parati village lowland (Q7)	0	0	0	1	0	0	0	0	0
Trails upper Salto Parati (Q8)	0	0	0	0	0	0	1	0	0

--- not sampled

Jaguar, like puma, was found during both the local expedition and during the Biosphere Expeditions project. Both species were detected in two of the eight sampled locations (quadrats), resulting in a 'naïve' proportion of area occupied (PAO) estimate of 0.25, although the puma was detected more frequently (for an explanation of naïve PAO, please see bottom notes of Table 2.4d below).

The estimated PAO remained the same for puma (25%) because it held a capture probability of 1, whilst jaguar was estimated to occupy the area in its entirety (100%), probably as a result of its reduced detection probability (0.1). Ocelot show a higher estimated PAO than both puma and jaguar (37.5%). This result for ocelot combined with a low capture probability (0.15), also yielded an estimated area occupied of 100% (Table 2.4d).

Table 2.4d. Occupancy results for pumas, jaguars, and ocelots in the Guaratuba Bay area.

Species	AIC	w_t	*p* (± SE)	Naïve PAO	PAO (± SE)	Frequency
Jaguar	17.00	0.289	0.1000 (0.067)	0.250	1.000 (0.000)	0,03
Puma	13.00	1.00	1.0000 (0.000)	0.250	0.250 (0.153)	0,06
Ocelot	20.91	1.00	0.1500 (0.08)	0.375	1.000 (0.000)	0,05

Constant model used Ψ(•)p(•), equal number of parameters (K=2) and Δ AIC = 0. Proportion of area occupied (PAO) is calculated with PRESENCE taking into account detection probabilities. PAO is mathematically represented by the Greek letter Ψ (psi). Naïve PAO is derived from the number of quadrats the species was found by the number of sampled quadrats (i.e. it does not take into account detection probability), *p* is the probability of detecting either species in the jth survey. AIC is the Akaike Information Criterion, and w_t is the AIC model weight. * Number of records by the total number of sampling days (64).

2.4.3. GIS mapping

Production of GIS maps with reliable distribution data is one of the main goals of the Jaguar Corridor project.

Two maps were produced. The first is limited to the Guaratuba Bay area, but includes all eight quadrats sampled from the eastern and western range considered in this report (Fig. 2.4d). Background features were provided by the Paraná Institute of Environment (IAP) and improved by tracing a large extent of the bay area in ArcView GIS 3.2 (ESRI, Redlands-CA, USA) from the topographic map of Guaratuba (SG-22-X-D-V-4-NO). The Guaratuba topographic map in turn was produced by the Directorate of Geographic Service (DSG) of the Ministry of Defense.

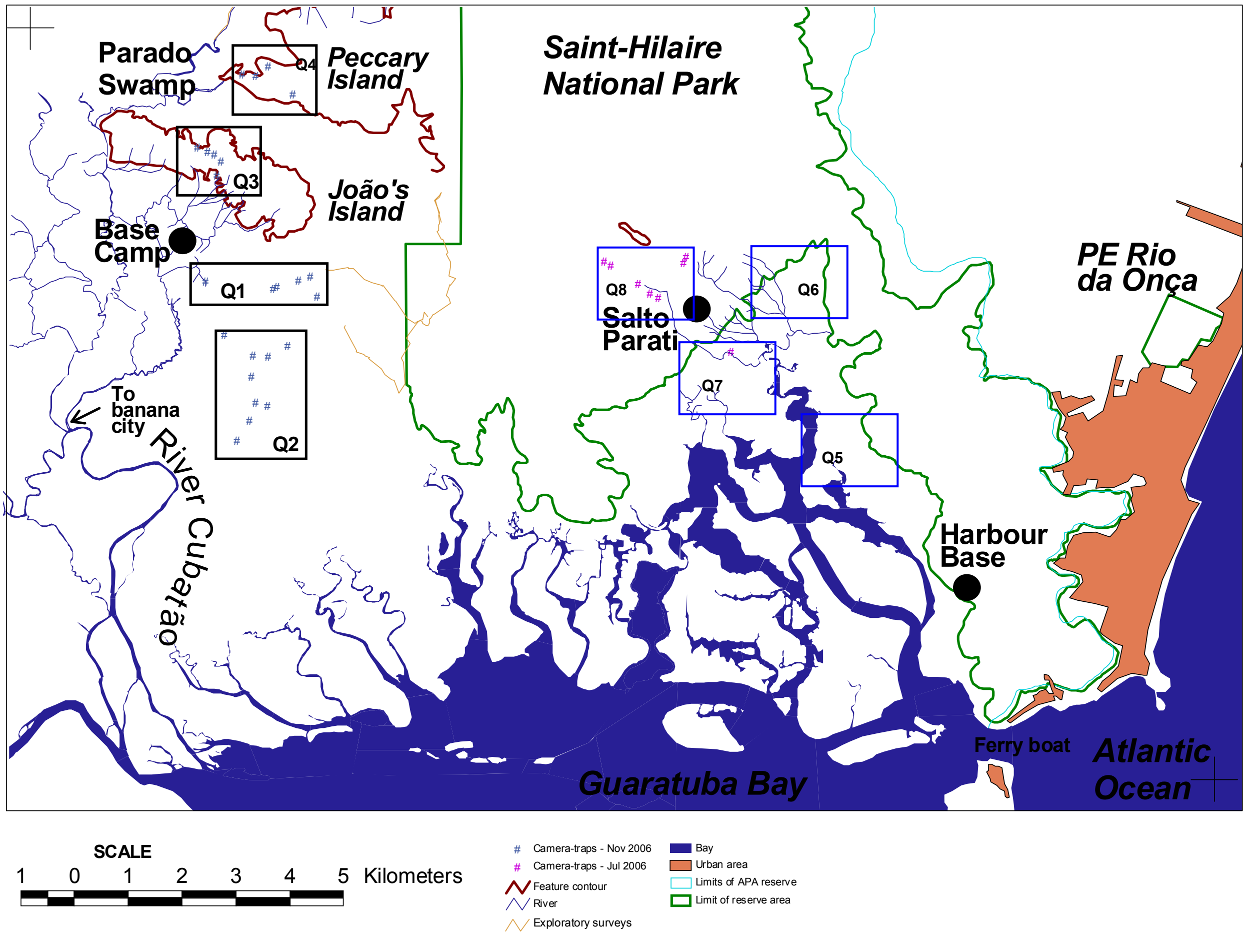


Figure 2.4d. Map of the study area encompassing sampled quadrats from where data have been collected for analysis. Also includes reserve boundaries, position of camera-traps, and location of familiar features and localities. Coordinates (UTM, Datum SAD 69) at upper left corner (X,Y respectively) is 22J 726,000 and 7,151,000; lower right is 22J 748,000 and 7,137,000. Quadrats in black (left) are in the western range, while those in blue (right) are within the eastern range of the study area. GIS features have been kindly provided by the Paraná Institute of Environment (IAP).

The second map was intended to provide a first overview of the entire 'Jaguar Corridor' study area, encompassing the Guaratuba Bay plus a large portion of the Serra do Mar mountain range and adjacent habitat areas where jaguars have been recorded, including the Paranaguá Bay further north (Fig. 2.4e). It was generated from two different GIS background features, one representing features of the southeastern portion of the state of Paraná, and provided by the IAP, and the other representing the northeastern portion of the state of Santa Catarina, provided by the Foundation for the Environment (Fatma).

Additional details and contours of protected areas were provided by Ibama and by the Society for Wildlife Research and Environmental Education (SPVS). All features were combined, edited and generated in ArcView GIS 3.2 (ESRI).

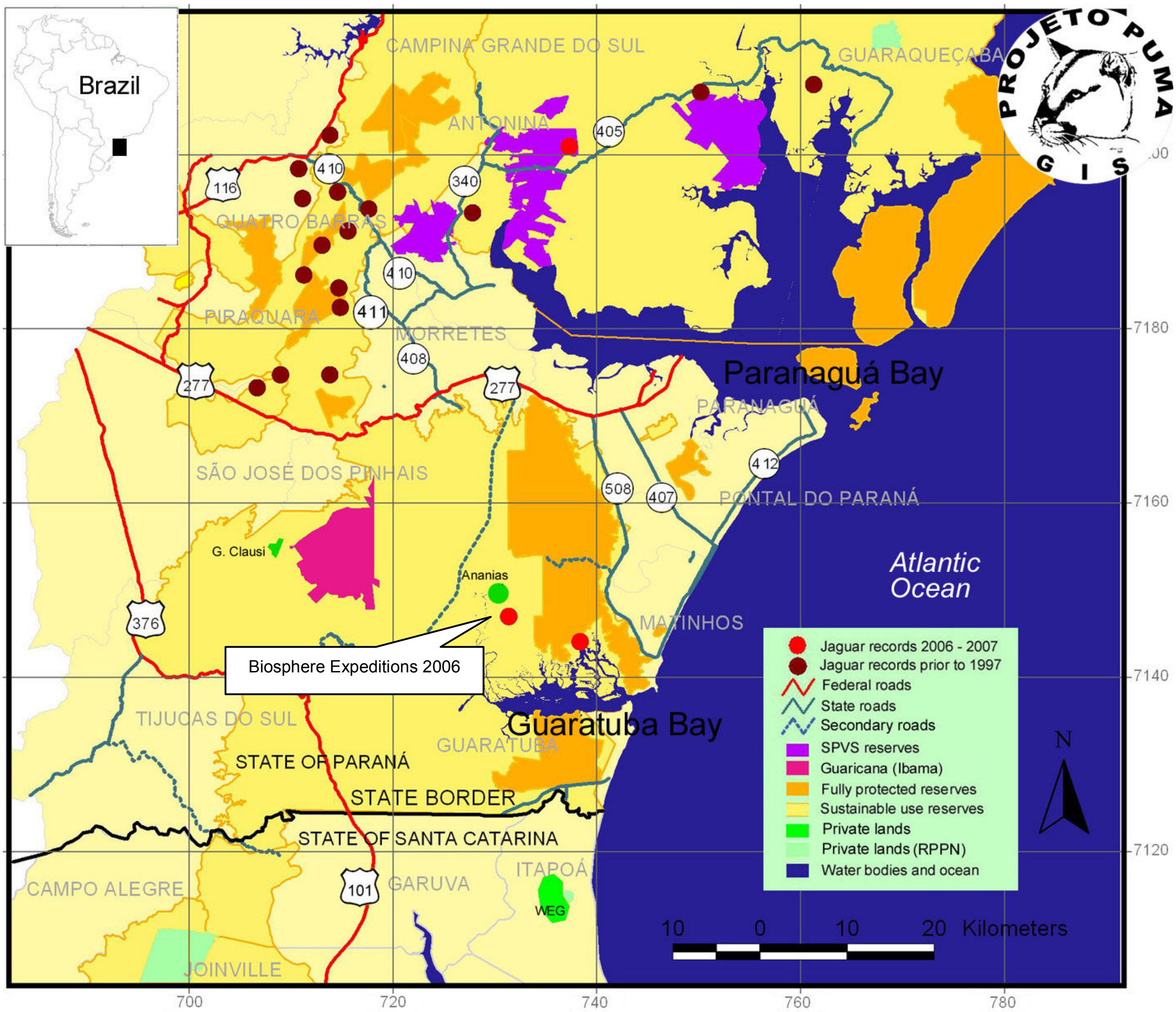


Figure 2.4e. This map was generated from GIS features kindly provided by several organizations. The Foundation for the Environment (Fatma - Santa Catarina), Paraná Institute of Environment (IAP), Brazilian Institute of Environment and Renewed Resources (IBAMA) and Society for Wildlife Research and Environmental Education (SPVS). Jaguar records prior to 1997 are displayed with permission of M.R.Leite (Leite 2000). Coordinates in UTM, datum SAD69.

2.5. Discussion & Conclusions

2.5.1. Jaguar, puma and ocelot presence

The fact that jaguars and ocelots were detected once in a quadrat and then not detected again in the same quadrat meant, for occupancy calculations (PAO), that their detection (or capture) probabilities were less than 1. In contrast, if a species is detected at a given quadrat in every sampling occasion, its detection probability equals 1, i.e. it will always be recorded when present.

Jaguars and ocelots were recorded fewer times than puma. However, their resulting low capture probability produced a proportion of area occupied (PAO) of 100% in the software PRESENCE or, in other words, the jaguar and the ocelot were considered to be present everywhere. This result may appear counterintuitive at first, as these two species could arguably be considered rare, because it was so difficult to detect them. Calculations of PAO, however, based on the capture history, take into account that the jaguar and ocelot were very difficult to detect in the study area, even when present. In fact, the capture history shows that they were detected only once in each quadrat where they were found. To PRESENCE, the fact that it was so difficult to detect them, even in the quadrats where they were present, meant that they may have gone largely unnoticed in the other quadrats, i.e. they might have been actually present over the entire study area, but with such a cryptic behaviour that they were not detected.

It may be easier to understand the way PRESENCE has estimated jaguar and ocelot presence by looking at the contrasting results of puma, which had the maximum detection probability (p=1). The puma was easy to detect where it was present, being easily 'recaptured' where it was recorded. PRESENCE results considered that the puma could be detected in every quadrat that it was present, so the number of quadrats where it was found (naïve estimate of occupancy) corresponded exactly to its PAO (calculated occupancy).

The results for puma are consistent with those in the highlands of southern Brazil, where pumas were found to be one of the easiest species to detect when present, provided adequate substrate for track imprinting was available (Mazzolli 2006). Unfortunately, jaguars no longer inhabited the area, impairing comparisons. However, the PAO results for jaguar in the Guaratuba bay are unlikely to be accurate, as the species is also known to roam over relatively open trails and along beaches rather than in dense forest (Schaller and Crawshaw 1980) and on undisturbed roads and open trails (Meffei et al. 2004) like the puma. Thus, if present, the jaguar was expected to have left enough tracks to be repeatedly detected during the intensive surveys.

The literature has only vague information on capture probabilities of jaguar from tracks or other signs, partially due to the fact that capture probabilities using signs as evidence are quite a new methodology (see Mackenzie *et al*. 2002). What's available are probabilities used to calculate abundance using CAPTURE (e.g. Maffei et al. 2004, Soisalo and Cavalcanti 2006) not directly comparable with those from PRESENCE. Empirical evidence indicate, however, that signs may be regularly found (Schaller and Crawshaw 1980, Rabinowitz 1986) including near the current study area (Leite & Galvão 2002) and may even be more frequent than those of puma (Silveira et al. 2003).

The frequency jaguar sign found by Leite & Galvão (2002) in the Serra do Mar mountain range, approximately 40 km north of study area was 0.15 per day (32 records ÷ 216 field days), five times more than in the study area and twice that found for puma. This is one of the reasons why it is not recommended to extrapolate results found in the study area to surrounding habitats.

It is assumed that tracks provide an easier way to detect felids in areas crossed by 'mud' roads and trails, as they will more likely than not cover a larger, more continuous sampling area than camera traps. This assumption may not be true for dense forested areas with trails covered with leaf-litter. In such habitat it is probably easier to detect felids with camera traps set along the trails. In the current study, tracks could be observed outside track traps, as trails were often muddy (more often than most of us whished!) and certainly sufficient to capture jaguars tracks. Camera traps were, by contrast, already expected to yield low capture results (and in fact did not record any puma or jaguar), as they were set at faint animal trails covered with leaf-litter, where pumas and jaguars are not expected to wander as often as in open trails. The reasons camera traps were not set to maximize puma and jaguar capture were: (1) there was no intention to identify individuals; (2) track records were expected to provide a good recording method; (3) it was a way of minimise the risk of theft; (4) species richness was expected to be better represented, as open trails may be selective in attracting some species and repelling others.

In any case, doubting PRESENCE results may also be supported by previous data simulations. Situations when PAO may be inaccurate are expected, as when estimates near to 1 are a result of low detection probabilities (<0.15). In this case, estimates should be considered with caution, particularly when the number of sampling occasions is also small (<7) (MacKenzie *et al.* 2002). This is the case for the jaguar, as detection probability was equal to 0.09 (thus less than 0.15), and PAO was equal to 1. The number of quadrats was also small (n=8), which may have favoured the distorted PAO calculated for the jaguar. The number of sampling occasions (n=3), apparently small, consisted in most instances of several days of intensive effort, so increasing the effort was unlikely to yield a different result.

The fact that the jaguar was so difficult to detect is therefore more likely to be related to low area fidelity[3] and reduced population numbers, probably in the face of the low prey availability in the study area, rather than the fact that they were present everywhere, but went undetected. Hence, the few jaguars that are persisting in the study area may be just crossing it to reach other sites with more abundant prey.

The best illustration for that reasoning comes from Q7, where a jaguar was recorded crossing very close by to a village. It is more likely that Q7 is a crossing place, as it does not appear to be prime habitat for jaguars. Evidence for that inference comes from the reduced species frequency and complete absence of peccary records during sampling in the entire eastern range. The jaguar recorded, however, headed to the mangroves, where capybara are know to exist, giving support to the conjecture that Q7 is probably a crossing place.

[3] Fidelity can be defined here as the permanence of the species in a circumscribed area for few days and its return to the same area after a short period.

It is important in this context to mention that this does not diminish the importance of the study site for jaguar conservation, as it is part of one of the few remaining blocks of connected jaguar habitat in the Atlantic evergreen forest. Furthermore these areas could be upgraded from corridors to full habitats if prey species were given opportunity to prosper. Hunting is not allowed by the Brazilian environmental law, but that does not seem to have impaired poaching. Only a community-based approach for conservation with self-enforced laws could be effective in reducing poaching. There is still an impressive forest cover left these areas, reducing the need for a full habitat restoration programme and the high investment required for such an enterprise. Grant schemes aimed at wildlife corridor projects need to incorporate the fact that there are circumstances when corridor effectiveness has nothing to do with plantation of seedlings. In fact what matters is the restoration of corridor and habitat functionality, which will be best as it approaches the original, primitive conditions for the area.

It is more difficult to find an alternative explanation for the low detection probability of ocelots other than the difficulty to record them where they are present. It was not possible to make inferences of their occupancy based on prey availability, since their prey base, in contrast to the larger cats, consists mostly of small mammals (Konecny 1989, Meza et al. 2002, Wang 2004) and reptiles (Meza et al. 2002) that were not sampled during this study. However, it is likely that the ocelot's prey base was not a limitation for their presence, as it was not for the puma either. It may just be that ocelots are not easily detected in the study area even when present. In contrast to puma and jaguar, detection of ocelot depended mostly on camera trap efficiency, presumably because ocelots utilised dense cover more often.

Study design considerations should always take into account the relationship between the amount of data obtained and the effort and cost of the survey. For PRESENCE analysis it is recommended that sampling units (quadrats) should be surveyed at least three times when detection probability is high (> 0.5 survey-1), and that for a rare species its is more efficient to survey more sampling units less intensively, while for a common species fewer sampling units should be surveyed more intensively (Mackenzie and Royle 2005).
As jaguars may be considered rare, it should be more efficient to find new areas for surveying. One of the strategies to meet this requirement is to have a mobile camp, such as the one built for the 2006 expedition. The expectation in terms of jaguar occupancy for the next surveys are to find sites where jaguars exhibit a higher fidelity, such as those observed by Rabinowitz (1986) in Belize, or by Schaller and Crawshaw (1980) in Pantanal, where jaguar movements could be revealed for several days. Higher site fidelity would be an indication of areas in the jaguar's southern Atlantic range likely to harbour a better habitat for the species.

2.5.2. Habitat quality inferred from species richness and occurrence of indicator species

Two parameters from the results other than PAO may be used to estimate habitat quality: species richness and occurrence of indicator species. While observed species richness (R) was quite similar between the eastern and western ranges of the study area, estimated results in CAPTURE indicated the possibility of occurrence of a larger number of species in the western range that were not detected during surveys. It was also the place where the tapir and peccaries, species that are increasingly rare in the region, were detected, and where puma was repeatedly detected. This biological evidence of better habitat quality in the western range is corroborated with the apparent disturbance of the eastern range caused from human occupation.

It must be emphasised that in spite of the fact that the comparative results indicate the western area as a less disturbed site, its faunal diversity was not as good as it was expected. Twenty nine species were of mammals over 1 kg in weight were expected to be found: howler monkey *Alouatta guariba*, capuchin monkey *Cebus nigritus* (Primata); crab-eating fox *Cerdocyon thous*, bush dog *Speothos venaticus*, yaguarundi *Herpailurus yaguarondi*, jaguatirica *Leopardus pardalis*, oncilla L. tigrinus, margay *L. wiedii*, puma *Puma concolor*, jaguar *Panthera onca*, tayra *eira barbara*, otter *Lontra longicaudis*, quati *Nasua nasua*, racoon *Procyon cancrivorus*, skunk *Conepatus chinga*, (Carnivora); tapir *Tapirus terrestris*, 'bororo deer' *Mazama bororo*, gray brocket deer *M. gouazoubira*, dwarf-deer *M. nana*, red-brocket deer *M. americana*, white-lipped peccary *Tayassu pecari*, collared-peccary *Pecari tajacu* (Artiodactyla); paca *Cuniculus paca*, agouti *Dasyprocta azarae*, capybara *Hydrochoerus hydrochaeris*, brazilian porcupine *Sphiggurus villosus* (Rodentia); white-eared opossum *Didelphis albiventris* (Marsupialia); lesser ant-eater *Tamandua tetradactyla*, nine-banded armadillo *Dasypus novemcinctus* (Xenarthra) (Cabrera 1957, Margarido & Braga 2004). Tapir was detected only once during spring and never during a whole month of summer survey, and peccaries were detected only indirectly from manioc depredation. In addition track and camera trapping results yielded very low species richness and frequency. According to local information this may be partially related to seasonal migration; information that needs to be verified in future.

2.5.3. Management implications

The Serra do Mar range is one of the few remaining refugia for the Atlantic forest jaguar, but results have shown that both the number and frequency of the species found in the study area were surprisingly low. Although lying within a highly threatened ecosystem, subjected to human encroachment, the Guaratuba Bay and surrounding areas are relatively well preserved in terms of forest coverage. The explanation for the species scarcity found must be related to direct human interference such as those caused by overhunting. From east to west and from south to north there is at least 15 km of dense forest not reached by roads, except the infrequently used 'mud' roads to Parati village and the Saint Hilaire/Lange National Park. And beyond that, the forest is continuous in both directions albeit with narrow corridors.

The area is, however, crossed by trails used for illegal extraction of palm heart, resulting in extensive areas where adult palm stands are simply absent, and where poaching may occur, causing a reduction of wildlife populations. The problems connected with illegal palm heart extraction are also the ones connected to illegal (and mostly unrecorded) poaching. While actual killings of jaguars and pumas do not seem to be a significant problem locally, poaching of their prey may be one of the reasons for reduced presence of jaguar in the area. Several species of carnivore show variations in density according to availability of prey (Fuller & Sievert 2001), including the tiger (Karanth et al. 2004). Direct evidence of poaching was not found during the surveys, but reduced presence of peccaries serves as an indicator. During the expedition, a manioc plantation was destroyed in Q2 (western range) by a herd of peccaries, the only instance where peccaries were recorded. Locals immediately reacted by persecuting the animals. From this anecdotal evidence it is easy to understand why peccary numbers are reduced in the study area, although in this particular case the property owner issued instructions not to kill them. Until quite recently, people inhabiting the area depended on manioc as their primary way of subsistence. The slash and burn way of producing this local root was then prohibited in a large extent of the study area due to the implementation of protected sites law and the enforcement of environmental laws that limited exploitation of the endangered Atlantic forest.

Peccaries are generally easy to find where they occur, even in areas that are not extensively covered by forest or as remote (Mazzolli 2006). Their habit of ranging extensively over their territories and the fact that their hooves imprint easily on trails and mud are reasons why they are easily detected when present. It is reasonable to assume that the inability to record their tracks was an indication of severely reduced population numbers in the study area.

The fact that peccaries may be hunted for meat by people literally living in the forest, combined with the fact that they are a menace for manioc plantations, may have caused their decline over several decades. Reduction of poaching can only be solved by law enforcement, environmental education and value-oriented conservation, but manioc depredation can be solved by the installation of a simple but effective system shown to us by Mr. João in Q3. He surrounded his manioc plantation with a large net made with ropes (Fig. 2.5a). According to him depredation no longer occurred after this
.

Figure 2.5a. Effective protection of manioc plant against depredation by herbivores using a simple, large net surrounding the plantation.

According to Mr. Ananias, owner of an area 1,600 ha in size that encompassed the base camp and quadrats 1, 2 and 3, his land was originally occupied by a large number of families when he acquired it about 20 years ago. He stated that the land was intensively exploited for timber, and only initial stages of forest regeneration could be found, due to large areas of manioc plantation. At that time, no palm heart was to be found and animals were even more scarce. Indeed ruins of an old manioc mill near base camp are an indication of that past. Evidence of tapir in Q1, which was not recorded there before (in twenty years) may be a sign that the ecosystem is recovering in the western range of the study area.

2.5.4. Management recommendations

It is recommended that this and/or adjacent areas be converted to officially protected areas to ensure the long-term conservation of the habitat. Coupled with that conversion, an advanced base camp for rangers and researchers must be set to ensure that protection plans are enforced and that monitoring is constant. Without that the area will be considered abandoned by local people and all palm heart will be removed as a result. Likewise in the nearby Saint Hilaire National Park.

The areas sampled during this study (Figs. 2.4d and e) are some of the most difficult places to reach and therefore probably one of the least affected by human interference, as they are surrounded on the eastern and northern sides by the Saint Hilaire NP, on the western side by a swamp thick with grasses, and in the south by the bay.

Another recommendation that may implemented to improve both wildlife and forest sustainability is the incentive for extraction of fruits of the palm heart to produce juice rather than to cut the palm tree. The palm heart species that inhabits the Atlantic forest (*Euterpe edulis*) once cut will not regenerate like the Amazonian palm heart. Fruit from both species make an excellent juice (açaí), appreciated and consumed in Brazil during the summer season and now increasingly in demand as Brazilian and international health food providers are discovering açaí as a rich source of antioxidants. A rough estimate shows that the fruit may be sold by the collector at US$0.30 per kilogram, resulting in an approximate income of US$7.5 per tree every year. One tree produces one palm heart each eight years at best, sold at US$0.9. The incentive for the fruit industry among local communities would likely raise the value of palm heart, which would for this reason be tendered for, providing a self-regulating mechanism of habitat conservation. Further, collectors would now be more wishful to exploit the fruit than to cut the tree. This would not impact the palm heart industry, as most of the Brazilian production comes from the Amazon, and today there are several homogeneous plantations of a number of palm species that produce commercial palm heart.

Regarding the jaguar conservation along the entire stretch of Serra do Mar considered in the Jaguar Corridor Project, extending from the State of Santa Catarina to the State of Paraná, historical cases in northern Santa Catarina State exist where jaguars dispersing from source areas were poached due to livestock depredation. To reduce the chances that future dispersing jaguars suffer the same fate, and increase the chances of jaguars recolonising portions of their previous historical distribution, it would be ideal if efforts to record the species' presence could go beyond the capacity of the current study to record them. Currently it is impossible to check every piece of information and gossip about jaguar presence. Indeed a jaguar may be identified by ranchers and killed before anyone knows it was present. It would be within the project's capacity, though, to verify areas where jaguars had previously been recorded as present. One way to do the previous recording would be to compel ranchers to produce a proof of jaguar depredation when it occurs, in exchange for compensation for jaguar livestock depredation. Compensation could be linked with the need for a proof of depredation, so ranchers would be compelled to record tracks and other jaguar signs, reducing the work overload on project personnel. Once a jaguar was recorded, it would be then possible to establish direct communication with the local community for further arrangements aimed to ensure the survival of the species in the area.

2.5.5. Further expedition work

Results presented here suggest that jaguar detection probabilities are very low in the study area, a situation that is unlikely to change in the near future. It is within the aims of the expedition to detect jaguar habitats that need to be restored, just like the one characterised in this first expedition, but mostly, it is necessary to identify jaguar refuges. These refuges can be defined as areas that are rich in prey, are frequently occupied, and are breeding places.

If the same base camp is used during future expeditions, which may be the case as there are logistical constraints for a highly mobile camp, it would be ideal to explore surroundings as much as possible in search of eventual jaguar refuges. As discussed above, recording jaguar may be largely independent from camera trap equipment. Therefore, tracks and other sign would suffice for a first survey attempt. This procedure, however, is rather bold for a scientific project involving laypeople, as the usual procedure is to demonstrate what has been previously recorded and tested, avoiding surprises.

Exploring new trails and roads, especially in remote forested areas, with a volunteer team, for example, is different from taking them to known places. Our experience with Biosphere Expedition teams, however, have shown that this is possible. Volunteer teams by themselves were able to navigate through rivers on a canoe and through new forest trails that neither staff nor expedition team members had been to before. This autonomy has enabled the execution of several simultaneous tasks by different teams, provided new information for the project and at the same time produced a satisfaction for the group that seemed to be unsurpassed by any other activity. It seems that the most difficult and remote places to reach were also the ones that were most fun to explore for team members. Exploration, therefore, should be a constant in future expeditions, even if demanding a higher survey effort.

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Appendix 1. Expedition diary by David Moore.

21 October

Not so much of a diary entry, but a message to say David (Moore, your expedition leader) is about to arrive in Germany for the packing up and final preparations to start before we both fly to São Paulo on Monday. There we hope to pick up a Land Rover Defender, have some meetings and do some shopping, before heading to Matinhos*.

*http://maps.google.com/maps?q=Matinhos,+Brazil&ie=UTF8&z=12&t=h&om=1&iwloc=A

If you click on this link and then look slightly south and west, then you'll be able to see the channel that David and I (and later you) will be heading up to reach base camp.

Work is in progress there already, overseen by Dr. Marcelo Mazzolli (your expedition scientist). David, Daniel (from Biosfera Brazil, whom some of you may have dealt with already when booking flights etc. and who will be coming out to assist for the first week or so) and I will be helping out over the next couple of weeks, putting the finishing touches to base, our procedures and work plan so that you have your nice comfy platforms and tents to sleep on/in when you arrive, as well as somewhere to work and something to eat. If you're lucky ;->

On another note, we are introducing a new procedure on our expeditions in an effort to reduce our environmental impact. Eventually something like the document I am attaching now will form part of everyone's welcome pack and I hope you don't mind if we are using you as guinea pigs on this expedition to test this out. David will talk you through the document and what's specific to Brazil during your first day briefing session, but I would be grateful if you could have a look at this now and come on the expedition with some thoughts and comments to give to David and me.

We're looking forward to seeing the first slot in a couple of weeks. Safe travels & see you soon.

Dr. Matthias Hammer
Managing Director
Biosphere Expeditions

25 October

Hi everybody! This is David and I'm sending you the first diary entry from São Paulo where Matthias and I arrived yesterday morning to begin the preparations for the launch of the new jaguar and puma research expedition. No tales of exotic animal sightings yet, but just a few lines to let you know what we've been up to the last couple of days: mainly shopping for some of the initial supplies for the base camp – stocking the first aid kit, getting stationery supplies and camping equipment. Luckily we've had the help of Daniel from Biosfera Brasil who has been indispensable at navigating us around the choking streets of this huge city and getting us to all the right places. Yesterday we spent most of the day at Land Rover Brazil negotiating the release of our lovely green Land Rover and it's already insured, installed with a GPS transmitter and appropriately decorated with the relevant Biosphere Expeditions and Land Rover stickers ready for slots one's arrival in about ten days.

This evening we're packing up and preparing to drive down to Matinhos tomorrow to meet up with our scientist Marcelo. From there we'll take the boat up the channel to get us to base camp where we can see how things are progressing and what still needs to be done. No doubt you're as keen as I am to discover our progress over the next few weeks. Hopefully the next email I send will be from the satellite link-up at base camp and I promise not to recount any exaggerated stories of mosquito or snake infestations or other nasty things (unless of course they're true). Looking forward to meeting you all soon….

30 October

Thursday’s drive down from São Paulo to Matinhos gave a first glimpse of patches of the Atlantic forest, which once covered pretty much the entire coastline. Marcello was waiting for us at the harbour base from which our boat will leave for the three hour journey up the channel to our forest base camp.

In order to catch the high tide we made an early start on Friday to get straight to base camp and assess what still needs to be done for slot 1’s arrival in a few days. Part of the base camp includes a working farm (with two entertaining pig-wild boar mongrel piglets) and a house, which we will use for cooking, eating, equipment storage etc. A local worker took us a few hundred metres along one of the trails to show us a puma track he had recently found. Marcello explained how to distinguish a puma track from that of a jaguar and how not to confuse it with that of a dog! We also decided on the location of the ten tent platforms and temporary shower booths, which are under construction now.

Mosquitos are not too bad and the citronella repellent seems to work well on them!

The weekend was then taken up in a shopping frenzy here in town. Everybody is really intrigued by our presence here and is asking lots of questions about the project and why we need 150 one-metre long poles of wood, 15 pillow cases, machetes, lamps, plastic showerheads etc… Fortunately the initial shopping list is now pretty much complete so we’re moving on to laminating, photocopying etc. and tracking down the cook! We’ve also pretty much developed the work plan (attached). Slot 1 will be the trailblazers in the genuine sense of the word, setting up the trails, quadrats and transects that the teams to come for the next few years will be working over. But everyone in this first year, please remember that the itinerary is only a rough outline. Things have a tendency to change in the field, as you are about to find out ;->, so please stay flexible!

It’s been great to meet up with Marcello and see how enthused he is by the project and the boost that it is giving to his work. He’s looking very pleased indeed with the 25 camera traps which have just been delivered, and as you can see from the itinerary part of our task will be finding locations for these, installing them and checking them.

Early tomorrow morning we’ll be heading back up to the camp to finish construction and set-up. My next diary will be either from there by satellite uplink or from Matinhos again when we come back for last minute shopping and arrangements on Friday or Saturday before meeting slot 1 Sunday morning.

3 November

We’ve just arrived back at the Matinhos town base after three days up at the jungle base camp where we have been setting up the camp and getting everything in place for team one’s arrival on Sunday.

We set up the first tent platform on Tuesday and began creating the tracks around the section of forest, which is now the newly named ‘Palmito Grove’ tent complex. We recruited the help of some of the farm workers, which meant we could also spend our time on clearing the trails, ordering the equipment, chopping wood for the fire, getting rid of the junk, rearranging the house, building the outdoor shower (it’s amazing what you can do with bamboo and palm leaves!), finishing off the data sheets …. and much more! You’ll also be pleased to hear that we also tracked down our cook, Olga, who lives a little further down the river and who made a great first impression in the kitchen.

This afternoon we‘re off to do the food shopping and printing in town and buying some of the last-minute supplies. Marcelo and I will then be leaving tomorrow to drive over to the Curitiba Holiday Inn where we’ll be meeting the first team at 07:00 on Sunday morning. Matthias will be staying back here at the harbour base, preparing sandwiches for us before we take the boat in early afternoon. We’ve located a couple of shops in Matinhos that are open on Sunday and sell Wellington boots and other last-minute supplies you may want to buy, so we’ll make a little stop there on our way.

Bon voyage and see you soon!

10 November

With six cameras traps and six track traps set on quadrat 1 and a good progress on quadrat 2 today, there is lots to report from the first week here in the forest.

Our food supplies for two weeks along with twelve teams members and luggage made for a cosy boat ride and we weighed down quite heavily on the final approach through the mangrove before arriving at basecamp. The rains had made the track up to camp and the surrounding trail very slippery, but by evening time we were more or less settled in to the camp and acquainted with its workings, ready to launch in to a jam-packed training day on Monday. We spent quite a lot of time explaining the workings of the GPS and how to take compass bearings, etc. before venturing out in to the jungle. There Marcelo gave us instructions on how to set up the camera trspd, one of our main tasks for this first week. With our brains full of all these details, I think we were pleased to get out in to the field on Tuesday to make our first 'recce' - quite a task on some of the muddy trails with some streams and log crossings to navigate.

Once familiar with the main trail of this quadrat 1, we split up on the Wednesday with two teams heading out to place camera traps 30 to 50 metres off the main trails and two other teams cutting secondary trails out in order to place traps further inside the jungle. Whilst the camera trap setters made good progress, the trail blazers found it tough going and their route blocked by dense thicket. Thursday saw a second more concerted hacking effort (while the other teams had the lighter task of smoothing over mud squares to create track traps) and with a further six traps set on the new secondary trails by the time the remaining hardcore "macheteers" made it back to base last night we were able to consider quadrat 1 'loaded and primed'!

Well in the swing of the work now and with drier trails and sunshine too (after some overcast days with torrential downpoars) we made faster progress on quadrat 2 today. Slot 2, be warned though. Hot sunny days also means low cloud cover at night, so the heat radiates off quickly and night time temperatures dropped to 8˚C. So come prepared with a warm set of clothing and a sleeping bag to suit as well as a thermarest to insulate you from the cold coming from the platform base.

While we finish off this patch tomorrow, Marcelo will be taking a small team over to the quadrat 3 to check out the terrain (and hopefully find a trail). Next week we'll be concentrating on transect work and trap checking before moving on to quadrat 3 with slot 2 to trap and sample that area.

The generator is on late tonight so we have electricity flowing for the lights and are recharging some of the equipment. Whilst a few of the team members have headed off for a well-earned bit of sleep, the rest of us are sitting here, chatting and quaffing our "51" Cachaça, the local "truck drivers" rum.

12 November

Quadrats 1 and 2 are now set with all cameras and track traps in place and quadrat 3 has been scouted out. Thanks to everyone for putting the effort in!

The team is now having a well-earned day off at base and we've had time to sort out the GIS (Geographical Information System) information on the computer and catch up on data entry.

When you read this the pictures on www.imagestation.com/album/pictures.html?id=2101763541 should be updated, so have a look at what it's like out here!

Also attached are three files of interest. "gis brazil.jpg" shows the location of the quadrats, base and connecting trails. Red feet icons indicate track traps, blue cameras indicate camera traps and yellow deer the site of an animal encounter or a noteworthy track. We are hoping to add more information as time progresses and of course it will be slot 2's job to fill in the gaps in quadrat 3.

"gis brazil.kml" will only work if you have Google Earth (http://earth.google.com/) installed on your local machine. If you do, it will show you much the same GIS information within Google Earth and you can then zoom in and out and take a closer look at the trails and waypoints.

Finally, the outline plan for slot 2 is also attached.

And that's it for modern gizmo stuff for today – I'm back to my hammock. It's Sunday after all ;->

14 November

We're sitting on the bench outside the base camp house where Alan is photographing the new patch of blue sky, which is coming our way after a couple of rainy days, making for some interesting swampy trails.

Clare, Martyn, Alfred and Marcelo have just returned from their afternoon reconnaissance boat mission to the much-talked-about 'Peccary Island', a possible location for an eventual fourth quadrat (perhaps next year!). No peccaries spotted, but Clare was very amused by her sighting of the abandoned toilet bowl in this remote location. The team was pleased to see that the GPS reading showed that they were not too far from some of the waypoints Helmut had noted when traversing quadrat three on his trail finding sortie yesterday. With many of these trails and locations now transferred to the satellite map, we're starting to see where some of the trails link together and can build up a reasonable picture of the surrounding terrain.

Marcelo also had a good conversation with some of the inhabitants in quadrat three who indicated areas where jaguars are known to descend from the mountains at certain times of the year.

The transect cutting has proved challenging in the muddy hills and mammal sightings have been low, unlike the snakes who have been turning up every day in various shapes and sizes. I just missed today's commotion at base camp when a two metre yellow and black fellow dropped from a tree near the doorstep amid a flurry of birds who set about dive bombing him (perhaps he'd been stealing eggs) as he slithered under the rocks causing a mouse to scarper! According to 'Google', he was the rather common and non-poisonous 'Caninana' (translated as tropical rat snake).

Weather depending we shall set about checking and changing the films if necessary of the quadrat one camera traps tomorrow!

17 November

The soaring temperatures during the last two days of the first slot (up to 32ºC yesterday) meant we were able to return to all the camera traps in the field, check that they were in full working order and change the batteries and films as necessary. A couple of cameras needed to be brought back to base to be fiddled with in order to restore them to full functioning capacity. Whilst most of the analogue cameras still had film in them, Alfred's counter had already moved up to '20 photos', so we have just dropped the film in to be developed back here at the harbour base to see if we have captured any images. Meanwhile, one of the digital cameras has offered us a glimpse of an armadillo's backside disappearing down the trail!

With slot one now continuing on with their travel plans or returning home, we're looking forward to meeting the next team and progressing further with the data collection and improving our understanding of the area around our base.

21 November

The trails are more like streams and the waterway, which once stopped about 300 m from the house is now almost up to the house, but this has done nothing to dampened the enthusiasm or hamper the indomitable spirit of slot 2's initiation to the delights of Palmito Grove. Lots of the 'local' red wine has helped too, especially when accompanied by Italian Uno card rules.

Everybody was quick on the uptake for the GPS and jungle navigation training yesterday and even quicker up and down the trails out along the main trail to pick the first half of the cameras on quadrat 1 in the afternoon. Marcelo took Ali, Alice and Tom out along the far secondary trail B whilst I headed out to the end of the main trail with Robin, Brian and Georgie. We picked up the other cameras from the first part of the main trail and secondary trail B today. Slot 1 will be pleased to hear we located them with no trouble, even if some of the stream crossings now require extra balancing powers! Richard stayed at base yesterday and fashioned some very impressive removable mosquito screens for the windows and doors around base.

There was much excitement as we looked over digital cameras numbers 03 and 05 which had been brought back from the field. 03, which Janet, Alain and Helmut placed in the field together with Marcelo contains a reasonable shot of a red brocket deer and two unidentified mammal rear-ends! The rear-ends are really quite clear with nice large bushy furry tails, but despite all zooming and resizing efforts we are unable to decided whether it is fox, coati or even anteater. This is one of the disadvantages of the digital cameras compared to the analogue which are able to react to animal movement more quickly. If we do not place all the cameras out in quadrat 3, we shall return to the spot and place another analogue camera in the same location to try to secure a clearer shot. There was a similar case for the 05 digital, where a blurry striped tail could be made out against the dark background.

With the retrieval of the remaining cameras quickly completed, some of us are now back at base where we have been changing batteries and film and testing the cameras ready to take them out to the new quadrat over the next couple of days. Meanwhile Alice, Robin and Ali have taken the boat over to quadrat 3 with Marcelo to talk to the inhabitants over there and arrange a boat pick-up for us tomorrow morning so we can all head over for a full-scale reccee of our new terrain.

25 November

Three days of sunshine and sweltering heat have meant a run of good days out in the field. Robin, Ali and Alice made a full scale reccee of ' Peccary Island' on Wednesday, exploring all corners, setting five camera traps and confirming its island status i.e. no overland trails. They found armadillo, fox and racoon tracks and spoke of a pungent smell of 'cat' in several locations. The rest of the team went over to quadrat 3, walked the hilly Rua Iguaçu and established more camera traps.

On Thursday we returned to quadrat 3 and took the remaining cameras. Having got used to fairly rapid lunches under the canopy with our mosquito friends, we were really pleased to discover the end of the main trail in quadrat 3 with a couple of habitations and open land, great for bird-spotting and with amazing views of the surrounding mountains.

Yesterday (National River Day) saw a gathering of local NGOs at a settlement about three hours by boat from here. Marcelo took one team over to attend the meeting and inform them of the work we are doing here. Even if the proceedings were obviously in Portuguese, it was a good chance to share our discoveries (notably the complete lack of animals in our research area!) and get in touch with the local environmental police and other members of the local community working in conservation and interested in the potential development of ecotourism in this area. Meanwhile the rest of us set of on another exploration trek, this time to the end of quadrat 2 as far as the wide track and then off on new trails in search of the fabled jaguar river. The locals have talked to us about this spot, which we hoped we would be able to reach on foot. Though we managed a good 15 km, we found our progress hampered in both directions by impassable rivers. The GPS map is proving - very useful for logging these new trails and letting us see where we've been in relation to the surrounding topography. Tomorrow will be a rest day, but we're going to hire a local guide for Monday to reveal the navigable trail to this new spot.

Three dry nights have meant plenty of opportunity for spotting animal tracks. Hopefully the rain will continue to hold off so we can take the boat along the waterways tonight and fine tune our animal spotting skills by torchlight!

30 November

With our batteries recharged after a rest on Sunday we were ready to launch in to Monday's activities despite the steady rains. Thanks to local knowledge of one of the farm workers, Robin, Rich, Alica and I were able to make it over to the distant Jaguar River, lunch in a small hovel on the river banks and make it back in record time. The others headed off in the boat in search of a route through the swamplands up towards the mountains which had previously been a possibility for a base camp. No route was found, but the team were enthused by the waterways they had taken through the maze of swamp and reed.

Tuesday was the start of our camera recovery operation. While Rich and Brian recovered the closer cameras of quadrat 2, Ali and Tom managed to bring back all of the cameras from quadrat 3, having great fun making their way back through the underwater track. This day was my chance to discover the charms of Peccary Island as I headed off with the team to recover the five cameras planted over there (one of which contains a good shot of an armadillo). Despite its fearsome reputation as a tick haven, we benefited from the previous groups who had cleared decent paths and built up a good picture of the trails so we escaped fairly unscathed.

George, Brian and Tom had a tougher time getting the further cameras back from quadrat 2 on Wednesday, wading thigh high through the waterways. Robin, Rich and I took the softer option of driving the boat an hour down river with Olga to find the 'Jungle Bar', a favourite weekend haunt of the farm workers, to get in some supplies of our favourite singing wine and cachaça for our upcoming last-night celebrations. We were quite surprised to find ourselves in a very civilised little establishment in the middle of ' Banana City', a vast banana-producing swathe of land. We were able even to buy a large block of ice which survived the return journey back to base and made a refreshing addition to our afternoon/evening caipirinhas.

All cameras were skillfully recovered!

2 December

My last diary entry comes to you from the departure lounge at Sao Paulo airport. Packing up camp and shuttling the supplies down to the boat for the return to Matinhos and on to Curitiba went very smoothly and we had a great last night in the Matinhos pizzeria and down by the beach. Marcelo, Ali, Tom and I then had our last 'putting the expedition/world to rights' session at the Holiday Inn last night (as well as making detailed plans for Marcelo's much-mentioned dream Sumatran expedition!). Tom said last night that it was the mud and rain that really made the expedition special for him. Maybe he'd had too much wine by that stage! In any case, only a day out of the jungle and we were already reminiscing about our days staggering through the undergrowth, getting covered in ticks, pulling out the worm from George's toe, not to mention the evenings holed up in our cabin with 'kashaaasa' and Uno. The night Ali spent lying awake hammering SOS morsecode on to the platform for three hours due to suspected large cat outside her tent probably deserves some kind of diary mention as well. And Marcelo also says that he heard a large cat roar on the same night….we'll have to see what kind of mention it gets in the report!?

Thanks to everybody for all their hard work and enthusiasm, and all their tips and suggestions for next year's expedition (thigh-high waders were quite high on the list – or perhaps just plain old webbed feet - along with more hammocks for test-driving when back at base!). Marcelo is already enthusing about his further plans and ideas for 'getting beyond Peccary Island' and perhaps even introducing Land Rover based activities from Banana City. I shall back at Biosphere's German office on Monday so will be bringing Matthias up-to-date of all our discoveries, adventures and ideas! Best wishes and Merry Christmas…!