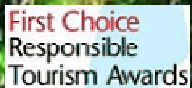
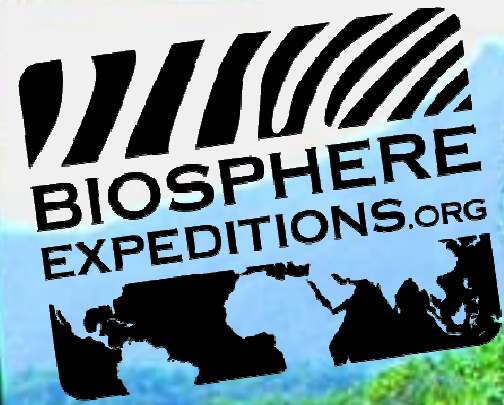


EXPEDITION REPORT

Expedition dates: 14 – 26 May 2011
Report published: May 2013

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



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Germany



EXPEDITION REPORT

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

**Expedition dates:
14 – 26 May 2011**

**Report published:
May 2013**

**Authors:
Marcelo Mazzolli
Project coordinator
Projeto Puma**

**Valeska Oliveira
Field Scientist**

**Matthias Hammer (editor)
Biosphere Expeditions**

Abstract

An expedition to the southern Atlantic forest of Brazil was conducted with Biosphere Expeditions in May 2011, to the APA (Area of Environmental Protection) of Guaratuba in the Serra do Mar mountain range. This was the fifth Biosphere Expeditions survey in the area and the seventh overall including local expeditions. The primary aim of the surveys is to locate core habitats for jaguar and puma at their southern range in the Atlantic broad-leaf rainforest, and develop conservation strategies and guidelines for these habitats and their resident species based on information gained locally. Sampling was conducted in the locality of Canasvieiras, in the municipality of Guaratuba and consisted of sign surveys and the deployment of ten camera traps. Data collected included species richness and observed occupancy. Jaguar was not recorded during this expedition, but several species important to the project objectives were. In terms of species predominance, tapir was most often recorded, followed by deer and ocelot. One surprise was the relatively high number of records of white-lipped peccaries, one of the jaguar's main prey species, and geographically restricted as a result of overhunting. The fact that large cats are not recorded during short volunteer expeditions is normal, but results accumulated by surveys over several years show that the jaguar is rare in the region. Species richness of medium-sized and large mammals was high considering the short duration of the survey, (n=15 species). Animals are difficult to see in this region, but in spite of that, tapirs and the primates, howler-monkeys and capuchin monkeys were seen during surveys.

Resumo

Expedições ao sul da floresta Atlântica do Brasil foram efetuadas pela 'Biosphere Expeditions' em Maio de 2011, para a APA (Área de Proteção Ambiental) de Guaratuba, localizada na cadeia de montanhas da Serra do Mar. Este foi o quinto levantamento da Biosphere Expeditions na área, e o sétimo levantamento total se expedições locais forem contabilizadas. O principal objetivo do projeto é localizar áreas de habitat principal para a onça-pintada e o puma no limite sul da distribuição da Floresta Atlântica costeira, e desenvolver estratégias de conservação baseadas em informações obtidas localmente, de maneira a produzir diretrizes para conservação destas espécies e de seu habitat. A amostragem foi conduzida na localidade de Canasvieiras, no município de Guaratuba e consistiu em levantamentos de vestígios de mamíferos e uso de dez armadilhas-fotográficas. Dados coletados incluíram riqueza de espécies e ocupação observada. A onça-pintada não foi registrada, mas várias espécies de importantes para o objetivo do projeto foram. Em termos de predominância não houve variação em relação aos outros anos, com a anta ocupando um primeiro lugar, e segundo lugar de veados e jaguatirica. Uma surpresa foi o registro relativamente alto de queixada, uma das principais presas da onça, e geograficamente restrito em razão de caça excessiva. O fato de grandes gatos estarem temporariamente ausentes por curtos períodos de tempo é normal, mas resultados acumulados ao longo dos anos mostram que a onça-pintada é rara na região. A riqueza de espécies de médio e grande tamanho foi alta para a curta duração do estudo, (n=15 species). Os animais são difíceis de visualizar na região, mas apesar disto a anta, e os primatas bugio e macaco-prego foram avistados durante o estudo.

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Please note: Each expedition report is written as a stand-alone document that can be read without having to refer back to previous reports. As such, much of this section, which remains valid and relevant, is a repetition from previous reports, copied here to provide the reader with an uninterrupted flow of argument and rationale.

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 aims to continue the only jaguar and puma conservation project in the Atlantic broad-leaved rainforest. The expedition's study site in the APA (Area of Environmental Protection) of Guaratuba, in the Serra do Mar Mountain range, 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.

The APA (Area of Environmental Protection) of Guaratuba is 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 in an important area of its historical range. 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.



Figure 1.2.a. Flag and location of Brazil and study site.

An overview of Biosphere Expeditions' research sites, assembly points, base camp and office locations is at [Google Maps](#).

The study area is situated in the APA (Area of Environmental Protection) of Guaratuba, although much of the Serra do Mar mountain Range in the State of Paraná, as well as its bays, are of interest to this project. The Serra do Mar mountain range harbours the largest continuous patches of Atlantic rainforest of Brazil.

The Atlantic rainforest of Brazil is 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.

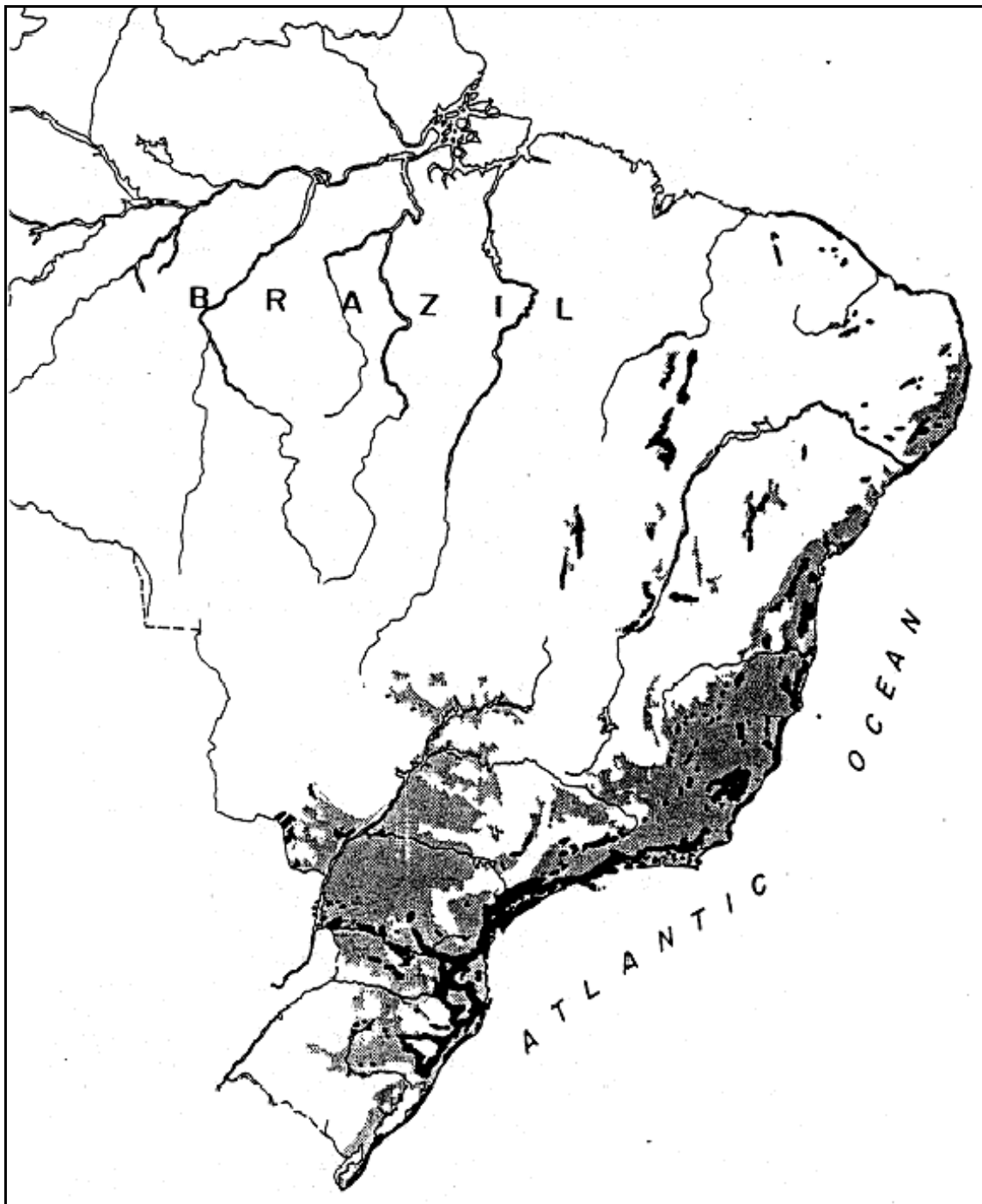


Figure 1.2b. Map of the Atlantic forest showing estimated extent around 1500 (grey) and extent in 1990 (black).

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.

1.3. Dates

The expedition ran over a period of two weeks from 16 to 26 May 2011 and was composed of a team of international research assistants, guides, support personnel and an expedition leader (see below for team details).

1.4. Local conditions & support

Expedition base & transport

The expedition assembly point was Curitiba, where expedition team members were met by the expedition leader and by the local scientist to be taken directly to base camp (see map below) using three four-wheel drive Land Rover Defenders kindly provided by Land Rover Brazil.



Figure 1.3a. Map showing study area including study bases, main road network, and major landmarks. © Google Earth.

Prior to the team members' arrival, staff prepared base camp from 12 May 2011. The facility is owned by a Mr. Simões who kindly provided access to it. The location of base camp in 2011 was the same location as 2010, 2007 and 2008 (see above).

Base camp consisted of fourteen tents installed on wooden platforms and one jungle hammock, where the team slept, and a house where meals were served and other communal activities were conducted.



Figure 1.3b. Base camp with tents installed on wooden platforms above the forest floor.

There was a dedicated cook to prepare main meals. Lunch often consisted of a snack taken to the field, whereas dinner was the main meal. There was 110V electricity at base.

Field communications

There was no telephone, and mobile phones did not work at base. The nearest landline telephone was about one hour from base camp. Regular expedition diary updates were uploaded to www.biosphere-expeditions.org/diaries for friends & family to access.

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 were no serious medical incidents. There were some sore muscles and joints as well as some cuts, bruising and minor insect bites.

1.5. Expedition scientists

The expedition's field scientist was Valeska Buchemi de Oliveira. Born in Belo Horizonte, Brazil, Valeska is a Biological Sciences graduate of the Catholic University of Minas Gerais, specialising in research design and environmental impact studies of mammal communities. In this capacity Valeska has worked in the Protected Areas and Priority Conservation Areas in regions of the Cerrado, Atlantic Forest and the Amazon biomes. Valeska has also worked in conservation through research with private reserves (RPPNs) and with various research and conservation institutions.

The expedition's chief scientist was Dr. 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, England, and Peru, and has surveyed lions in Botswana. Marcelo has been working with Biosphere Expeditions since 2006 as scientist in Brazil, and has also participated as a Biosphere Expeditions consultant scientist on the Peru expedition and as a scientist on the Oman expedition.

1.6. Expedition leader

Malika Fettak is half Algerian, but was born and educated in Germany. She majored in Marketing & Communication at the University of Frankfurt, which led her to jobs in PR & Communications. She has travelled widely, especially in Africa and Northern Europe. Her love of nature and the outdoors, and taking part in a few Biosphere expeditions, persuaded her that a change of career was in order and here she is since 2008, leading expeditions and desperately trying to make herself useful around the office :) Malika is a keen sportswoman - triathlon, skiing, volleyball, etc. and enjoys the outdoors.

1.7. Expedition team

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

15-27 May 2012: Tamara Caddy (Australia, journalist), Miriam Cadney (UK), Sudheer Koneru (USA), Sridhar Kotagir (India), Rod McGregor (UK), Irmtraut Schumann (UK), Nicola West (Australia), Nicole Wrisley (USA).

1.8. Expedition budget

Each team member paid towards expedition costs a contribution of £1,190 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	11,310
 Expenditure	
Base camp and food includes all meals, rent, building materials, base camp equipment	2,155
Transport includes fuel, vehicle maintenance, vehicle insurance, local travel	405
Equipment and hardware includes research materials, research gear	1,237
Staff includes salaries, travel and expenses, Biosphere Expedition tips, gifts	3,778
Administration includes bribes, registration fees, sundries, etc	454
Team recruitment Brazil as estimated % of PR costs for Biosphere Expeditions	2,980
 Income – Expenditure	 301
 Total percentage spent directly on project	 97%

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, Swarovski Optik, Motorola, Cotswold Outdoor, Globetrotter Ausrüstung, Snowgum and Gerald Arnhold for their sponsorship.

Projeto Puma, Biosphere Expeditions' local partner for this project, and its founder Dr. Marcelo Mazzolli were crucial to the success of the expedition. Thank you also to Daniel Contrucci of Aoka who initiated the whole project by establishing contact between Projeto Puma and Biosphere Expeditions and still gives support to the expedition from São Paulo.

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.

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2. Puma & jaguar survey

Marcelo Mazzolli
Projeto Puma

Valeska Oliveira
Field Assistant

2.1. Introduction

The Brazilian Atlantic Forest harbours a high biodiversity and it is one of the most threatened ecosystems in the world (Myers et al. 2002). Less than 10% of this biome remains and most of the area is fragmented (Ribeiro et al. 2009). In this scenario the Serra do Mar region is the biggest patch of Atlantic Forest in Brazil, including the area where this research was conducted.

The jaguar is highly endangered in the Atlantic Forest, with only about 200 individuals left (Leite and Galvão 2002), their distribution restricted to few and disconnected forest patches (Fig. 2.1a).

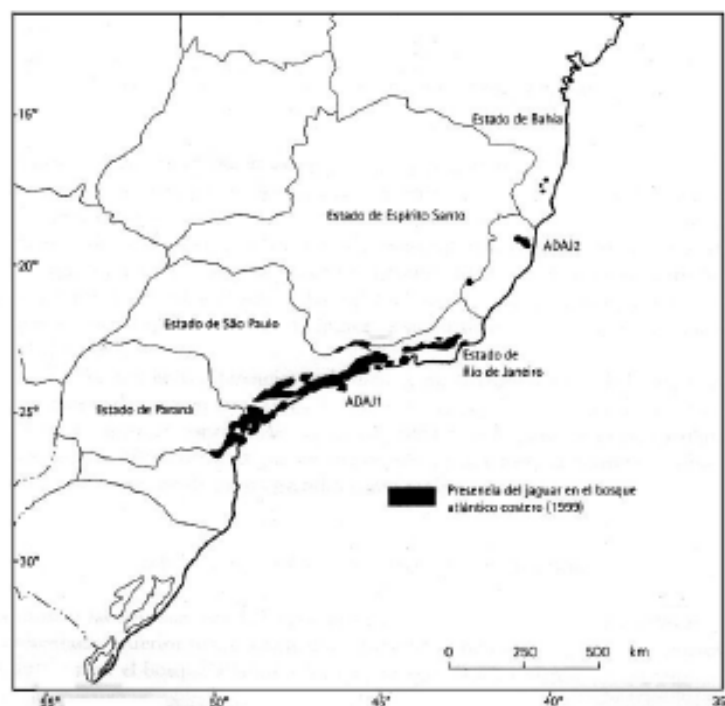


Figure 2.1a. Distribution of the jaguar in the Atlantic coast forest, distant from larger population found in the Amazon and Pantanal. The isolation and small population size renders it vulnerable to stochastic, random effects, with associated loss of genetic diversity and increase of homozygosis and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

The above map was based in the assumption that the largest patches of forest harboured jaguars, when in fact our surveys have shown that the species is not present in many of the apparently connected forest patches. The situation is worsened by the fact that these populations are isolated from larger continental populations that, if connected, could provide source for recolonisations and increase in genetic diversity.

It is also a fact that jaguars are disappearing at fast rates, having lost as much as 1 latitudinal degree of their historical distribution per decade, as demonstrated from data obtained at their southernmost range in the Atlantic Coast Forest (Mazzolli 2009) (Fig. 2.1b).

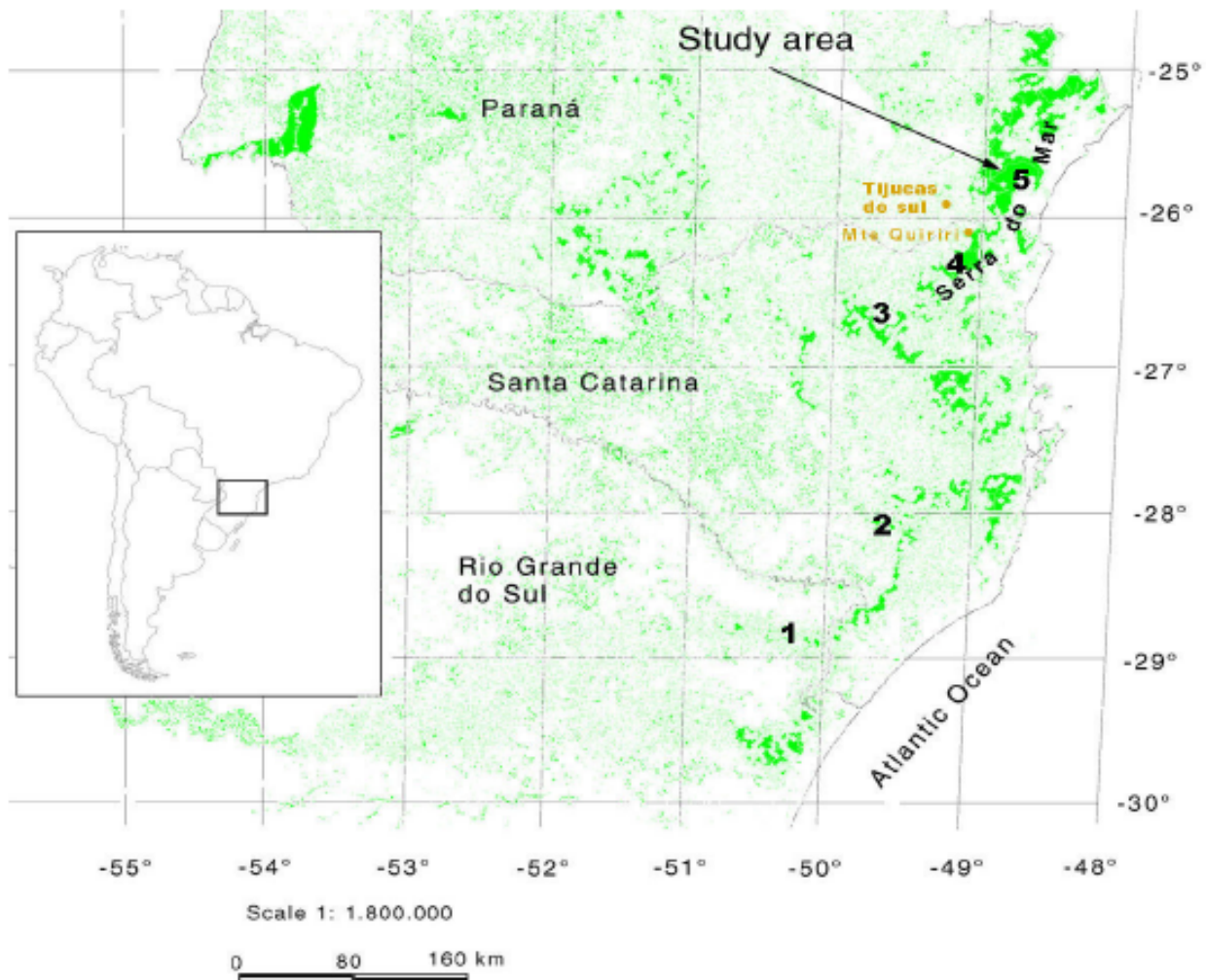


Figure 2.1b. Map of remaining fragments of Atlantic forest in southern Brazil (source: SOS Mata Atlântica, www.sosmatatlantica.org.br). Numbers 1 to 4 are records of last jaguar specimens in the area. Record dates show fast, northward loss of distribution. 1 - 1985 in the municipality of São José dos 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.

Expeditions conducted since 2006 have conducted five surveys in the region, recording jaguars, pumas, and other mammals, plus gaining knowledge on habitat quality. The project focused on the presence/absence of jaguars and its prey, defining important areas to protect and areas critical for jaguar survival. Core areas based on this sampling scheme and on the frequency of rare and endangered species were defined. Also, meaningful meetings with environmental agencies (e.g. national and state environmental agencies ICMBio and IAP) were held to provide information for habitat management.

Other areas close to Canasvieiras have been sampled during previous expeditions, such as the Saint Hilaire/Lange National Park and Guaratuba Bay. In 2007 base camp first moved to the Canavieiras region, and has been maintained there since then. Canasvieiras was chosen as the base camp location to increase the chance of recording rare and endangered species that serve as indicators of habitat quality and to locate core distribution areas. The area has also a lower harvest pressure on palm heart.



Figure 2.1c: Land Rover crossing river to reach the sampling areas.

The jaguar was recorded in 2006, in Guaratuba Bay, and in 2008 in Canavieiras, through tracks and vocalisation (see expedition reports on www.biosphere-expeditions.org/reports).

Study area

The study area, in the locality of Canasvieiras, encompassed private lands (Mr. Simões' land) and public and corporate lands (Ambiental Reflorestadora; Copel). It is just 13 kilometers from Saint Hilaire/Lange National Park, inside the Guaratuba Environmental Protection Area, a reserve of sustainable use, where productive activities of low impact are allowed. Within the area, 14 contiguous cells were sampled.

Base camp was 12 kilometers from the federal road BR-277 that leads to Curitiba, the Parana State capital. The drive to base camp along a dirt road took a long 1.5 hours due to bad road conditions. From base camp, it was often necessary to drive even further to reach sampling areas (Fig. 2.1c above).

The surrounding mountains reach over 1,500 metres in altitude, but the area sampled was around 320 meters in altitude. The vegetation consisted mostly of montane and sub-montane broadleaved Atlantic Forest.

2.2. Methods



Figure 2.2a. Team members being briefed at base camp on data entry and other study procedures.

Training of team members

The team was trained to use GPS to record coordinates of interest, and to navigate in the forest using a compass and maps. Track identification and recording was facilitated by laminated sheets with tracks in life size. The team was also trained on how to install camera and track traps, and on animal identification (Fig. 2.2a). Some excursions into the forest were done under the supervision of Biosphere Expeditions staff and other excursions were made by team members themselves. Other studies have already detailed the importance and validity of volunteer's field data collection (e.g. Foster-Smith & Evans, 2003).

Ecological sampling

Data on mammalian presence was collected from field surveys in 14 different cells of approximately 4 km² each (2 x 2 km) that were distributed over the study area (Fig. 2.2b). The procedures for identifying mammalian presence included camera trapping and recording of any mammal signs, such as calls and scats¹, but mostly by tracks. Track identification is the most reliable and quick method to identify species in the study area, but not for all species. Tracks of lesser cats were not distinguished among the different species, neither were those of deer.

For occupancy information, a species was recorded only once in each coded cell per day, whereas frequency information was collected of all records of a species on a given day.

The team walked the trails looking for signs and taking photos of tracks together with their coordinates, and recording information in field data sheets. Locations of camera-traps were also recorded (Fig. 2.2c). All the data were transferred on to history/capture sheets at base camp. That is where coordinates obtained with GPS were converted to cell codes using MapSource software.

The trails had different lengths, and the main information collected was the presence of a species record in the cell visited. This allowed for observed species occupancy (number of cells present or absent) and frequency.

Resampling of cells is desirable in animal studies, as mobile species will be present in some instances and absent in others, thus the presence or absence of a species from a certain area can only be established with repeated sampling. The aim was to sample each cell at least three times, but in reality some were sampled more than others, mainly due to repeated surveys in the proximity of base camp (Table 2.2a).

¹ Only those that are identified macroscopically –wild felids in Brazil are not identifiable even microscopically with precision (Vanstreels 2010) and the same applies to other scats. This should be stressed as many researchers identify species indiscriminately by guesswork based on scats found, and some scientific journals will accept and publish such studies. DNA analysis of scats has also shown that visual identification of scats has very high error rates (Davidson et al. 2002).

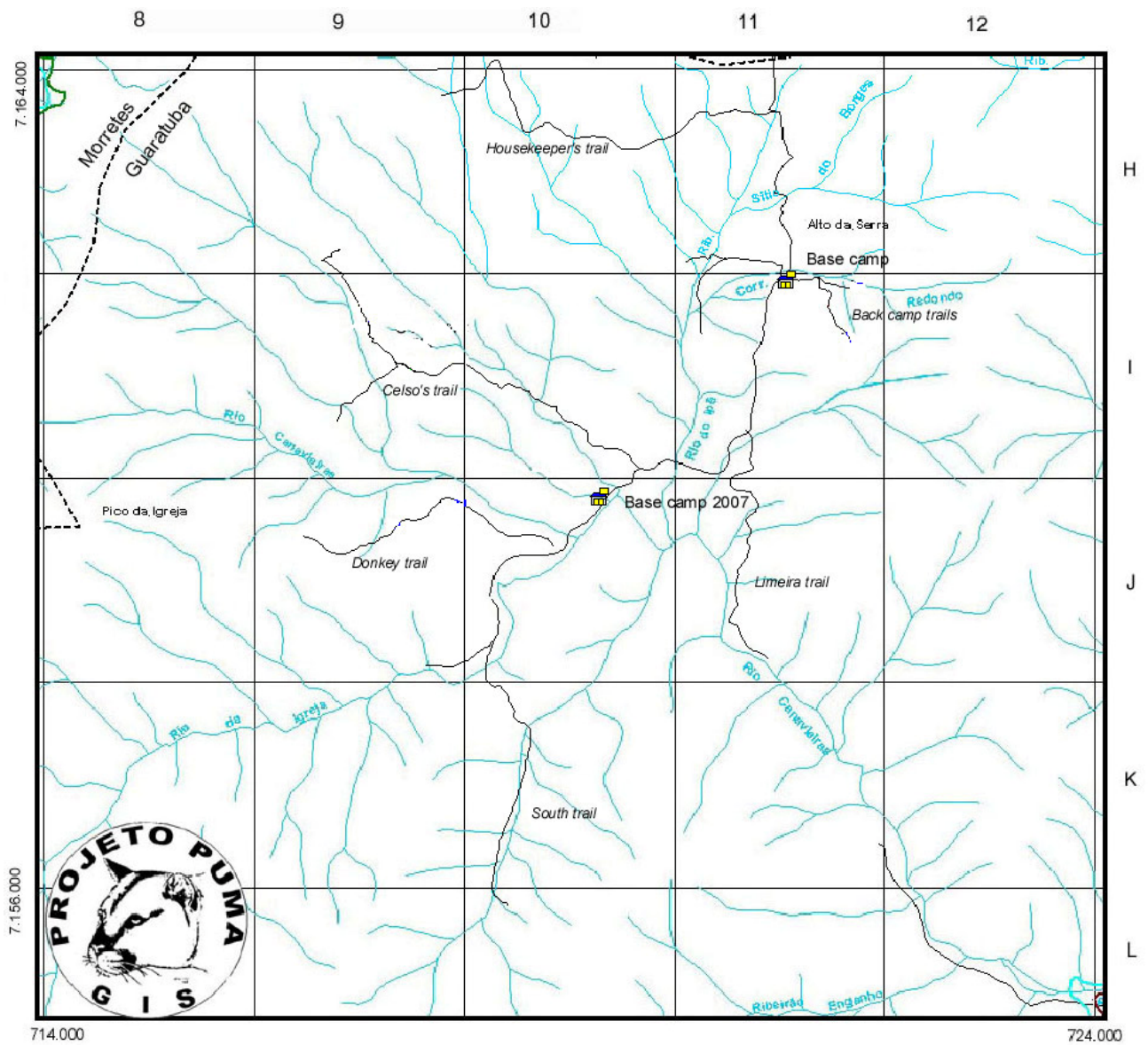


Figure 2.2b. General map of the sample area displaying base camp and main trails, and with the coded grid cells overlaid.



Figure 2.2c. Team in the field, installing camera traps and setting a track trap on main road.

Table 2.2a. Cell resampling scheme showing cell codes. Numbered columns marked with X represent the number of sampled occasions. These represent cells where data were actually recorded.

Cell	Number of times resampled							
	1	2	3	4	5	6	7	8
H10	X	X						
H11	X	X	X	X				
H12	X							
I10	X	X	X	X				
I11	X	X	X	X	X			
I12	X							
I9	X	X						
J10	X	X	X	X	X	X	X	X
J11	X	X	X					
J9	X	X	X	X	X	X	X	
K10	X	X	X					
K9	X	X	X	X				
L10	X							

Analysis

Analysis included the estimation of relative abundance/frequency of records and occupied cells, beside the estimation of species richness (SR) using [EstimateS software](#) (ver. 7.5.1) (Colwell 2005). Correlation and regression analysis were performed with [BioEstat](#) 3.0 to check the relationship between the sample effort on the cells (number of visits) and the species richness, and between observed records per cell (observed occupancy) with frequency. A Qui-square test was also performed to check for differences on species richness between them (Zar 1996).

Camera trapping

Ten digital camera traps were placed in the study area along trails. Total sampling effort amounted to 63 camera traps-nights (Table 2.2b). Memory cards and batteries were first installed into the cameras at base camp under the supervision of the expedition leader and the field scientist. Cameras were not set or removed all at once, so the period they stayed in the field varied.

Table 2.2b. Sampling period and results of individual cameras (ID column), including date of installation and removal, cell installed and working period.

ID	Date installed	Cell	X	Y	Date removed	Species	Total trap nights
2	18/05/2011	H11	720377	7162190	Stolen	-	0
3	22/05/2011	I9	717796	7161036	26/05/2011	-	4
4	18/05/2011	J9	717829	7159798	25/05/2011	-	7
5	22/05/2011	K10	718551	7156966	25/05/2011	-	3
6	22/05/2011	K10	718248	7156151	25/05/2011	-	3
10	19/05/2011	K9	717970	7157706	25/05/2011	White-lipped-peccary	6
11	10/05/2011	I11	721091	7161959	16/05/2011	-	6
15	19/05/2011	J9	717697	7158157	25/05/2011	-	6
20	17/05/2011	I10	718742	7160765	22/05/2011	-	5
16	16/05/2011	I11	721494	7161516	26/05/2011	-	10
11	17/05/2011	J11	720848	7159658	26/05/2011	-	9
20	22/05/2011	I10	718758	7160838	26/05/2011	-	4
Total camera trap-nights							63

2.3. Results

Training and performance

Team members gained enough knowledge on trail navigation to orientate themselves without assistance after few days of training and getting used to the methods. They returned at the scheduled time, checked and retrieved camera-traps in the field. Each person showed different abilities to different tasks, and had a good overall performance (Fig. 2.3a to 2.3c).



Figure 2.3a. Two action snapshots of the 2011 expedition: track identification, and data entry with camera installation.



Figure 2.3b. Team at base camp completing the data sheets.

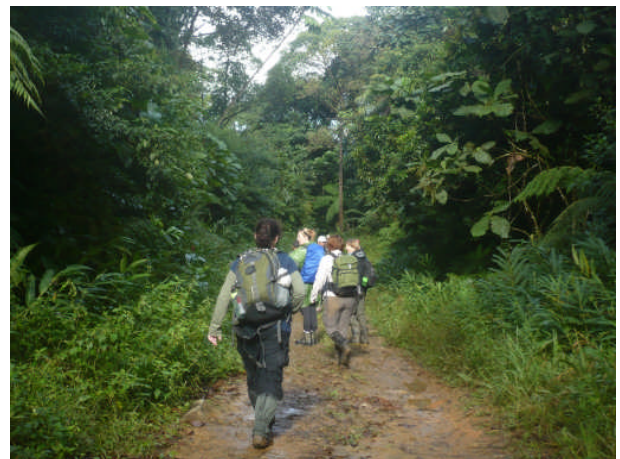


Figure 2.3c. Team crossing rivers and walking on the main road to reach sampling areas.

Species occurrence

During the two weeks of the expedition, nine days were dedicated to sampling. One additional day with journalists was added to the sampling effort. During ten days of field surveying, a total number (frequency) of 90 records of 15 species were obtained. When considering only records by cell (thus excluding repeated species in the same cell), 67 records were made.

As in 2007 and 2008, tapir was the species most recorded, by number of cells occupied (n=10). Deer was the second most recorded species (or group, as it is not possible to tell apart tracks of different species with precision). Deer was recorded in seven cells and ocelot was recorded in four cells (Table 2.3a). Most records were made from tracks (Fig. 2.3d), and only one species was recorded with camera-traps (Fig. 2.3e).

Table 2.3a. Species recorded during the Biosphere Expeditions survey in May 2011, with information on cell code and type of record (vestige, sighting, vocalization, camera trap), and frequency.

Species	Latin name	Cells	Type of record	Overall frequency
Brown howler monkey	<i>Alouatta guariba</i>	J9	Sighting	1
Capuchin monkey	<i>Cebus nigrinus</i>	J9/K10	Sighting, vocalisation	2
Crab-eating fox	<i>Cerdocyon thous</i>	I10/I11/J10/K10	Tracks	4
Paca	<i>Cuniculus paca</i>	I9/J10/K10	Tracks	5
Nine-banded armadillo	<i>Dasyus novemcinctus</i>	H10/I10/J9	Tracks	3
Opossum	<i>Didelphis aurita</i>	I10	Tracks	1
Tayra	<i>Eira barbara</i>	J10	Tracks	1
Ocelot	<i>Leopardus pardalis</i>	I10/I11/J10/L10	Tracks	5
Lesser cat (undefined)	<i>Leopardus sp.</i>	I10	Tracks	2
River otter	<i>Lontra longicaudis</i>	J10	Tracks	1
Deer	<i>Mazama sp.</i>	H10/H11/I10/I11/J9/J10/J11	Tracks	14
Raccoon	<i>Procyon cancrivorus</i>	H10/I10/J10	Tracks	3
Puma	<i>Puma concolor</i>	K10	Tracks	1
Tapir	<i>Tapirus terrestris</i>	H10/H11/I10/I11/I9/J10/J11/J9/K10/L9	Tracks, scats	23
White-lipped peccary	<i>Tayassu pecari</i>	K9	Tracks, camera	1

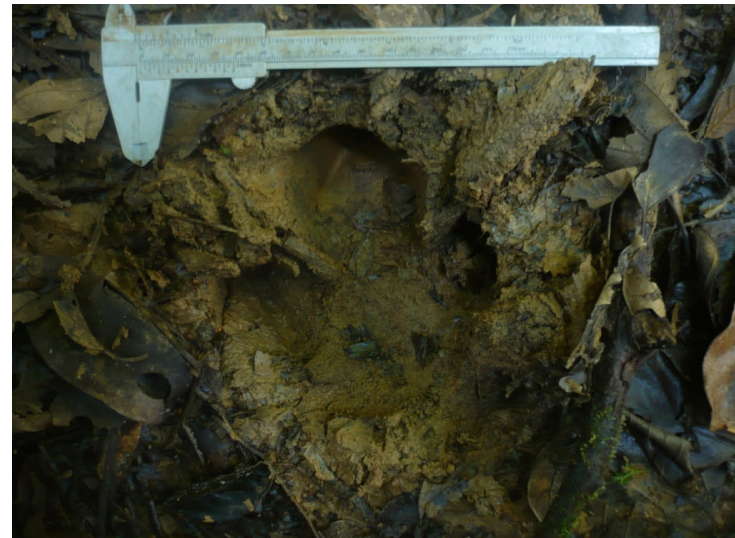


Figure 2.3d. Sample of tracks recorded during in May 2011, clockwise from top left: puma, paca, tayra and tapir.



5/20/2011 4:20 PM



5/20/2011 4:21 PM



Figure 2.3e. Camera trap pictures of *Tayassu pecari* (white-lipped-peccary).

One of the aims of the project was to verify habitat quality, which is done through identification of clustering of species and community composition in different areas of the study site. To do that, both presence and frequency measurements were obtained and compared.

There was a visible and statistically significant relationship between the records by cell and frequency; the species with more records were also most widespread species ($rS=0.9552$; $n=15$; $p=0.0000$), that is, the species most often recorded was also the species most widely spread (Fig. 2.3f, Table 2.3b).

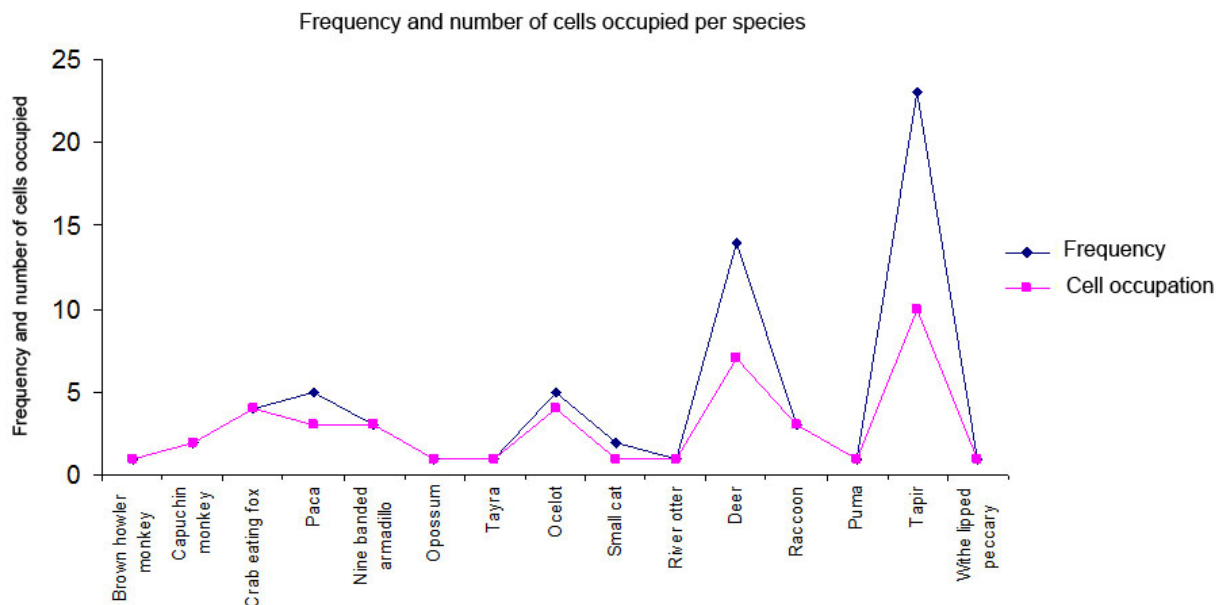


Figure 2.3f: Visual relationship between frequency and number of records per cell.

Table 2.3b: Raw data with total frequency and occupation per cell.

Cells	H10	H11	H12	I10	I11	I12	I9	J10	J11	J9	K10	K9	L10	L9
Records	5	4	0	13	6	0	2	18	2	9	5	1	1	1
Species	4	2	0	8	4	0	2	8	2	5	5	1	1	1
Visits	2	4	1	4	5	1	2	8	3	7	3	4	1	1

A frequent concern of scientists is the reliability of inferences from data collected. Aside from correct identification of species, how much can our data really say about differences of community composition or number of species (species richness) per area? One step towards answering that question is to verify whether the number of species or records are due to better habitat quality or simply a biased byproduct of sampling one location (or cell) more often than others.

There was a visual relationship between both recorded variables (frequency and occupancy) with number of revisitations to each cell. The cell with the highest frequency of records was J10 (Fig. 2.3g).

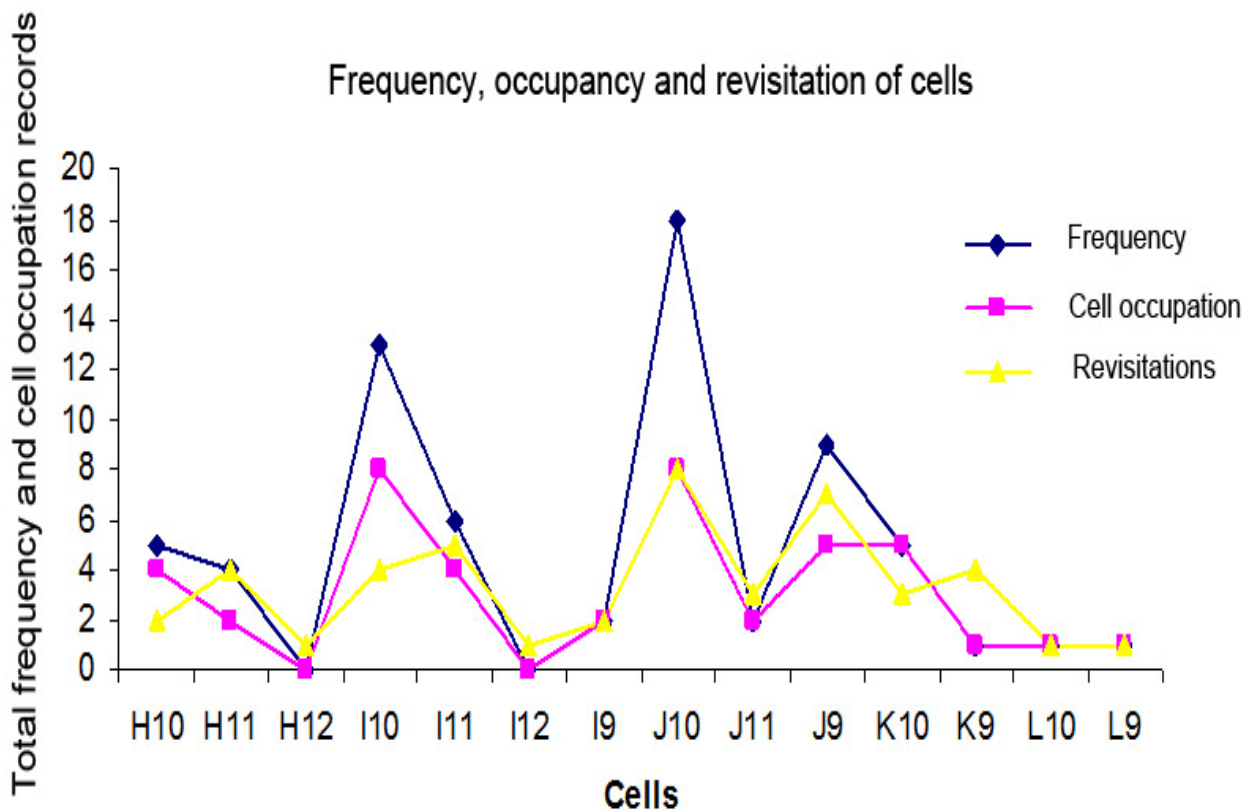


Figure 2.3g: Visual relationship between both recorded variables (frequency and occupancy) with number of revisitations to each cell..

Because of the relationship effort-result, cell J10 (the most visited cell) also had the highest number of species ($n=10$), and this effect also applied to overall results: the most visited cells were the cells with more species recorded ($r_s=0.7574$; $n=14$; $p=0.0017$), also shown through regression analysis, having almost 50% on the species richness explained through sampling effort ($F=13.7332$; $df=13$; $p=0.0032$).

Although there was an apparent variation in number of species recorded per cell, number of species in each cell (species richness) did not vary significantly between cells ($\chi^2=8.0640$; $df=13$; $p=0.8394$).

According to a species accumulation curve generated on EstimateS software, not all species of medium-sized and large mammals in the study site were recorded, but their actual number is not supposed to be much higher, reaching 23 species in the area (species richness estimated: 20.4 species, with standard deviation ± 3.6).

This expedition had the second highest number of species recorded ($n=12$) of all Biosphere Expeditions to the area, the otter, paca, and otter being recorded for the first time. In total 18 mammals species have been recorded in the study area during Biosphere Expeditions. The jaguar was not recorded this year, being last recorded in 2008, while puma was recorded only once.

Species Acumulation Curve

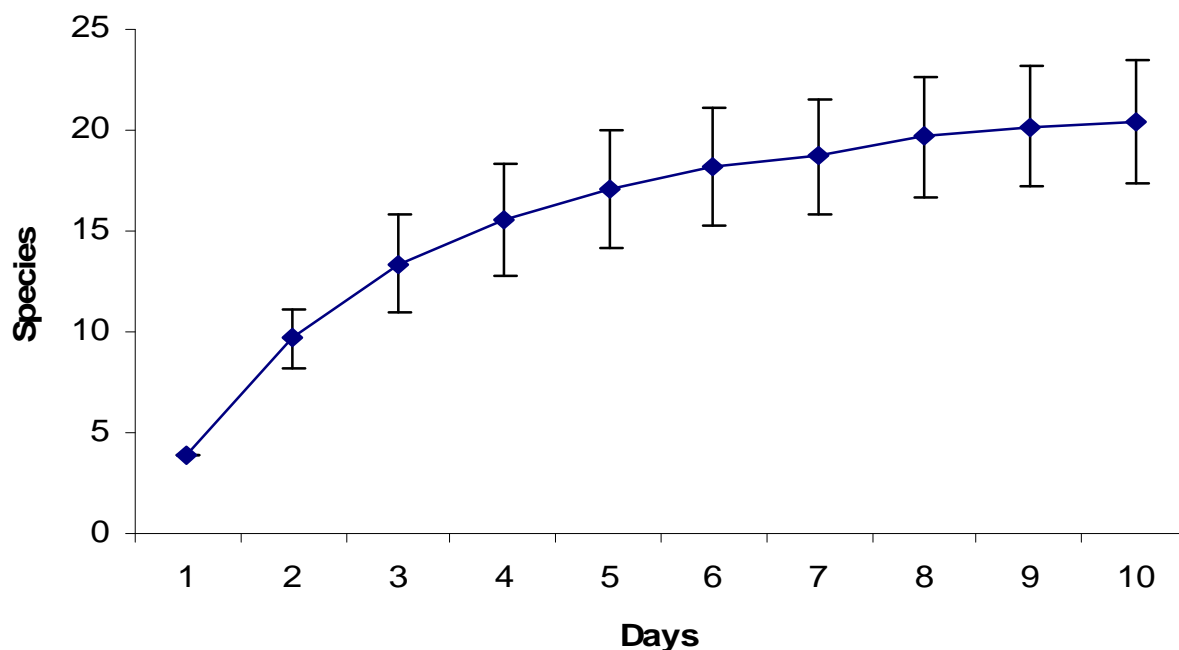


Figure 2.3h: Species curve displaying the number of species recorded increasing and almost stabilising with sampling time.

Table 2.3c. Species recorded during five Biosphere Expeditions in the study site.

Species	Common name	2006	2007	2008	2010	2011
<i>Alouatta guariba</i>	Brown howler monkey	x				x
<i>Cebus nigritus</i>	Capuchin monkey	x		x		x
<i>Cerdocyon thous</i>	Crab-eating fox	x	x	x	x	x
<i>Cuniculus paca</i>	Paca					x
<i>Dasyprocta azarae</i>	Agouti	x	x			
<i>Dasybus novemcinctus</i>	Nine-banded armadillo	x	x	x	x	x
<i>Eira barbara</i>	Tayra			x		x
<i>Hydrochaerus hydrochaeris</i>	Capybara	x				
<i>Leopardus pardalis</i>	Ocelot	x	x		x	x
<i>Lontra longicaudis</i>	River otter					x
<i>Mazama americana</i>	Red brocket deer	x	x	x	x	
<i>Mazama gouazoubira</i>	Gray brocket deer	x				
<i>Panthera onca</i>	Jaguar	x		x		
<i>Pecari tajacu</i>	White-collared peccary			x	x	
<i>Procyon cancrivorus</i>	Raccoon	x	x	x	x	x
<i>Puma concolor</i>	Puma	x	x	x		x
<i>Tapirus terrestris</i>	Tapir	x	x	x	x	x
<i>Tayassu pecari</i>	White-lipped peccary		x			x
Total: 18 spp.		13	9	10	7	12

2.4. Discussion & conclusions

Species presence and habitat integrity

The relationship found in sampling effort and the two recorded variables (species' frequency and observed occupancy), together with lack of statistical difference in number of species among cells, preclude any inferences of better quality of environment related to number of species per cell.

That is the reason why the general method employed in the "Jaguar Corridor" to detect habitat integrity is not based on number of species per habitat (species richness), but on species composition. Some species are more vulnerable to human interference, and are thus found only in more preserved areas. The fact that species richness does not always relate to habitat quality has been previously demonstrated during our expeditions (Mazzolli and Hammer 2008a).

Species such as jaguar and white-lipped peccary, for instance, are only found, or found more often in the inner cells of the study area, within core areas of the study site. The current study site may itself be considered a core area. Outlying areas do not have tapirs as easy to detect as in the study site. The 2006 expedition in the Guaratuba Bay area, with the highest species richness of all expeditions, yielded just one record of tapir and none of white-lipped peccaries.

Studies that monitor species over many years are uncommon, as most lack the ability to find funding for prolonged periods. With continuous monitoring, we are able to detect change in species composition and occupancy. Data accumulated during the years have shown that tapirs seem to have become more common and widespread. The 2011 expedition was the first to record countless tapir tracks near to base camp, and in 2010 puma tracks recorded during local surveys were found on a trail behind base camp and on the main road. Monitoring has also demonstrated the continued rarity of some species (such as white-lipped peccaries) and jaguar.

Track recording was the most efficient method of species detection and yielded representatives from all species sampled. There was a significant photo record of white-lipped peccary, confirming the species (it is difficult to confirm exact species occurrence through tracks). The species accumulation curve indicates that more species are expected to occur on the area.

The high species richness found in the area in only ten days of surveying is a good result, pointing to the importance of the area to mammal conservation. Beside this, it was possible to record endangered and rare species that have already disappeared from most places in the country. Species such as white-lipped-peccary, collared-peccary and tapir are very scarce in Brazil nowadays and throughout their original geographical range.

The species most recorded were tapir (23 records), deer (14 records), ocelot and paca (five records each). It is not unreasonable to say that there was a high number of tapir records, because its tracks were easy to see and recognize.

Despite the fact that the team used life size track drawings for comparison with what was found on trails, deer tracks could not be related to a certain species, so the record were all lumped into a general “deer” category. Records about peccaries showed the same problem, and the tracks were related to “peccaries”, without specifying the species.

The jaguar has once again proved to be an uncommon species in the study area. Since Biosphere Expeditions surveys began in 2006, it has been recorded only three times by Biosphere Expeditions and Project Puma, with an additional record made by the staff of the NGO SPVS in the Cachoeira reserve. In addition, enquiries made at the environmental police at Morretes regarding presence of jaguar or jaguar depredation on livestock yielded no addition records, nor did enquiries at a land owner of an area in the Graciosa mountains, where jaguars had been recorded prior to 1997.

As pointed out in previous expedition reports (available via www.biosphere-expeditions.org/reports), the absence of jaguar during sampling does not mean that it is extinct on the area, as the species has been sporadically recorded, but it does mean that it is rare. Initiatives to guarantee its persistence in the area should be pursued (see management recommendations below). The Serra do Mar mountain range is able to harbour a jaguar population if spatial connections and corridors can be maintained and enhanced, and poaching reduced.

Finally, it is important to highlight the hunting pressure on the region. Although some degree of protection is provided by private rangers and the illegality of any form of hunting, local people have told us that hunting for subsistence and commercial purposes is widespread.

Management recommendations

Other reports have emphasised that the good condition of the study area (relative to the surrounding areas) is due to the frequent patrolling by rangers of several local landowners. Rangers by themselves cannot protect the entire forest. Instead it is necessary that the community as a whole begins to protect it, and this will only happen when the community benefits from the forest in a sustainable way so that the forest has a value to the community (the ‘what pays, stays’ principle). Habitat quality is lacking in the study area when compared to pristine ecosystems, or if compared to its own past, historical condition. Much has to be done to bring it back to its best condition, and this can be done by involving local communities in best management practices of native resources. When forest resources have a valuable and can be managed adequately, then there will be an interest to protect them.

The 2008 report (Mazzolli and Hammer 2008b) also mentioned the ecological state tax that goes to the municipality of Guaratuba, due to the fact that a large portion of it is under legal protection, but also the fact that nothing is converted into environmental conservation. This is an issue that has to be solved, as these government funds are either not used or used for purposes other than conservation. As mentioned during the 2008 expedition report, ‘It is recommended that application of this fund should be revised and means should be implemented so that it can go towards payment of rangers and incentives for sustainable use of forest products, such as for the extraction of fruits of the palm heart to produce juice, rather than to cut down the tree (which is illegal and also detrimental for wildlife)’.

Perhaps the best solution is the extension of Private Reserves of the Natural Patrimony (RPPNs) that already encompass several smaller private properties. This type of reserve is officially enshrined in Brazilian law, enabling the managers of such reserves to apply for public funds for environmental protection and management. Owners of RPPNs are also freed from the annual tax on rural areas (ITR) and may apply to an ecological fund from the 'Tax of Merchandise Exchange' (ICMs). The ICM tax is collected at state level and distributed to municipalities in accordance with a series of criteria. One of the criteria that enables the municipality to receive a larger share of this fund is to have protected areas. The more protected areas the municipality has, the more of this fund it is entitled to. Owners of RPPNs can increase the municipality's ICMs share, and may therefore negotiate to receive a percentage in turn to cover maintenance costs.

The area already has an agroindustrial production unit, located in the Candongas district of Morretes. It is a community project that enables local families to use its facilities to process their products, such as jams, juices, etc., at a semi-industrial scale. There is a potential to include the processing of açai juice at this facility. It is recommended that an investment in capacity-building be applied for with the collaboration of the local people to increase sustainable management of the local environment. Hunting is not allowed by the Brazilian environmental law, but that does not seem to have impaired poaching.

Priorities for future expeditions

Future expeditions should incorporate other trails into the trail system to be surveyed and these trails will have to go further into the forest. This can be achieved by signalling better the existing trails so that more ground can be covered in less time. Other trails by the State Park of Marumbi, in Morretes can be covered also to expand the study area and increase the reliability of the jaguar and puma population study.

It is also desirable that other groups of species be incorporated into the survey; species that can be sampled near base camp. This tackles two issues. First, to increase the scope of the project and opportunistically investigate other biodiversity issues that may be important for the conservation of the area. Second, it will provide a chance for team members who find the long trails challenging to contribute to data collection through a less strenuous activity.

Regarding involvement of the local community into conservation of the study area, team members could help to start showcasing the sustainable use of the fruit of the palm heart, which is a valuable market product and has been under-explored. This initiative may help the community to give value to the forest, as this native species, the juçara palm-heart, grows only in shaded areas and particularly in the forest.

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Appendix 1. Expedition diary by Malika Fettak

3 May

Hello everyone and welcome to the first diary entry for Biosphere Expeditions' Brazil 2011 expedition. I am Malika Fettak, Operations Manager of Biosphere Expeditions, and I will also be your expedition leader for this project. Working with me will be Valeska Buchemi de Oliveira, our scientists on the expedition as well as some more local helpers I will introduce you to in due course.

I am writing this from Sao Paulo, where I am at the moment. We've just had a great press conference with Land Rover here, telling the press about our project and taking delivery of three very new and very shiny Defenders. It's a shame that these shiny new cars will never look the same again, not just because we have put Biosphere Expeditions stickers on them (see www.facebook.com/biosphere.expeditions1), but especially after they've been put through their paces on this expedition, in terrain they were after all made for ;)

This kind of press work is important for us and not to be underestimated in our efforts for jaguar, puma and the Atlantic Rainforest as a whole. The more people know, the more likely they are to want to do something to conserve it. So it's great that Land Rover has thrown its PR weight behind this and is supporting us with the vehicles.

Our plan for the next few days is to do some last minute shopping as well as retrieving & reviewing all our equipment stored in Sao Paulo. With me to do this is Daniel, who is kindly guiding me through this incredibly big city. I'd be lost without him - he will be my eyes, my ears and my mouth for the next couple of days, patiently driving me from shop to shop as well as translating my English into Portuguese. Please be prepared that only very few Brazilian will speak English.

One of my stops will be to get a Brazilian SIM card and once I have this, I will all let you have my number.

My next diary entry should be from the Atlantic Rainforest with news of base camp.

Hope everyone's preparations are going well and I look forward to meeting you all soon!

Malika Fettak
Expedition leader

P.S. Excerpts of the diary are also on www.facebook.com/biosphere.expeditions1 and you don't need a Facebook account to see this – just click on the link and then on "Wall" on the left and you should be able to see it.

4 May

We are ready & packed up here in Sao Paulo. Today will be spent driving down to Guaratuba and then up into the mountains of Serra do Mar, our study site and base for the next couple of weeks.

My Brazilian mobile number is +55 11 99220779, but please note that this number is for emergency only (i.e. being late for assembly). There is very little mobile phone reception around base camp and certainly no internet, so won't hear from me for a week or so until I get back to "civilisation" with tales of getting the base and our research tasks ready.

8 May

We have come back to Curitiba today to pick up a bunch of press people for a two days visit to base. This short press trip was organised in collaboration with Land Rover Brazil and should have some good effect for the project and our efforts of educating the public. Back in the digital world for one night, here are some updates from the field:

Base camp is ready for your arrival and will be put through its paces by the press. Over the last few days, we cleaned up the wooden cabin, built new platforms, set up the tents on them, etc.. Aparecido, our housekeeper and neighbour down the road was a great help, as always, as was his wife Lucia.

Not only does he know the cabin's water system, he also knows how to remove a wasps nest from our veranda using banana leaves ;).

The whole area around Morretes has seen serious flooding during the last couple of months and the road up to base has suffered a lot as a result.

Let's call it Land Rover terrain - it will certainly be an adventure to use it! The acai palms have decided to take a break - this year they have no fruits, so unfortunately we won't be able to include the planned acai activities into the expedition this year. The good news is that we have not seen any rain since our arrival, so keep your fingers crossed that the dry period is holding on!

12 May

Back in Curitiba we've dropped ten tired but happy Brazilian journalists at their hotel. For most of them it was their first wilderness experience including a night in a tent. The outcome of these two days of PR work will include a TV trailer and articles in various magazines, all talking about jaguar conservation, which is a great result for our public education efforts.

On our first survey walk yesterday we found different tracks pretty close to the cabin including ocelot, tapir & raccoon and we can't wait to go out in the field with our first expeditioners due in a few days. We're now heading back to basecamp. Safe travels & see you soon!

16 May

Rain, rain, rain. Wet conditions in the Brazilian Atlantic forest since Valeska and I left for Curitiba to meet the team. Fully packed on return, including ten expeditioners, both Land Rovers struggled hard on the muddy road up to base camp, but finally made it. The team did well during the training session but had to cope with pouring rain on the first survey walk.

Thanks to Imtraud who brought an umbrella, (is that in our kit list?) the datasheets stayed relatively dry while everything else taken today got wet, wet, wet.

21 May

We're in Matinhos on our day off today. Time for everyone to do some shopping, to enjoy the beach, the bars & restaurants. We had a great first week in basecamp and everyone was working hard to cover the survey trails & set up camera traps. Unfortunately none of the electric showers are able to be used anymore due to heavy rainfall a couple of days ago. Since then, Neoza our great cook, has been heating up large amounts of water in the afternoon for everyone's "bath". I remember it was Tamara asking everyone during dinner what the first thing to do would be when back in civilisation. You'll guess everyone's answer: A hot shower!

Unfortunately Sudheer & Sridhar have decided to leave the expedition today because of family duties. We have to say goodbye as they will be making their own way back to Curitiba from here. Thanks to both, it's been a great pleasure to meet you not only because you brought two alive & free range chickens from the neighbour, for Neoza to cook!

24 May

We were blessed with dry & sunny weather since back at base from the day off in Matinhos. Two teams each day covered many kilometers on their survey walks. Tracks of all study animals including puma were found except from the elusive jaguar.

Nevertheless the study site habitat seems to be improving. More or less all jaguar prey is present in the area and the level of human interference is decreasing. Along the main road up to camp we recognized quite a lot of abundant houses and signs saying "vende se" (for sale). Similar to other urban areas young people are moving away into the cities.

The GPSs have become our best friends, but they cannot replace our local field guide, Aparecido. Nicola, Irmtraut & Miriam followed him on the pretty much unexplored South Trail. He led the group on a 11 km walk including five "dry feet" river crossings! With his help Valeska, Shridar, Sudheer, Tamara & Nicola also track-logged the Housekeeper's Trail onto our GPSs - the most adventurous trail this year where the team had to climb banks of mud and showed great team spirit by helping each other out. Proud & happy faces during the daily review in the evening; Sudheer even stated this to be his lifetime adventure ;)

25 May

Visitors in basecamp yesterday evening. Aparecido and Lucia brought freshly cut palmheart and showed us how to peel & prepare it for eating. Cut in small pieces and dressed with fresh lemon juice (a lemon tree grows behind the cabin) - delicious!

27 May

Goodbye Brazil expeditioners, Goodbye Irmtraut, Nicola, Nicole, Miriam & Rod! Valeska and I are back at basecamp (The Land Rovers made it up & through the muddy with the 2nd attempt ;)). Hope you all have a safe journey to your next destinations or back home.

30 May

My time in Brazil has come to an end. Back in Sao Paulo after a long drive yesterday, our equipment is now safely stored and the Land Rovers are handed back. Tamara, Valeska & I will make our way to the airport in the afternoon, each of us departing in different directions back home.

Thank you everyone for being a great research team, coping with pouring rain, mosquito bites, blisters, mud & burning showers. The expedition has been a great success and I want to thank everyone for their efforts and contribution. More than 80 kilometers have been walked, 90 recordings of 18 different species were made. We camera-trapped a group of seven white-lipped peccaries, another species classified as critically endangered. I hope we have shown you that your input is essential in this little-researched and important area. The report will go into much more detail but for now, I think we can all be proud of what we have achieved.

All the best and we hope to see you again some day on one of our expeditions.

Malika