

Research for the conservation of the jaguar (*Panthera onca*) in the Selva Lacandona, Chiapas, Mexico.

Final Report



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Antonio de la Torre de Lara

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adelatorre@miranda.ecologia.unam.mx

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Introduction.

The jaguar (*Panthera onca*) is the largest cat in America. The continuous habitat destruction and poaching of jaguars and their prey items have caused its extirpation from much of its former habitat range to such degree that today the jaguar occupies only about 46% of its historical distribution. One of the most important populations of jaguar in Mexico occurs at the Selva Lacandona, in the state of Chiapas in the Mayan Forest. The Lacandona, including the Montes Azules Biosphere Reserve, is part of one of the most important Jaguar Conservation Units (JCU), which extends from south-eastern Mexico to Guatemala and Belize; JCU represent landscapes with the highest probabilities of maintaining, at long-term, jaguar populations for Central America and Mexico (Sanderson *et al.*, 2002). However, no specific quantitative estimates of the population size of jaguars for the Selva Lacandona exist. In order to evaluate the conservation status of this species in the region, the aim of this project was to study the basic population ecology of the jaguar in the Montes Azules Biosphere Reserve through camera-trapping technique in combination with capture-recapture sampling method. Specific objectives were: 1) to determine jaguar abundances and densities across space and time, and 2) develop a solid baseline for the numbers of jaguars for the region of the Selva Lacandona.

Location of the study area.

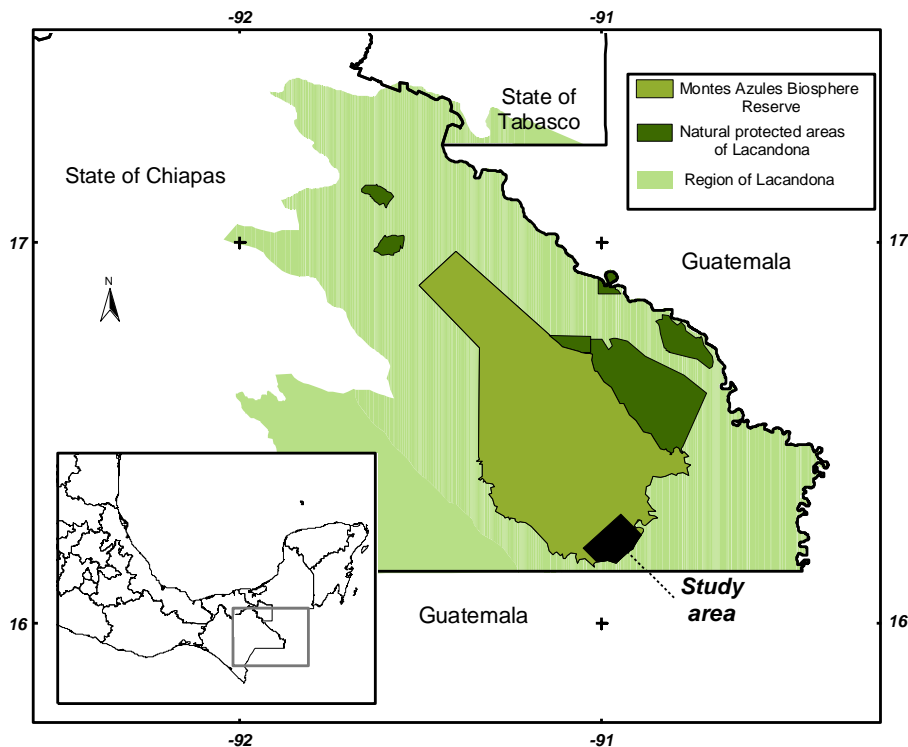


Figure 1. Map of the study area. The Montes Azules Biosphere Reserve is located between 16° 06'N and 16° 49'N latitudes and between 91° 45'W and 91° 30'W longitudes.

Methodology.

Estimation of jaguar abundances and density was accomplished via capture-recapture technique, in this case through camera-trapping; this technique was originally applied for studying tigers in India (Karanth, 1995; Karanth and Nichols, 1998; 2002), and subsequently applied for estimating densities of other cryptic species as leopards, ocelots and jaguars (Trolle and Kery, 2001; Lynam, 2002; Maffei *et al.*, 2002; Wallance *et al.*, 2002; Henschel and Ray, 2003; Maffei *et al.*, 2004; Silver, 2004; Silver *et al.*, 2004; Soisalo and Cavalcanti, 2006). The camera-trapping protocol used here follows the standardized protocol of WCS for the estimation of jaguar abundances (Silver 2004), and the protocol developed in the symposium *EL JAGUAR MEXICANO EN EL SIGLO XXI* for monitoring jaguar populations in Mexico (Medellín *et al.*, 2006).

The study was conducted in the southern area of Montes Azules Biosphere Reserve in dry and rainy seasons, in an area of approximately 80 km². Owing the limited number of camera-traps, during the dry season, the sampling area was divided into four blocks with an area of approximately 20 km², each block was formed by 8 camera-traps stations. Sampling of the first two blocks was conducted within the first 30 days of the study; subsequently the next two blocks were sampled (60 days of field work – 960 traps days). During the rainy season the entire study area was sampled simultaneously by 33 camera traps stations during 60 days (1980 trap days). In order to increase the probability of individual identification, great part of the camera traps stations were formed by *checkpoints*, checkpoints are stations conformed by two camera-traps placed one in front of the other. Survey design was done in a homogeneous way; nevertheless, camera-traps were placed in sites where jaguar signs were previously observed, or in sites familiar to the jaguar at a short distance from the selected points. Camera-traps were active 24 hours per day. We considered each day as event of capture, thus we had 30 capture events for the dry season and 60 for the rainy season.

Estimation of jaguars in the sampling area, by means of the data generated by camera trapping, was evaluated using the program CAPTURE (Otis *et al.*, 1978). The program CAPTURE estimates population size using the following steps: 1) Test the violation of the capture-recapture assumptions (including the population closure); 2) Checking the data between various statistical test models and the overall model selection statistic to decide the appropriate model for the data collected; 3) Estimation of capture probability and population size *N*, associating standard error and confidence intervals. The program CAPTURE generates an estimate of absolute abundance. To estimate jaguar density at Montes Azules Biosphere Reserve, we calculated the effective sampling area. The effective sample area encompasses the camera traps with a surrounding buffer area that takes into account those individuals whose home ranges may include areas that are only partially contained within the sampling area pattern (Silver, 2004). Two approaches have been used to estimate buffer width in jaguars research with camera traps: 1) the method developed by Wilson and Anderson (1985), subsequently used and recommended by Karanth and Nichols (1998), and applied in other jaguar camera trap capture-recapture survey (Wallance *et al.*, 2003; Maffei *et al.*, 2004; Silver, 2004); and 2) the recent approach used and recommended by Soisalo and Cavalacanti (2006), which only uses the Mean Maximum Distances Moved by the individuals recaptured. In this study we applied Soisalo and Cavalacanti's (2006) approach. In order to estimate the population size of the jaguar at the Selva Lacandona region, we estimated the potential habitat using the National Forestry Inventory in combination with Geographic Information Systems.

Level of achievement of the project's original objectives.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Estimate jaguar density in the Montes Azules Biosphere Reserve (MARB).			x	The main goal of this project was estimating jaguar densities at MABR by means of camera trapping technique in combination with closed capture-recapture methods. For the dry season we obtained a density estimate of 2.6 jaguars/100km ² , and for the rainy season 5.4 jaguars/100km ² .
Develop a solid baseline of potential number of jaguars at the Selva Lacandona region.			x	Basing on density estimates, we extrapolate these numbers to the jaguar potentially suitable habitat within the Federal Reserves at Selva Lacandona. Our estimate is that 197-95 jaguars could occur at

				approximately 3,650 km ² of protected suitable habitat at the Selva Lacandona.
Dissertation thesis for Master Science degree for the P.I. of this proposal.		X		The dissertation theses for Master Science degree of the P.I is now in process.

Unforeseen difficulties that arose during the project and how they were tackled.

Our prospective survey should have been conducted in November 2006, but we lack all the resources and equipment necessary to begin at that time, thus it was rescheduled for January 2007. Our survey during the rainy season was planned for September and October of 2007, but the weather conditions of the region did not allow us to work in this period, we had to delay it to November 2007-January 2008. Another difficulty was to find proper personal at the local communities to act as field guides, just a few people know the area inside the reserve and only a few of them were interested in the well development of the project and the conservation of their natural environment.

The three most important outcomes of this project.

1) The main goal of this project was to estimate jaguar densities at Montes Azules Biosphere Reserve (MARB) by means of camera trapping technique in combination with the closed capture-recapture models (Karanth and Nichols, 1998; 2002; Silver *et al.*, 2004). We obtained two jaguar density estimates in the sampling area (Table 1), one for the dry season (March-May 2007), and other for the transition of the rainy to dry season (November 2007-January 2008). We observed a variation of jaguar densities through the two sampling periods, probably due to the temporality of the study area (Table 1).

Table1. Jaguar density estimate of the South Montes Azules Biosphere Reserve for the two sampling seasons.

Period	Sampling area in km ²	Effective sampling area km ²	Density estimate (jaguars/100 km ²)
Dry season (Mar-May 2007)	80	154	2.6 (se ± 2.1)
Rainy season (Nov 2007-Jan 2008)	82	146	5.4 (se ± 2.2)



Figure 2. Repeated photographic capture of the jaguar “TONY” at Montes Azules Biosphere Reserve. Jaguars were identified examining the location and shape of the rosettes on them. Individual identification of the animals photographed is essential to estimate densities through this technique.

Table 2. Surface protected by the Federal Natural Protected Areas of the Selva Lacandona region, potential habitat surface in these reserves, and probable population size based on density estimates obtained in our study.

Name of the reserve	Protected surface (km ²)	Potential habitat for the jaguar in the reserve (km ²) *	Estimation of population size	
			5.4 jaguars / 100 km ²	2.6 jaguars / 100 km ²
<i>Reserva de la Biosfera Montes Azules</i>	3,312	2,806	151.5	73.0
<i>Reserva de la Biosfera Lacantún</i>	619	609	32.9	15.8
<i>Áreas de protección de flora y fauna Chan-kin</i>	122	118	6.4	3.1
<i>Áreas de protección de flora y fauna Metzabok</i>	33	21	1.1	0.5
<i>Áreas de protección de flora y fauna Naha</i>	38	28	1.5	0.7
<i>Monumento Natural Bonampak</i>	43	44	2.4	1.1
<i>Monumento Natural Yaxchilan</i>	23	25	1.4	0.7
TOTAL	4,190	3,651	197	95

3) This project represents the first estimation of jaguar densities using the standardized protocol developed in the last symposium *EL JAGUAR MEXICANO EN EL SIGLO XXI* for the national census of jaguar (CENJAGUAR). This is relevant because Mexico is the first country conducting a census at national scale for their most important remaining populations of jaguar. Furthermore, the baseline data of the numbers of jaguars at the Selva Lacandona obtained here are important to estimate the population viability on the basis of the upcoming Population and Habitat Viability Assessment, which emerged in the last symposium *EL JAGUAR MEXICANO EN EL SIGLO XXI*.

Involvement of local communities and how they have benefit from the project.

During the fieldwork we gave talks in the “*asamblea ejidal*” of townships and communities adjacent to the reserve; our aim was to inform the local people about the project. The talks gave special emphasis on the subsistence hunting because this activity causes an important pressure on the population of the preys used by the focal species of this study. The South part of Montes Azules Biosphere Reserve is adjacent to townships and communities and many people of these communities practice subsistence hunting inside the reserve. We are blissfully unaware of the current rate of tillage inside the reserve, although we suspect that this practice has great impact on the populations of the natural preys of the jaguar inside the reserve.

Four local people were hired as guides for the fieldwork, to open trails, and to drive a boat. The salary of these people was approximately £ 5.00 per day of work. PI of this project and two other people slept over with a local family of the community of Chajul, we paid about £ 3.5 per person for each night.

Are there any plans to continue this work?

The main goal of this project was to estimate jaguar densities at MARB. This objective was achieved in this project. We would like to know for certain, the current status of the jaguar outside the reserves in the Selva Lacandona region; the potential habitat for jaguars outside the reserves is diminishing day by day, and jaguars outside the reserve face conflicts with local communities due to predation upon domestic animals. Other important issue in the conservation of the jaguar at the Selva Lacandona region is to maintain the natural corridors that maintain connections between important adjacent populations of jaguar. The current rate of deforestation at the Selva Lacandona region is a serious threat that in the future could cause isolation of the reserves; for the conservation of this species at

that region, it is imminent to identify potential areas that serve as corridors not only for jaguars but for other emblematic species.

Dissemination of the results.

We expect that the results of this project, and the information obtained will be published in scientific international journals and in international and national divulgation magazines that focus in conservation. We will present this work at international and national meetings that focus in conservation and ecology. In order to intensify the coordination of conservation plans of the jaguar, the information obtained here will be given to the authorities of the Mexican Federal Government, the National System of Natural Protected Areas, and other international groups interested in the conservation of this species.

Timescale.

Anticipated length of the project (x)

Actual length of the project (X)

Activity of the project.	2006		2007												2008						
	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
<i>Prospective survey.</i>	x		X																		
<i>Development of the strict protocol followed in the fieldwork. During this period adjusted all the details before sampling.</i>			x	x																	
<i>60 days of filed work at Montes Azules Biosphere Reserve (dry season).</i>					x	x															
<i>Development of the films and analysis of the results obtained during the dry season.</i>							X	x	x	X											
<i>60 days of field work at Montes Azules Biosphere Reserve (rainy season).</i>										x	x		X	X	X						
<i>Talk at the communities meeting (1 every two weeks).</i>					x	x				x	x		X	X							
<i>Development of the films and analysis of the result obtained during all the sampling, and preparation of the final manuscript.</i>												x	x			X	X	X	X		

				Reserve during the 120 days of fieldwork (two months per survey). The actual amount was greater than expected because we spent more time at field (approximately 80 days per survey)
Food and supplies:	£ 1080	£ 1080	+ £ 0	The amount spent in food and supplies was congruent to the amount requested.
Fuel for a boat:	£ 263	£ 515	+£ 252	Our laboratory has a boat in the Montes Azules Biosphere Reserve. The use of this boat was fundamental in the research because inside the reserve there are no roads or trails, and the rivers in the area are the best way move. The fuel for the boat was bought in nearby communities. The cost per litre was about £ 0.75. In the budget we requested £ 263 for fuel, but we spent about £ 260 in each survey.
TOTAL	£ 5071	£ 5018	£ 53	Exchange rate: \$ 20 Mexican pesos per pound £.

Which are the next important steps?

The most important step to follow is to present the information obtained to the authorities. The evidence obtained should contribute as a critical element in the decisions made for the conservation of the jaguar in Mexico and the Selva Lacandona region. The information obtained through this survey must be used by the Mexican federal government in two ways: 1) Field data should be the basis for the coordination of a sound management plan for Montes Azules Biosphere Reserve, and 2) it should be a key element in the groundwork of the National Jaguar Conservation Strategy. The success of this project will be reflected in new guidelines for management and conservation plans of the jaguar in Mexico and the Montes Azules Biosphere Reserve.

Personally I would like to add that this project made me realize of the importance of this type of studies, especially in my country; I look forward studying a Ph.D. on ecology and conservation of tropical mammals. In the Selva Lacandona a great biological diversity exists, unfortunately it faces critical threats to its conservation; hence the study of its richness is imminent not only to have knowledge of the Mexican diversity but also to create baselines for its management and conservation.

Additional comments

Agradecimientos

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- Sea World and Bush and Garden Fund.
- Wildlife Conservation Society (Jaguar Conservation Program).
- CONACYT

The Rufford Small Grants Foundation's logo was used in the talks and meetings where we presented this project. We expect that in the future we can present this project in international and national meetings, at this time we will continue using RSGF logo.

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