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Keywords: 2MX/Chimalapas/hunting/jaguar/livestock predation/*Panthera onca*/status

Abstract: The region known as Los Chimalapas in the municipalities of Santa María and San Miguel Chimalapa, Oaxaca, maintains one of the largest jaguar populations in Mexico, probably because of its remarkable biodiversity, size and difficult access, imposed by physical, social and political factors. This species is important due to its role in ecosystem dynamics, where it acts as a regulating factor for prey populations. The species faces serious conservation problems in the region, and since the year 2000, predation on livestock (equine and bovine) has become more frequent around human settlements and pastures close to the forest edge. The results of our study in the region show fragmentation and habitat loss, fur and pet trade, and non-sustainable hunting of its main prey (peccaries, agouties, deer and tapirs), as the main threats to the jaguar population. This work is the beginning of an effort to generate a conservation strategy, monitoring work, and sustainable use of the jaguar and its prey in the Chimalapas region.

STATUS OF JAGUARS IN THE REGION OF LOS CHIMALAPAS, OAXACA

IVÁN LIRA TORRES AND GABRIEL RAMOS-FERNÁNDEZ

Resumen

La región conocida como Los Chimalapas en los municipios de Santa María y San Miguel Chimalapa, Oaxaca, todavía alberga una importante población de jaguar en México, probablemente debido a su notable biodiversidad, extensión e inaccesibilidad provocada por cuestiones físicas, sociales y políticas. Esta especie destaca por su importante función en la dinámica de los ecosistemas, actuando como factor regulador de las poblaciones de sus presas. Sin embargo, observaciones recientes sugieren que la especie enfrenta serios problemas de conservación en la región, y desde el año 2000 es frecuente el reporte de ganado doméstico (equinos y bovinos) depredado por jaguar en los alrededores de las comunidades y en los potreros cercanos al borde de los bosques de la región. Los resultados de nuestro estudio en la región indican que las principales amenazas a la población del jaguar son la fragmentación y pérdida del hábitat, el comercio de pieles, el mercado de mascotas y el uso indiscriminado de las especies que son las principales presas del jaguar (pecarí, agutí, venados y tapir). Este trabajo es un esfuerzo para generar una estrategia de conservación, monitoreo y uso sustentable del jaguar y sus presas en la región de Los Chimalapas.

Palabras Clave: Jaguar, Chimalapas, cacería, depredación de ganado.

Abstract

The region known as Los Chimalapas in the municipalities of Santa María and San Miguel Chimalapa, Oaxaca, maintains one of the largest jaguar populations in Mexico, probably because of its remarkable biodiversity, size and difficult access, imposed by physical, social and political factors. This species is important due to its role in ecosystem dynamics, where it acts as a regulating factor for prey populations. The species faces serious conservation problems in the region, and since the year 2000, predation on livestock (equine and bovine) has become more frequent around human settlements and pastures close to the forest edge. The results of our study in the region show fragmentation and habitat loss, fur and pet trade, and non-sustainable hunting of its main prey (peccaries, agouties, deer and tapirs), as the main threats to the jaguar population. This work is the beginning of an effort to generate a conservation strategy, monitoring work, and sustainable use of the jaguar and its prey in the Chimalapas region.

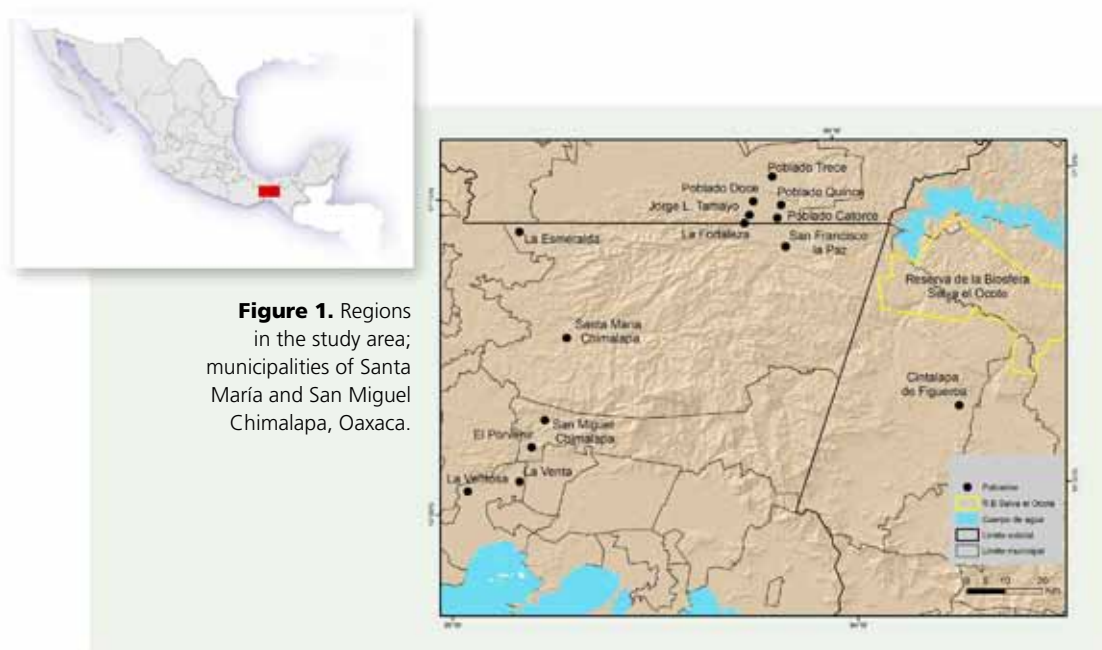
Key words: Jaguar, Chimalapas, hunting, livestock predation.

Introduction

Although Mexico is the fourteenth largest country in the world, it ranks third in biological diversity, which makes it a megadiverse country (Mittermeier *et al.*, 1997; Ramamoorthy *et al.*, 1993). However, its biodiversity is at great risk of disappearing due to anthropogenic activities. It is estimated that only 40% of Mexico's primary forest cover still remains and the annual deforestation rate is 4.2%, the highest in Central America (Challenger, 1998). Most of the biodiversity that still remains in Mexico occurs in inaccessible regions where indigenous people are predominant and poverty is still a major problem. In spite of the efforts made by a number of governmental bodies and non-governmental organizations over the last two decades, biological conservation in Mexico has become a difficult task (Caballero, 2000).

One of the priority regions for biodiversity conservation in Mexico is Los Chimalapas, in the state of Oaxaca (Arriaga *et al.*, 2000). It is a large region (590,993 ha) that has not been much explored and contains the second largest area of well-preserved tropical rainforest in Mexico, after the Maya Forest (Caballero, 2000). However, it is not included within the National System of Protected Areas, and, although community conservation areas are being established, there is still a strong pressure over its natural resources (Cid, 2001).

Wild animals in the region are a source of income or food for the human population, but hunting practices are not sustainable and pose a threat to long-term ecological and economic benefits provided by such animals. An example of this is the conflict due to predation on livestock –horses and cattle– by wild carnivores in the region of Los Chimalapas, as a consequence of the decline in the populations



of their natural prey. Predation caused by jaguars carries a greater risk and financial impact than those caused by other carnivores. When livestock farmers do not receive support from the government to protect their livestock, they are often forced to hunt the predators (Cid, 2001; De Avila, 1999; Naranjo, 2002; Schiaffino *et al.*, 2002).

Although Los Chimalapas probably contains one of the largest populations of jaguars (*Panthera onca*) in Mexico, this has not been well documented yet. This study is a first effort to collect the information available on the jaguar in this vast region. Its aim is to propose high priority strategic actions that contribute to jaguar conservation and monitoring, as well as the sustainable use of the main prey of the jaguar in the region.

Study area and methods

The study area is the region of Los Chimalapas, in the state of Oaxaca. It includes the municipalities of Santa María and San Miguel Chimalapa, which cover 458,086 and 132,907 ha respectively (Figure 1). This area represents about 7% of the surface of Oaxaca and has a population close to 12,000 people, less than 1% of the total population of the state (Gobierno del estado de Oaxaca, 1990).

The region is estimated to contain more than 462,945 ha (78.3%) of well-preserved natural systems of different types, such as tropical evergreen forest, tropical deciduous forest, cloud forest, conifer forest and oak forest (Torres Colín, 2004; Figure 2). These systems are extremely rich in animals and plants, and have many endemic species (Caballero, 2000; Briones-Salas and Sánchez-Cordero, 2004; Government of the state of Oaxaca, 1990; González *et al.*, 2004).

The study involved 12 months of fieldwork, distributed between August 2003 and July 2004. We used three main sources of information: 1) review of publications and search in databases of domestic and foreign biological collections; 2) visits to sites with and without reports of jaguar presence by local people. In each visit we



Figure 2. Cloud forest in Los Chimalapas, Oaxaca.

looked for reliable evidence of jaguar presence (scats and tracks), examined remains of prey in different sites of the region and collected skulls and skins of individuals killed; and 3) interviews with residents of communities near the area potentially occupied by the jaguar.

We had informal conversations and conducted two kinds of interviews on jaguar sightings: semi-structured interviews (Furze *et al.*, 1996; Figure 3) and short interviews. Local authorities in the communities we visited helped draw up a preliminary list of people with experience as hunters. The list of people grew as the interviews were being conducted, and we included people considered to be key informants about the status of **jaguar** in the region (Furze *et al.*, 1996). The semi-structured interviews followed the model shown in Annex I and were aimed at getting informants to respond to all the concepts included in the model, giving them freedom to include any other topics. This model was used to compile qualitative information provided by local people about the jaguar's historical range, biology, threats and traditional uses.

Short interviews on current and historical jaguar sightings were systematically conducted with all the people living near potential jaguar areas. The interviews included the following questions: 1) Have you ever seen a jaguar? 2) When (date and time) and where did you see it? 3) How many animals did you see? 4) What were the animals doing when you saw them? Reports providing a physical description of the animal without the need of a picture or drawing were considered reliable. Informal conversations included all conversations with local people about issues related to the current or historical status of the jaguar and the animals of the area without following a pre-established model.



Figure 3.
Interview with a
hunter in Ejido
El Porvenir,
municipality of San
Miguel Chimalapa.
Photo: Iván Lira-Torres

Results and discussion

We compiled 12 records of jaguar presence in Los Chimalapas. Eight records (66%), were obtained in the visits to the region and based on the following evidence: tracks, scats, claw marks on trees, remains of prey and an examination of injuries caused to livestock in several sites, as well as the collection and photographs of skins of hunted jaguars (Figure 4 a, b, c and d, Figure 5 a, b). We only obtained one record (8.3%) in the databases of domestic and foreign biological collections.

We only found three publications that mentioned the specific sites where jaguar records were obtained in the state of Oaxaca (Goodwin 1969; May, 1981; Leopold, 1965). These historical records are restricted to southeastern Oaxaca, in Juchitán and Tehuantepec. Jaguar occurrence in Los Chimalapas was confirmed on the basis of a review of records in collections, field visits, interviews, tracks and the collection of specimens. Although the area is considered as a high-priority terrestrial area by Conabio, the Mexican National Commission for the Knowledge and Use of Biodiversity (Arriaga *et al.*, 2000), it does not have any protection in the Protected Area System (ANP) of the Ministry of the Environment and Natural Resources (Semarnat) National Commission for Protected Areas (Conanp).



Figure 4. Evidence of jaguar presence in Los Chimalapas, Oaxaca. Top: jaguar marks on tree in study area; center and bottom; jaguar tracks in study area; bottom left: adult cattle killed by jaguar, showing a skull fracture.

Photos: Iván Lira-Torres

Considering the estimate of 1 jaguar/15 km² reported for Calakmul Biosphere Reserve (Ceballos *et al.*, 2002), and given that the region comprises 4,629 km² of well-preserved habitat, Los Chimalapas was estimated to have a population of 309 jaguars (Table 1).



Figure 5. Skins of jaguars hunted in Los Chimalapas, Oaxaca. Top: skin of adult male hunted in Santa María; bottom: skin of young male hunted in San Miguel.

Photos: Iván Lira-Torres

A minimum number of 50 breeding individuals has been proposed as necessary to prevent a population from having problems due to loss of genetic diversity; a minimum number of 500 is considered to guarantee long-term conservation (Aranda, 1996). The variety of natural systems, low level of disturbance and isolation of Los Chimalapas suggest that this region may contain one of the largest jaguar populations in Oaxaca, which would make it one of the populations with the greatest chances of persisting in the long term.

The main threats to the survival of jaguars in the region are habitat loss or degradation, subsistence hunting, public unrest in the state and the development of infrastructures (Table 2; Figure 6). On the whole, the interviews showed that livestock depredation by jaguars reflects an imbalance in the local ecosystem. Under natural conditions and with its natural prey species available at natural levels, felids do not usually attack livestock. If they live in suitable areas with enough prey and little or no human influence, they tend to avoid humans and their domestic animals (Almeida, 1986). The lack or decline of natural prey due to subsistence hunting or diseases spread by domestic animals may be the cause of attacks in intermediate areas between conservation units and livestock farming areas (Bowland, 1992).

Human persecution of large felids because of livestock predation or the potential danger they represent to human lives is the last stage in the process of their disappearance outside protected areas (Nowell and Jackson, 1996). Persecution even takes place within protected areas, so jaguars survive in inaccessible places where they are difficult to hunt. This is the case of Los Chimalapas, its ruggedness has contributed to maintaining jaguar populations but also makes it difficult to study them *in situ*.

Table 1. Estimate of the size of jaguars population in Los Chimalapas, Oaxaca

Site	Region	Area in km ²	Habitat types present	Low density (1 jaguar/20 km ²) **	Conservative estimate of density (1 jaguar/15 km ²)*	Connectivity	Population viability (≤50 adult individuals)
Los Chimalapas (Municip. of Santa Maria and San Miguel Chimalapa)	Sierra Madre del Sur in Oaxaca and Chiapas	4,629	Tropical rainforest, cloud forest, tropical deciduous forest	231	308	Uxpanapa, Selva El Ocote Biosphere Reserve, Sierra Madre de Chiapas	High conservation priority in Mexico and Central America
Total # jaguars				231	308		

Table 2. Main threats to the long-term survival of jaguars in Los Chimalapas, Oaxaca

Threat	Number of surveys
Habitat loss and/or degradation	40
Subsistence hunting	40
Competition with introduced species	10
Public unrest	5
Development of infrastructure	1
Other economic activities	1
Medicinal uses and pet trade	3

Figure 6. Hunting of potential jaguar prey in Los Chimalapas, Oaxaca.

Photo: Iván Lira-Torres



In fact, poor management of livestock health, the presence of diseases such as brucellosis and leptospirosis, ecto- and endoparasites, the lack of genetic and reproductive management (Solano *et al.*, 2001) and the effect of floods, droughts and forest fires are the main factors that determine livestock production and survival, rather than jaguar predation. In Los Chimalapas, as in most places with extensive livestock farming in the Neotropics, the operations are rudimentary and herds are exposed to risks in areas that are not suitable for farming. Besides, livestock becomes almost feral, which contributes to predation and livestock theft. This is a common illegal activity in farms whose foremen, workers and neighbors are not closely watched by ranch owners and blame big cats for livestock losses (Hoogesteijn *et al.*, 1993).

Besides poor management of livestock, jaguar predation on livestock in Los Chimalapas may be due to a decline in the abundance and/or a change in the distribution of its natural prey (Polisar, 2000; 2002). Several of the most important prey species for the jaguar, such as peccaries (*Tayassu* spp.), pacas (*Cuniculus paca*), Mexican agoutis (*Dasyprocta mexicana*), white-nosed coatis (*Nasua narica*) and brocket deer (*Mazama temama*) are also the ones most consumed by local people (Cid, 2001; Ojasti, 1984). Deforestation is followed by human settlements and subsistence agriculture, using wild animals as a source of protein. Deforestation is thus an indirect factor of the decline in natural prey for the jaguar, through subsistence hunting. This leads jaguars to substitute their prey for domestic animals to cover their energy requirements. Once they learn to hunt calves or young cattle, they devote their efforts to this (Rabinowitz, 1986).

Apart from being affected by deforestation and subsistence hunting, the status of jaguars is worsened because it is occasionally hunted. Local people who carry guns usually shoot any felid they see because they consider them a threat. Many animals are left injured, maimed and thus unable to hunt their natural prey, which leads them to target livestock, more abundant and easier to hunt (Schaller, 1996). This was observed when examining two specimens hunted in the communal land of La Fortaleza, municipality of Santa Maria Chimalapa and Ejido El Porvenir, municipality of San Miguel Chimalapa. In general terms, residents of these areas said jaguars repeatedly attacked and killed their livestock, so they decided to solve the problem by killing jaguars. The necropsy of the hunted specimens showed that one of them –the one hunted in La Fortaleza– had injuries, scars and gun pellets encapsulated near the cervical region, as well as a broken lower left canine. This suggests that it had had previous encounters with humans and was injured on several occasions. The jaguar in Ejido El Porvenir was hunted because it also killed livestock, according to the locals. However, the necropsy did not show previous scars and the animal was young, so it may have been killed in a casual encounter.

This situation is similar to that documented by Rabinowitz (1986), who observed that 75% (10-13) of the skulls of the livestock-attacking jaguars he examined had old scars caused by gunshots. Out of 65 jaguar skulls examined in Venezuela, 19 be-

longed to livestock predators; 10 (53%) of these skulls had previous scars of shotgun or rifle shots, and fragments of lead bullets incrusting in the bone, causing damage to their vision and teeth (Hoogesteijn *et al.*, 1993). This evidence shows that some problem jaguars are the result of the bad practices and activities of some farmers, who do not manage their livestock properly and shoot carnivores opportunistically.

Among the general management measures aimed at reducing the effects of predation, three main aspects have been considered (Hoogesteijn *et al.*, 1993): 1) the control of problem jaguars that predate on livestock; 2) the shift from extensive to intensive livestock farming using electric fences to optimize production and feeding cattle with fodder, 3) mechanisms to compensate farmers for losses caused by jaguars. It is important to mention that eliminating jaguars is a palliative treatment of the symptoms but does not solve the causes of the problem in any case (Rabinowitz and Nottingham, 1986; Schaller, 1996).

In general, jaguars and humans can coexist, and several communities in the north east of the municipality of Santa María Chimalapa are a clear example of this. It is important to say that jaguar predation in these areas is partly caused by the hunting pressure on potential jaguar prey, especially in forest areas that were cleared to be transformed into pastures, with introduced grass and crops.

Perspectives for future work

To determine the status of jaguars in Los Chimalapas, we propose a long-term project using three assessment methods, according to the recommendations issued in the Symposium “The Mexican Jaguar in the 21st Century” (Chávez and Ceballos, 2006):

- 1) Camera trapping, which will start an early warning program on the current status of jaguars in the area; it will also be used to monitor the impact of the management measures mentioned below.

- 2) Develop a program to assess and monitor subsistence hunting through the sustainable management of potential jaguar prey by the community.

- 3) Promote and conserve the large habitat fragments that still exist in the area; create and maintain strips of natural vegetation along the edges of streams and rivers, around lagoons, pastures and crops adjacent to large forest areas in the ejidos in the north east of Santa María Chimalapa. This measure will contribute to a flow of animals between forest patches, which will provide natural prey to jaguars and reduce livestock predation. The results of the camera trapping study will also be used to identify the forest patches and corridors used by wildlife and optimize conservation efforts (Medici *et al.*, 2006). This project will provide elements to help solve jaguar-livestock and jaguar-hunting conflicts, as a first step in the jaguar conservation strategy of Los Chimalapas in the state of Oaxaca.

