

Andean Cats and Puna Biodiversity

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Final Report

Argentina, Jujuy province, Greater Vilama Landscape
2009 – 2010



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Our project would have not been possible without the support from the all of you!

Section 1:

Summary (max 200 words)

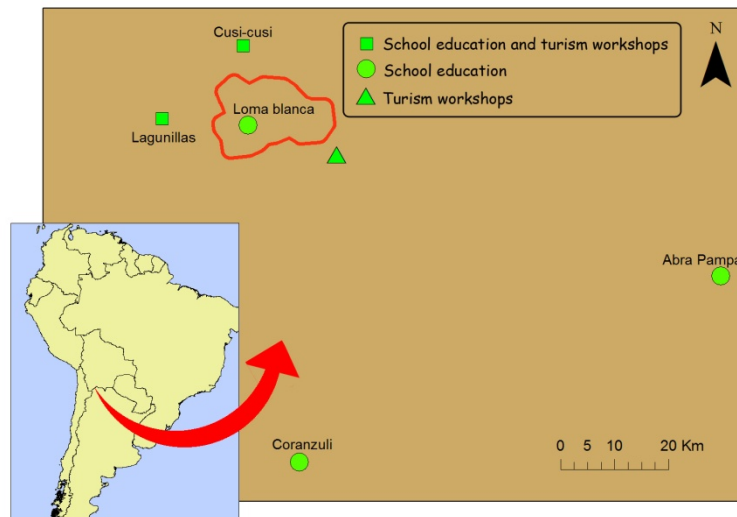
To accomplish our long-term goal of using the Andean cat (among the most endangered felids in the world) as a flagship for biodiversity conservation of the Argentina Puna, we aimed at enhancing our understanding of its ecological needs, improving local people attitudes towards carnivores, building their capacity to participate in the implementation of a protected area, and supporting the development of conservation-friendly activities. We produced the first population estimates of sympatric Andean and Pampas cats and a poster with activities on the importance of protected areas; carried out educational activities with almost 350 young students at 5 communities, one training/networking workshop of local Education Officers, and a capacity building course on the environmental implications of tourism development; designed a handbook on camera trapping for rural people; completed 8 scientific papers, 1 book chapter, 7 conference presentations, and 4 reports; collected data for 2 graduation and 2 PhD theses. Community participation work peaked in a stakeholder participatory workshop (March 2011) to analyse the development of community-based eco-tourism in the region. We were successful at producing important ecological information, improving greatly the profile of Andean cats among local communities, and spreading the awareness that wildlife conservation is compatible with social development.

Introduction (max 500 words)

The Andean cat (*Leopardus jacobita*) is one of most endangered felids in the world and occurs almost exclusively in the Puna ecoregion, a regional conservation priority. Andean cats have a fragmented distribution associated to prey availability, low population numbers, and are threatened mainly by habitat loss, hunting by local people, and, possibly, competition with other carnivores, particularly the similar-sized Pampas cat (*Leopardus colocolo*). A key issue that was identified by our previous work is the lack of knowledge on this cat, its rarity and ecological role among local people as well as the poor understanding that conservation biologists have of the causes of its rarity.

To favor the conservation of the Andean cat and, through it, of its natural habitat, we selected the Greater Vilama region (Jujuy province, NW Argentina) as our study area, because it is located in the centre of a large section of the Andean cat's distribution range, has suffered relatively little alteration by humans (thanks to its remoteness), and has been the focus of previous actions by our team. As main partners we had identified *Warmi* (a native women association from the high Andes of Jujuy province), the National Park Agency (APN), and the other members of Andean Cat Alliance (AGA). These organizations would ensure connections with local authorities, National government, and the international conservation community, respectively.

To enhance our understanding of the ecological needs of Puna carnivores, we aimed at developing innovative research and monitoring protocols, largely based on sign counting and camera trapping data. To improve local people's negative attitudes towards carnivores, we planned to build their capacity to participate in the implementation of a protected area, deliver conservation education, form a network of local people and institutions aiming at implementing conservation-friendly development activities, and support such kind of initiatives. Through these tools, we expected to improve greatly the profile of the Andean cat among local communities and spread the awareness that wildlife conservation is compatible with social development.



Map showing the location of the study area in Argentina and the villages where we carried out awareness raising activities. The red line envelops the area covered by our ecological surveys.

Project members

Mauro Lucherini, project leader. PhD in Zoology, Researcher at CONICET (Argentine National Commission for Scientific Research) with extensive experience in field study of mammals, conservation biology of carnivores (member of both Cat and Canid Specialist Group, IUCN), expedition leadership to remote areas, team building, and fund raising.

María José Merino, leader of the education and community participation component. Master in Environmental Education, Secondary school Science Professor for the government, she has 13 years of experience in Environmental Education, ample knowledge of conservation education as applied to preservation of carnivores, and teaching.

Juan Reppucci, field data collection and processing, wildlife monitor and student training. PhD candidate in Biology at Universidad Nacional del Sur in the final stages of his thesis; he has ample experience in field study of carnivores, satellite imagery, and received training in population abundance models.

Estela Luengos Vidal, field data collection. Postdoc biologist with a scholarship from CONICET, has wide experience in student field training, carnivore live trapping, field data collection and analysis, as well as field logistic.

Elisa Pizarro, education and community participation activities. Graduated Translator. As member of the initial team, she carried out some education activities before abandoning the project at the end of 2009.

Cintia Tellaeche, field data collection, education and community participation activities. PhD candidate in Biology at Universidad Nacional del Sur since 2010. She started participating in the project expeditions since 2009 and became permanent member of the team since the moment she obtained a scholarship for her PhD on the Andean cat.

Section 2:

Aim and objectives (max 200 words)

Our project aimed at using the Andean cat as a flagship for the conservation of the Puna biodiversity, building the capacity of local stakeholders to participate in conservation.

Objectives:

- Develop an efficient protocol for surveying/monitoring Puna carnivore population abundances, based on occupancy models, and use it to identify key conservation areas. After the initial field tests, we found that, given the low detection probabilities and low population densities of cats, occupancy models were an unsuitable tool, decided to change our short-term objective, and used field surveys to analyze carnivore habitat requirements. Additionally, we plan to adopt a different surveying strategy, based on simultaneous camera trapping and radiotracking of tagged individuals to obtain the data needed to develop surveying protocols and identify key conservation areas.
- Produce a package of education tools designed to favour positive perception of protected areas and a simple handbook on camera trapping to be used by Wildlife Monitors.
- Increase training of our local Wildlife Monitors and Education Officers and hold a workshop to create a network of local people involved in wildlife conservation and empower them to take advantage of conservation-friendly job opportunities.

Methodology (max 500 words)

To survey carnivores we mainly used camera trapping and transect-based sign counts, while to monitor mountain viscacha (Andean cat main prey) population abundances, we coupled transect-based sign counts, line transect direct counts and camera trapping. Sign count transects were 20 m wide and 400 m long and data on Mt. vizcacha faecal pellets abundance categories were recorded every 25 m. We also counted pellets in 1.5x1.5 m plots. All sighted Mt. viscachas were recorded and their distance from transect estimated by two experienced researchers along line transects. To cover a larger than ever area, we deployed 55 single-trap camera stations across a variety of habitat types and covering an area of approximately 130 km² (Fig. 1). We will analyze these data using the novel site occupancy approach based on repeated observations of presence/absence. Although this technique may also be used to estimate population abundances over larger areas than the traditional capture-recapture approaches, our preliminary analyses indicate that the low detection probabilities and population densities will enable us to apply these data exclusively for the study of habitat use.

To produce the first population density estimates of sympatric Andean and Pampas cats we used the data we had previously collected by camera trapping, built a capture history for each individual identified (by its unique spot and stripe pattern) based on the time and location of the photo captures and applied a recently developed class of models for spatial capture-recapture using a Bayesian framework.

To favor positive perceptions of/attitudes towards protected areas we designed a set of site-specific activities for school-age kids and placed it on the back of a poster with attractive photographs. We produced 500 posters and distributed them to our Education Officers and school teachers working in the rural schools of the Puna. This new education material has already been used in the main villages at the borders of the Greater Vilama landscape. Additionally, we carried out two educational campaigns to work directly at schools with the new poster and the education materials previously produced by our project (a storybook, and different games). One of these campaigns was carried out in cooperation with the National Park Agency. An advanced draft of a handbook on camera trapping techniques for local people has been recently completed to foster local people's participation in conservation. We plan to print it in the next months and spread it to our local Wildlife Monitors, thus improving their training and empowering them to carry out basic monitoring activities, and all our partners, as well as relevant stakeholders.

In June 2009, we held a workshop for High-Andes Educators, to provide further training on wildlife conservation and facilitate networking with other institutions involved in the sustainable use of

natural resources in the study region. Following this workshop, we designed and gave a series of capacity building open courses to local communities and coordinated a participatory workshop to debate with all stakeholders on the development of community-based eco-turism initiatives in the Greater Vilama Landscape.

Outputs and Results (max 500 words)

Our analysis of camera trap data obtained during the campaigns completed thanks to the previous CLP grants was successful at producing the first population estimates of sympatric Andean and Pampas cats (**Tab. 1**). We were also able to show that detection probabilities, in our study area, were smaller for Pampas cat (0.02) than Andean cat (0.07).

Table 1. Density estimates for the sympatric cat populations obtained by camera trapping at the Vilama landscape using two different models: M₀: Traditional capture-recapture null model; SECR: spatially explicit capture recapture model.

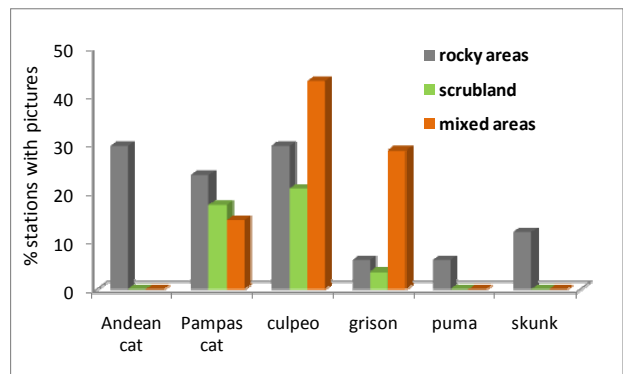
Year	Density (animals/100 km ²)			
	Pampas cat		Andean cat	
	M ₀	SECR	M ₀	SECR
2006	45	74	9	7
2007	126	78	13	12

Figure 1. Photograph of a pair of Andean cats taken by one of our camera traps in 2009.



The data from the camera trap campaign we carried out in 2009 proved extremely useful to obtain conservation implications from our density estimates. A total sampling effort of 2,830 camera trap days produced 77 carnivore events (**Fig. 1**). This data support our hypothesis that Andean cats are strictly associated to rocky areas, and avoid other habitats, whereas Pampas cats would be more flexible and make extensive use of scrublands (**Fig. 2**). They also indicate large niche overlap between these two small cats.

Figure 2. Use of the main habitats of the Puna by carnivores.



We completed Mt. vizcacha pellet counts at 51 points, 3 sign-count transects, and 10.8 km of direct count transects. We expect that these data, when pooled with those we recorded in our previous expeditions, will enable us to estimate habitat-related variations in prey availability and determine the most suitable techniques for monitoring prey abundance.

A number of outputs witnesses the large effort we devoted to community participation and awareness raising activities:

- We produced a poster with activities to increase awareness on the importance of protected areas for the conservation of biodiversity and improvement of local livelihoods (**Fig. 3**).
- We distributed educational material to the schools of 4 communities within our study region.

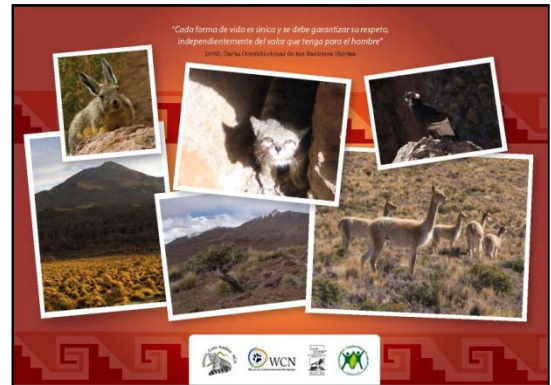
Figure 3. Front page of the new educational material we produced.

- One workshop to improve training and networking of our Education Officers was carried out (**Fig. 4**).

Figure 4. Invitation to our most recent workshop for educators.



- We completed two educational campaigns in cooperation with our local Education Officers and staff from the regional office of the National Park Agency. They enabled us to reach 5 schools from 5 localities and almost 350 young students. Local Education Officers should have already largely increased this figure.



- We organized and held a capacity building course to respond to the request from local communities, which have become involved in a communitarian tourism project, led by *Warmi* and felt they needed to improve their knowledge on the environmental implications of tourism development. The 3 to 4 hour-long course was given in the form of talks open to the whole community in 3 localities. A total of 60 adults participated (**Figs. 5 & 6**).

Figure 5. Poster announcing our capacity building activities.



Fig. 6. Community course at Lagunillas, NW Jujuy province, Argentina.



- An advanced draft of a handbook on basic camera trapping procedures for local people has been completed recently and will be printed soon.
- We coordinated a participatory workshop (Abra Pampa, April 11-12, 2011) to analyse the development of community-based eco-tourism initiatives in the Greater Vilama Landscape. The workshop was attended by 21 delegates, representing 3 NGOs, 1 native women association, 2 provincial government and 3 national government institutions, and 3 local communities (**Figs. 7 & 8**).

Figurea 7 & 8. Participatory workshop on sustainable tourism development.



- CLP award was instrumental to obtain additional funding from Wildlife Conservation Network (9,890 US\$), and Panthera (5,600 US\$).
- 5 papers reporting the data we collected have been published and 3 have been submitted in peer reviewed journals. 1 chapter in a very prestigious book on wildcats published by Oxford University Press, 7 conference presentations, and 4 unpublished reports to partners and endorsing institutions were produced. Ecological information we gathered forms part of 2 graduation and 2 PhD theses plus a postdoc project.

Achievements and Impacts

In the last years, we have been able to process the data collected through a large field effort in the preceding years. These results provide insights into Andean cat's population genetics, potential distribution range and the factors affecting it, intraguild competition and population densities.

Results of the genetic analyses showed that the Andean cat populations harbour extremely low genetic diversity. The unique population structure of this species suggests the existence of three genetically distinct groups that could be considered separate management units (Cossios et al. submitted).

The distribution models built on the presence records we helped collecting indicated that the climatic niche of the species is defined by extreme diurnal variations in temperature, cold minimum and moderate maximum temperatures, and aridity, characteristic of the Andean highlands but also of the Patagonian steppe, where the occurrence of the Andean cat has been confirmed recently. The Andean cat distribution range has a size ranging from 345,220 km², for the "best habitat", to 1,172,320 km², for the total potentially suitable habitat (Bennett et al. submitted).

Camera trap capture-recapture data showed that whereas the density of Pampas cats is relatively high for a little productive environment such as the Puna, the estimate for the Andean cat is rather low, and much lower than that expected for a carnivore of its size. It is important to mention that the figures we reported here are those that we consider the most reliable based on our knowledge of the biology of this cat, but that they are probably affected by the site we selected and the size of the effective trapping area. Nevertheless, irrespectively of the method used, the Pampas cat has population densities remarkably higher than Andean cat's, and this occurs in a site where Mt. vizcachas were very abundant and that could be classified as very good for Andean cats (Gardner et al. 2010, Reppucci et al. in press). This conclusion confirms the alleged rarity of the Andean cat (Lucherini et al. 2008, Marino et al. 2010) and supports the hypothesis that it is a habitat specialist living in fragmented populations centered in the rocky areas where prey is abundant.

Extrapolating the population density estimates for the Andean cat to its whole distribution range, the total number of living Andean cats could range from 2,416 to 14,068 individuals. However, if the hypothesis that the Andean cat is a habitat specialist is correct, the density figure we obtained would be representative of the "best habitat" conditions, while the density in most of the remaining potential range would be extremely low. In this case, the total population number would more probably range from 2,416 to 5,178 Andean cats. Following the IUCN Red List criteria, these figures would confirm the conservation status of the Andean cat as Vulnerable, a classification that had been adopted previously mainly based on expert opinions and not on numerical data (Acosta et al. 2008). Nevertheless, it must be clear that more data is needed on the habitat association of the Andean cat before we can provide any reasonably meaningful conclusion. This is why we have planned to dedicate our next research effort to comprehend habitat use by small cats, using camera trapping and radio telemetry simultaneously. Additionally, habitat requirement data would enable us to identify with a certain precision the areas of priority for the conservation of Andean cats populations and evaluate the effects of habitat modifications such as those produced by mining activities (there is a large open-air gold mine at the border of our study region).

Another reason why we think that this new research effort is necessary is that our results on the ecological niches of the Pampas and Andean cat, which are very similar in size and phylogenetically related, are strongly suggestive of a wide overlap. Their food niches are similar both in general (Walker et al. 2007) and where the two species co-occur (Tellaache 2010). Through camera trap data, we

showed that their activity patterns overlap extensively (Lucherini et al. 2009). Finally, their ranges were found to superpose both at the landscape level scale (Perovic et al. 2003) and at a finer scale (Napolitano et al. 2008). This whole body of evidence strongly supports the existence of interspecific competition between the Andean cat and the Pampas cat and that, given its higher population abundances, the Pampas cat is competitively dominant over the Andean cat. Thus, we are left with the spatial dimension to complete an analysis of the ecological niche of these two felids and understand the strength of their competition and its effects on the conservation status of the Andean cat.

The field data we collected in the course of 2009 were important not only to start providing a first insight into the spatial segregation of Pampas and Andean cat but also to progress in our search for efficient population monitoring protocols. Preliminary analyses of this information, in addition to those reported above, show that the use of camera trapping for tracking the evolution of Andean cat populations over large areas through occupancy models is probably limited by the costs, in terms of time and money, associated to the low detection probability and low densities of this felid.

While our research activities has the goal of building the body of knowledge that is indispensable to revise the conservation status of the Andean cat, determine its relationship with the Puna habitats and produce effective conservation strategies, we have constantly engaged ourselves in a range of actions that aim at addressing directly the poor knowledge and negative perceptions of and attitudes towards carnivores and particularly the Andean cat as well as of protected areas that we observed among local people (Lucherini & Merino 2008). With this long-term goal in mind, we have adopted two main strategies: increase conservation awareness among local stakeholders and the general public, and foster the participation of local communities in conservation. Our specific objective related to education and awareness rising has been accomplished and the outputs that we expected to generate have been produced. The increased offer of positions by the mining companies working in the study region affected our ability of retaining the local villagers we had already trained and of getting new persons interested in our proposal. Although we can still count on the help of a few local educators and monitors, we choose to adopt an alternative strategy and got involved in the development of sustainable, community-based tourism, a novel trail that may lead our project to potentially large outcomes. It has to be underlined that this was not an activity that we had planned in advance, and we decided to include it in our project because we noticed that local people were extremely interested in this tourism development project lead by the native women association *Warmi* and understood that natural resources are the main attraction to tourism they have but lacked the capacity to evaluate what activities are compatible with a sustainable use of these resources. Additionally, in spite of the fact that *Warmi* was able to access to funding from the Interamerican Development Bank (BID), we found that it counts on poor environmental impact advising. To fill this lack of expertise and, simultaneously, avoid the programming of touristic activities that may harm the natural ecosystems of the Puna, we travelled twice to the study region and conducted activities that were not included in our original proposal. In October 2010, we carried out the courses we listed among the outputs in the previous section. In December 2010, we participated to a trip specifically planned by *Warmi* to evaluate the tourism activities proposed by 3 local communities and provided a series of specific guidelines. Finally, in April we coordinated a workshop on community-based eco-tourism where a number of GOs and NGOs shared their vision and experiences on this topic with the representatives of local communities and *Warmi*, thus creating the bases for a more coordinated, joint effort for the development of sustainable tourism activities in the Greater Vilama.

Section 3:

Conclusion (max 250 words)

The research component of our project and the network of collaborations we have built through the years were successful at producing sound ecological information on the Andean cat that was not previously available and is of extreme utility for the designing of meaningful conservation strategies for this felid and its habitat. Specifically, we proved that the Andean cat is a rare species, probably limited by intraguild competition, and we contributed to identify its distribution range and determine that it has a very limited genetic variability. We also provided information supporting the hypothesis that Andean cats are strictly associated to rocky habitats, one of the most productive and diverse Puna habitat types. Finally, we expect that the data we collected in the last year will enable the identification of areas with great conservation value for the Andean cat.

All the activities, whether planned or not, we carried out with local people have been producing a slow, but constant and clear increase in their participation and conservation awareness while creating new opportunities to improve local livelihoods. Additionally, our continuous presence in the region is enhancing the profile of the Andean cat among governmental agencies in charge of wildlife management and tourism, as well as politicians and development NGOs. We expect that all these actions will ultimately reduce cat hunting (which is one of the major threats to Andean cats in our region) and favor more conservation-friendly attitudes among local stakeholders and the creation of a protected area in the Vilama landscape.

Problems encountered and lessons learnt (max 500 words)

The mayor problems we had with our objectives and the related outputs were:

1. The strategy that relied on the local villagers we had trained in the preceding years. Although we continued devoting a great effort to keep in touch with, provide new training and networking opportunities and a certain economic support to local Wildlife Monitors and Education Officers, the results we obtained were smaller than we expected. We argue that these disappointing results are due to two simultaneous, unexpected factors. In the last couple of years the mining companies working in the study region have expanded their activities and consequently increased their offer of positions (with much higher monetary compensations) for local workforce. The other problem was a weakness of our team. With the specific aim to support in community participation, we had included in our team a person living very close to the study area and with experience in these techniques, but this person, who was not part of our previous teams, proved to be little motivated. To overcome these problems, we dedicated more time and effort to cultivate the relationship with local institutions, a strategy that led us to increase our involvement in tourism, a type of initiative that generates greatly expectation among local communities.
2. Camera trapping proved not be suitable to produce the information needed for a cost-efficient monitoring protocol. Camera trapping is one of the field techniques most frequently used for surveying rare species and we used it successfully to produce crucial information. Nevertheless, its efficiency is limited for detecting population changes when capture probabilities are as low as those we recorded for small cats in the Puna. This led us to the decision to add radiotelemetry to obtain additional information that may enable us to refine the use of camera trapping for monitoring purposes. We also concluded that perhaps this objective was too ambitious for a short time frame such as that provided by the CLP grant.

The production of novel, sound ecological knowledge on the high Andes carnivore community and the cooperation with the activities generated through our partner *Warmi* were the most successful components of our project. The lesson that can be drawn from that is that determination and cooperation are key factors for success when addressing complex conservation issues. Without perseverance we would have been able neither to overcome the difficulties implied in field research with elusive and rare species nor to become involved in the development of communitarian tourism initiatives. At the same time, we would have never been capable of obtaining these strategic outcomes without the collaboration of several partners and the long-term support that we were able to receive through the 3 CLP grants we were awarded over the years. The other relevant lessons we

learnt through the course of the project is that a conservation project aiming to favor local communities participation should adopt an adaptive approach, because this is the best strategy to face unexpected challenges and take advantage of new windows of opportunity.

In the future (max 200 words)

The stakeholder workshop we held in April 2011 was successful as a starting point for programming a collaborative initiative for a conservation-friendly development of local communities in our study region, especially because it permitted the introduction to local communities of the project for the creation of a national Protected Area in the Greater Vilama by the National Park Agency, which we are supporting from a long time. We believe that this project has a huge potential for the conservation of Puna wildlife and plan to devote most of our future efforts to it, looking for new funding and partnerships that would be mostly used to support ecotourism initiatives and the creation of this PA. Another important step that we are undertaking is an ecological research based on live trapping and radiotracking coupled to camera tracking. With this innovative combination of techniques we aim at understanding the spatial niche of Andean and Pampas cats and thus produce the final piece of information needed to guide the development of meaningful conservation strategies. Finally, in the next few months we plan to complete our camera trapping handbook and expect that it will improve the work of our local wildlife monitors, protected area rangers and many of our partners.

Section 4: Appendices

APPENDIX I – Detailed report of project activities.

June 2009.

The networking and capacity building workshop we held in Tilcara (Jujuy Province) was attended by 7 Education officers and delegates of NGOs and GOs. It was especially useful to establish the bases for a cooperation between our project and the native women association *Warmi*.

July-August 2009.

We attended the International Mammal Conference (IMC10, Mendoza, Argentina), the most important world conference on mammals, where we shared with colleagues some of the results obtained by our project in 5 presentations.

We designed and produced a new educational material, specifically aimed at raising awareness and increasing the understanding of the importance and functions of protected areas.

We travelled to the villages of Coranzuli, Lagunillas, and Cusi Cusi to visit our Education Officers to keep contact and handle them educational material on protected areas we that we had obtained from the National Park Agency (APN).

September - December 2009.

During these months the team worked actively in the field in both community awareness activities and ecological data collection in our study area of north-western Argentina.

With our new educational material, we made classroom educational activities in the schools of four villages (Coranzuli, Cusi Cusi, Loma Blanca, and Abra Pampa) in October. These activities were carried out with total of 275 students whose ages range from 5 to 13 years, and in cooperation with some of our local Education Officers.

In November, a collaboration with APN (the national agency of protected areas) was conducted to work with school students in three villages (Lagunillas, Cusi Cusi, and Abra Pampa) with the specific objective of strengthening the relationship between local community and the protected areas located in the region and improving the perceptions of local people towards them. In this opportunity we worked with 90 children from kinder gardens and elementary schools (3 to 11 years).

We had meetings with two different groups of artisans on the creation of a network with the remaining members of the community.

We also had 3 meetings with the *Warmi* leaders, to discuss our collaboration with their community development actions and, specifically, the participation to a course and the building of an interpretation centre for visitors in one of the villages of the region.

To evaluate the habitat use of Andean felids, and their potential competitors and preys, we deployed an array of 55 camera traps across a variety of kinds of habitats and covering a larger than ever area of approximately 130 km². We obtained 77 carnivore events, many of those formed by multiple shots of the same individuals within a brief time.

We carried out three line transects, for carnivore evidence search, with the objective of completing previous samplings and training students. We recorded 79 carnivore evidences (63.3% of small felids, 30.4% culpeo, 2.5% puma, 3.8% lesser grison). Most of them were scats that will allow us to analyze the feeding habits, and thus to improve our understanding of the carnivore-human conflicts.

We started testing some new techniques to improve capture probabilities of Andean cats, such as new baits, and sound attractors. The performance of VHF radiocollars in the high Andes environment was also tested. This information will be needed to choose the more suitable radiocollar model for this species and type of environment.

In cooperation with researchers from Mendoza (CCT-CONICET, Argentina), we completed a short rodent capture survey to identify the species occurring in the area and estimate their abundance.

We continued working with local Wildlife Monitors (previously trained in the frame of this project); at the moment they are deploying cameras in the field to gather new Andean cat presence points in not previously surveyed areas. A local person was also hired to help us in the final stages of the sampling (we tried to hire local assistants from

the beginning, but this was impossible due the fact that the intensive mining activity in the regions has created a large number of employment opportunities).

During this period, we trained one graduate student, C. Rodriguez, who will develop a graduation thesis in the Argentinean Universidad Nacional de La Pampa. The data collected will also form part of E. Luengos post doc, the final steps of J. Reppucci's PhD dissertation and C. Tellaeché's PhD first steps, all at Universidad Nacional del Sur, Argentina.

January-September 2010.

We mainly devoted these months to analyze the ecological information we had previously collected and generate relevant scientific outputs (papers and congress presentations) and reports to partner institutions; evaluate strategies and techniques used in the first months, and elaborate and adopt corrections when necessary; produce grant submissions using the CLP award as counterpart; design the material for the new courses we were asked to give by local communities.

October 2010.

This field trip was specifically organized to respond to a request from two local communities in our study area of Jujuy province, NW Argentina. These communities (Lagunillas and Cusi Cusi) have become involved in a communitarian tourism project led by *Warmi* and felt they needed to improve their knowledge on the environmental implications of tourism development.

In an effort to maximize the number of attendants, previous to our field trip, we submitted the program of the course to the approval of both *Warmi* and local village authorities and asked them to inform villagers of our schedule using a poster we sent them. Additionally, we announced the talks to governmental and native authorities of all localities 2 to 5 days before the scheduled date.

The 3 to 4 hour-long capacity building course was given in the form of talks open to the whole community in 3 localities: Lagunillas, Liviara and Cusi Cusi. A total of 60 adults (16 to 55 years-old) participated to the talks.

The topics we discussed included:

- Biodiversity.
- Ecosystems.
- Environmental health and sustainable development.
- Contamination.
- Types of energy sources.
- Natural resources.
- Tourism and natural resource conservation.
- Laguna de Vilama RAMSAR Site.

We took advantage of the trip to accomplish multiple secondary objectives: 1. Keep contact with Education Officers, Wildlife Monitors and other villagers who have been cooperating with our project (travelling to Coranzuli, Loma Blanca, and Abra Pampa); 2. Visit Laguna Blanca (Catamarca province, NW Argentina), a community located within a Biosphere Reserve where the Andean cat occurs to learn about local people's experience with an ecotourism project was started a few years ago by the province government; 3. Continue our efforts to involve the Jujuy province governmental authorities in a management plan for the development of conservation-friendly tourism in our study area; 4. Complete ecological data collection on prey availability in the area we sampled last year, by carrying out vizcacha line-transect and fecal pellet counts.

November 2010.

We attended the Annual Conference of the Argentine Mammal Society (Bahía Blanca, Argentina), where we presented some of the most recent results obtained by our project in 2 posters.

December 2010.

We carried out this last field trip with two major objectives:

1. Advocate for an agreement as wide as possible on the importance of a workshop to give voice to all the stakeholders potentially or actually involved in the development of communitarian, sustainable tourism in the Greater Vilama.

With this in mind we tried to interview personally as many stakeholders as possible (travelling to the cities of Salta, San Salvador de Jujuy, and Abra Pampas) and raise their interest in this initiative. As a result we have already established a schedule and a list of interested parts for the workshop:

2. Provide technical advice on the wildlife conservation aspects of the tourism activities proposed by members of the communities of Lagunillas, Cusi Cusi, and Liviara. Specifically, we were invited by *Warmi* leaders to form part of a supervision trip to these villages carried out by Pro NOA, an NGO that is administrating the grants and loans obtained by *Warmi* for small local entrepreneurs. While in the field we provided direct inputs to the villagers involved in the initiatives and are currently elaborating a brief report to Pro NOA and *Warmi*.

April 2011.

We travelled to Abra Pamps, Jujuy province, to coordinate the "**Participative workshop: towards the development of sustainable tourism in the Highlands of Jujuy**", that was hosted by our partner *Warmi*. The two-days long workshop was attended by:

- Secretaria de Turismo (Jujuy Province Government)
- Dirección Provincial de Políticas Ambientales y Recursos Naturales (Jujuy Province Government)
- PRO Jujuy NOA (provincial development NGO)
- Asociación WARMI (provincial development NGO)
- Fundación EcoAndina (provincial development NGO)
- Delegación Técnica NOA, APN (national Government)
- Comité de las Montañas (national Government)
- Delegates from the three local communities
- Andean cat Alliance (international conservation NGO)

APPENDIX II – Full account of expenditure.

ITEM	Pesos	US\$*
Administration	1459.33	374.19
Communication	292.83	75.08
Driving authorization	251.00	64.36
Personal Insurance	552.00	141.54
Shipment	363.50	93.21
Education	3765.86	965.61
Education material design & printing	1100.00	282.05
Education supplies	1297.46	332.68
Web page actualization	480.40	123.18
Workshop	888.00	227.69
Equipment	89824.36	23031.89
Field equipment	39367.20	10094.15
Second-hand vehicle	39000.00	10000.00
Field supplies	8349.59	2140.92
Medical supplies	392.35	100.60
Electronic/Office supplies	2715.22	696.21
Stipends	17076.05	4378.47
Education coordinator stipend (450P/month * 12 months)	7200.00	1846.15
Education officers stipends	3820.00	979.49
Wildlife Monitors stipends	300.00	76.92
Student stipends	5756.05	1475.91
Transportation	50460.75	12938.65
Accommodation	7324.50	1878.08
Buses	10291.00	2638.72
Field vehicle maintenance	8130.92	2084.85
Flights	8215.10	2106.44
Food	6190.76	1587.37
Fuel	4039.50	1035.77
Parking	133.00	34.10
Road fees	49.00	12.56
Taxi	125.66	32.22
Truck rental	5961.31	1528.54
TOTAL	162586.35	41688.81

*we used here a US\$:ArPesos rate of exchange of 3.9:1

APPENDIX III –Complete list of scientific material produced by the project.

Papers in peer-reviewed journals and books:

1. Cossíos D., Lucherini M., Ruiz-García M., & Angers B. 2009. Influence of ancient glacial periods on the Andean fauna: the case of the pampas cat (*Leopardus colocolo*). *BMC Evolutionary Biology* 9:68-80.
2. Lucherini M., Reppucci J.I., Walker R.S., Villalba M.L., Wurstten A., Gallardo G., Iriarte A., Villalobos R. & Perovic P. 2009. Activity pattern segregation of carnivores in the High Andes. *Journal of Mammalogy* 90:1404-1409.
3. Lucherini M., Reppucci J.I. & Luengos Vidal E. 2009. A comparison of three methods to estimate variations in the relative abundance of mountain vizcachas (*Lagidium viscacia*) in the High Andes ecosystems. *Mastozoología Neotropical* 16:223-228.
4. Marino J., Lucherini M., Villalba L., Bennet M., Cossios D., Iriarte A., Perovic P., & Sillero-Zubiri C. 2010. Highland cats: Ecology and conservation of the rare and elusive Andean cat. Pp. 581-596 in D. Macdonald and A. Loveridge, Editors. *The biology and conservation of wild felids*. Oxford University Press, Oxford, UK.
5. Gardner B., Reppucci J., Lucherini M. & Royle J.A. 2010. Spatially-explicit inference for open populations: estimating demographic parameters from camera-trap studies. *Ecology* 91: 3376-3383.
6. Reppucci J., Gardner B., & Lucherini M. In press. Estimating detection and density of the Andean cat in the high Andes. *Journal of Mammalogy*.
7. Merino M.J. & Lucherini M. Education contributes to the conservation of the endangered Andean cat. Submitted to *Conservation and Society*.
8. Cossíos D., Lucherini M., Ruiz-García M. & Angers B. Between high-altitude islands and high-altitude corridors: the population structure of the Andean cat. Submitted to *Animal Conservation*.
9. Bennett M., Walker S., Cossios D., Iriarte A., Lucherini M., Plissock P., Sillero-Zubiri C., Villalba L. & Marino J. Conservation implications of bioclimatic constraints to Andean cat distribution. Submitted to *Diversity and Distributions*.

Conference presentations:

1. Lucherini M., Luengos Vidal E., Manfredi C. & Reppucci J. 2009. Lowland and upland carnivores from the Southern Cone of South America. 10th International Mammal Conference (IMC10), Mendoza, Argentina.
2. Cossios D., Ruiz-García M., Lucherini M. & Angers B. 2009. Phylogeography and conservation of the rarest felid of the Americas: the Andean cat (*Leopardus jacobita*). 10th International Mammal Conference (IMC10), Mendoza, Argentina.
3. Marino J., Bennett M., Villalba L., Lucherini M., Iriarte A. & Sillero-Zubiri C. 2009. Ecological niche modelling for the rare and specialized Andean cat: implications for conservation in the high andes. 10th International Mammal Conference (IMC10), Mendoza, Argentina.
4. Lucherini M., Luengos Vidal E. & Reppucci J. 2009. Factors affecting small cat abundance in the High Andes of Argentina. 10th International Mammal Conference (IMC10), Mendoza, Argentina.
5. Reppucci J., Gardner B., Lucherini M. & Royle A. 2009. First density estimates of small Andean felids: which is really the rarest? 10th International Mammal Conference (IMC10), Mendoza, Argentina.
6. Tellaeche C., Reppucci J., Luengos E., Ortiz P. & Lucherini M. 2010. Hábitos alimenticios de dos especies de felinos simpátricos (*Leopardus jacobita* y *L. colocolo*). XXIII Conference of the Argentine Mammal Society (SAREM), Bahía Blanca, Argentina.
7. Reppucci J., Cuello P. & Rodríguez D. 2010. Coexistencia y segregación espacial de un ensamble de micro-mamíferos de la Puna. XXIII Conference of the Argentine Mammal Society (SAREM), Bahía Blanca, Argentina.

Unpublished reports:

2009. The Soul of the Andes. Annual report to Wildlife Conservation Network (WCN) and AGA.
2010. - Progress report to the Darwin Initiative project team.
 - The Soul of the Andes. Annual report to Wildlife Conservation Network (WCN) and AGA.
 - Report to Dirección Provincial de Políticas Ambientales y Recursos Naturales (Jujuy province government).

University student dissertations:

- Tellaeche, Cintia. 2010. Análisis de hábitos alimenticios de dos especies de felinos simpátricos (*Leopardus jacobita* y *Leopardus colocolo*). Graduation Thesis, Universidad Nacional del Sur, Argentina.

- Rodriguez, Carolina. *In progress*. "Análisis de la ocupación espacial de tres carnívoros en el noroeste argentino". Graduation Thesis, Universidad Nacional de La Pampa, Argentina.
- Reppucci, Juan. *In progress*. "Ecología y abundancia poblacional del gato andino (*Leopardus jacobita*) y gato de los pajonales (*Leopardus colocolo*) en los altos Andes Argentinos". PhD Thesis, Universidad Nacional del Sur, Argentina, supported by a scholarship from CONICET.
- Tellaeché, Cintia. *In progress*. "Uso del espacio y recursos tróficos por parte de dos especies de felinos silvestres gato andino (*Leopardus jacobita*) y gato de los pajonales (*Leopardus colocolo*) en la región Alto andina, Prov. de Jujuy". PhD Thesis, Universidad Nacional del Sur, Argentina, supported by a scholarship from CONICET.
- The project formed part of Estela Luengos Vidal's in progress postdoc (Universidad Nacional del Sur, Argentina, supported by a fellowship from CONICET) titled "Análisis comparativo de la competencia interespecíficas en tres gremios de carnívoros y sus efectos sobre la estructura gremial y las abundancias poblacionales".

APPENDIX IV – Reprints of the most relevant publications produced by the project.

CHAPTER 28

Highland cats: ecology and conservation of the rare and elusive Andean cat

Jorgelina Marino, Mauro Lucherini, M. Lilian Villalba, Magdalena Bennett, Daniel Cossíos, Agustín Iriarte, Pablo G. Perovic, and Claudio Sillero-Zubiri



Andean cat in Salar de Surire, north Chile. © Jim Sanderson.

Introduction

The concept of rarity is central in conservation, as is the linked topic of prioritization, and both issues are complicated (Dickman *et al.* 2006b; Mace *et al.* 2006). Rarity can be defined numerically or probabilistically (e.g. IUCN red list criteria), and while generally viewed as the undesirable consequence of a failure in conservation, some species are naturally rare, possibly as the result of being ecologically specialized (e.g. Ethiopian wolves, *Canis simensis*; Sillero-Zubiri *et al.* 2004). A rare animal population is usually defined as one with low numbers of individuals, but large populations can appear to be rare if animals

show elusive behaviour and survey procedures prove ineffective (i.e. an error in estimation), or if animals are sparsely distributed over a vast area and little distinction is made between terms like density and abundance. Whatever definition of rarity is involved, rarity poses problems when monitoring populations (Thompson 2004) and for conservation planning (Mace *et al.* 2006).

The 4–4.5 kg Andean cat (*Leopardus jacobita*) is arguably one of the rarer and certainly among the least known of the small cats (Nowell and Jackson 1996; Yensen and Seymour 2000; García-Perea 2002; Villalba *et al.* 2004; Fig. 28.1). In this case study we

Spatially explicit inference for open populations: estimating demographic parameters from camera-trap studies

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Abstract. We develop a hierarchical capture–recapture model for demographically open populations when auxiliary spatial information about location of capture is obtained. Such spatial capture–recapture data arise from studies based on camera trapping, DNA sampling, and other situations in which a spatial array of devices records encounters of unique individuals. We integrate an individual-based formulation of a Jolly–Seber type model with recently developed spatially explicit capture–recapture models to estimate density and demographic parameters for survival and recruitment. We adopt a Bayesian framework for inference under this model using the method of data augmentation which is implemented in the software program WinBUGS. The model was motivated by a camera trapping study of Pampas cats *Leopardus colocolo* from Argentina, which we present as an illustration of the model in this paper. We provide estimates of density and the first quantitative assessment of vital rates for the Pampas cat in the High Andes. The precision of these estimates is poor due likely to the sparse data set. Unlike conventional inference methods which usually rely on asymptotic arguments, Bayesian inferences are valid in arbitrary sample sizes, and thus the method is ideal for the study of rare or endangered species for which small data sets are typical.

Key words: Andes Mountains; Argentina; Bayesian analysis; camera trapping; data augmentation; hierarchical model; Jolly–Seber model; Pampas cats; spatial capture–recapture; trapping arrays.

INTRODUCTION

Estimating demographic parameters such as abundance (or density), survival, and recruitment, is a fundamental objective of many studies of animal populations, and such information is necessary in the conservation and management of any species. To that end, there are a large number of quantitative techniques used to obtain information about demographic parameters of populations. One broad class of methods, known as capture–recapture models (Seber 1965, Williams et al. 2002), is based on encounters of individuals resulting from repeated sampling of populations over time. Capture–recapture models represent a flexible class of methods that are in widespread use for many taxa. When applied to demographically closed populations (that is, populations not experiencing recruitment or mortality), these models provide information about population size, or density. A number of extensions (Cormack 1964, Jolly 1965, Seber 1965, Lebreton et al. 1992, Schwarz and Aranson 1996) relevant to demographically open systems allow for estimation of survival, recruitment, and other vital parameters.

Capture–recapture methods are classically applied to situations in which physical capture and marking of individuals is possible (e.g., live traps for small mammals, or mist nets for birds). However, recent advances in technology have spawned new methods of obtaining encounter data on wildlife populations without having to physically capture individuals. Two passive or noninvasive sampling methods that are growing in popularity include DNA sampling methods (Woods et al. 1999, Mowat and Strobeck 2000, Boulanger and McLellan 2001, Mulders et al. 2007) and camera trapping (Karanth 1995, Karanth and Nichols 1998, Trolle and Kéry 2003, Jackson et al. 2006). These methods make the application of capture–recapture models practical for many species for which they are otherwise impractical due to the difficulty of capturing individuals.

Spatial arrays of detection devices produce individual encounter histories for which capture–recapture methods may be applied. However, they also yield auxiliary spatial information in the form of a location of capture for each encounter. Historically, this information has either been discarded or used to compute ad hoc adjustments to nominal trap area based on observed movements so that an estimate of density could be obtained. To date, recent work on formalizing the use of spatial information to obtain density estimates has focused on closed populations (Efford 2004, Borchers

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ACTIVITY PATTERN SEGREGATION OF CARNIVORES IN THE HIGH ANDES

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Fundación Biodiversitas, CASEB, Pontificia Universidad Católica de Chile, Santiago, Chile (AI, RV)

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Intraguild competition may be reduced if ecologically similar species segregate temporally. Using data from 1,596 camera-trap photos, we present the 1st quantitative analyses of the activity patterns of Andean cats (*Leopardus jacobita*), Pampas cats (*Leopardus colocolo*), culpeos (*Lycalopex culpaeus*), and pumas (*Puma concolor*) in high-altitude deserts of the Andes. We compared daily activity patterns for these carnivores with those of mountain vicachas (*Lagidium viscacia*), the main prey of Andean cats. Activity patterns of all species were positively skewed toward night. Pampas cats displayed the greatest proportion of nocturnal activity, whereas Andean cats were the most diurnal. Activity of Andean cats differed significantly only from that of Pampas cats; Pampas cats also differed from pumas. Activity of Andean cats was generally similar to that of mountain vicachas. The dissimilar activity patterns of Andean and Pampas cats support the hypothesis of temporal niche segregation of these felids.

Key words: camera trapping, intraguild competition, *Lagidium viscacia*, *Lycalopex culpaeus*, *Leopardus colocolo*, *Leopardus jacobita*, *Puma concolor*, South America

Activity patterns of animals are determined by numerous factors. Abiotic environmental factors such as light and temperature may influence optimum daily and seasonal activity patterns (e.g., Nielsen 1983; Patterson et al. 1999). Body mass, human disturbance, social behavior, predator avoidance, prey acquisition, and competition also may affect activity in different forms (e.g., Bunnell and Harestad 1990; O'Donoghue et al. 1998; Rogowitz 1997). As a result, knowing when animals are active may be important for understanding their ecological niche and, hence, developing conservation plans for imperiled species (Hwang and Garshelis 2007).

The Andean cat (*Leopardus jacobita*), the Pampas cat (*Leopardus colocolo*), and the culpeo (*Lycalopex culpaeus*) are medium-sized carnivores found in arid, high-altitude regions in the Andes of Peru, Bolivia, Argentina, and Chile (Villalba

et al. 2004). Increasing evidence suggests that the ranges of these species overlap greatly in the High Andes and that these animals co-occur at the local scale (Lucherini and Luengos Vidal 2003; Lucherini et al. 2008a; Perovic et al. 2003). Intraguild competition has been found to have significant negative effects on carnivore populations (Linnell and Strand 2000; Palomares and Caro 1999), leading to speculation that competition within this South American guild of carnivores may be impacting the most endangered of these species, the Andean cat (Lucherini and Luengos Vidal 2003; Napolitano et al. 2008; Walker et al. 2007a). Interspecific competition can take 2 forms: exploitation and interference. In many cases, in the presence of larger species, small carnivores are affected by both types of competition and their density can be strongly reduced when compared to that expected solely on the basis of prey abundance (Linnell and Strand 2000). Because relative body size is the primary determinant of interspecific killing (Donadio and Buskirk 2006; Fedriani et al. 1999), smaller carnivores in the High Andes can be expected to segregate ecologically with the puma (*Puma concolor*), the largest carnivore occurring in the region, because of predation risk.

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Estimating detection and density of the Andean cat in the high Andes

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The Andean cat (*Leopardus jacobita*) is one of the most endangered, yet least known, felids. Although the Andean cat is considered at risk of extinction, rigorous quantitative population studies are lacking. Because physical observations of the Andean cat are difficult to make in the wild, we used a camera-trapping array to photo-capture individuals. The survey was conducted in northwestern Argentina at an elevation of approximately 4,200 m during October–December 2006 and April–June 2007. In each year we deployed 22 pairs of camera traps, which were strategically placed. To estimate detection probability and density we applied models for spatial capture–recapture using a Bayesian framework. Estimated densities were 0.07 and 0.12 individual/km² for 2006 and 2007, respectively. Mean baseline detection probability was estimated at 0.07. By comparison, densities of the Pampas cat (*Leopardus colocolo*), another poorly known felid that shares its habitat with the Andean cat, were estimated at 0.74–0.79 individual/km² in the same study area for 2006 and 2007, and its detection probability was estimated at 0.02. Despite having greater detectability, the Andean cat is rarer in the study region than the Pampas cat. Properly accounting for the detection probability is important in making reliable estimates of density, a key parameter in conservation and management decisions for any species.

Key words: Argentina, camera trapping, felids, spatial capture–recapture

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Management and conservation of species relies heavily on understanding the variation in population abundance or density for a target species. Thus, accurate estimation of population abundance is essential in making good decisions for conservation (Sadler et al. 2004; Thompson 2004). However, many carnivore species, which are frequently of special concern for conservation and management, tend to be difficult to study because of their elusive behavior and crepuscular or nocturnal activity patterns (Gese 2001; Smallwood and Schonewald 1998; Wilson and Delahay 2001). Solitary felids (e.g., tigers [*Panthera tigris*], snow leopards [*Uncia uncia*], and Andean cats [*Leopardus jacobita*]) tend to be even more difficult to monitor because of their large home ranges, low densities, and cryptic nature.

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Despite an increasing number of studies on small cats in the high Andes (Cossios et al. 2009; Napolitano et al. 2008), basic knowledge on the biology and ecology of these cats is still scarce (Marino et al. 2010; Napolitano et al. 2008). The Andean cat, classified as Endangered by the International Union for the Conservation of Nature and Natural Resources (Acosta et al. 2008), is one of the most endangered and least known felids (Nowell and Jackson 1996) likely because of the

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extreme difficulty in physically observing this cat and the inaccessibility of its habitat. Given the importance of understanding population abundance in establishing the conservation status of a species (Primack et al. 2001), this lack of basic biological information on the Andean cat renders the design of conservation actions near impossible.

The Andean cat has a limited range and is restricted to mostly high, arid regions of the Andes (Yensen and Seymour 2000). A number of threats to the Andean cat have been identified, including habitat degradation and fragmentation caused mainly by mining and ranching, prey reduction, traditional hunting (Acosta et al. 2008; Villalba et al. 2004), and potentially interspecific competition with other felids in the region (Acosta et al. 2008; Lucherini and Luengos Vidal 2003). In particular, the Andean cat shares its habitat with the more widely distributed, but poorly understood sympatric Pampas cat (*Leopardus colocolo*), which is classified as Near Threatened by the International Union for the Conservation of

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APPENDIX V – Draft of the camera trapping handbook for local wildlife monitors.

TRAMPEO FOTOGRÁFICO

MANUAL PARA MONITORES DE FAUNA



APPENDIX VI – Final document of the stakeholder workshop on sustainable tourism.



Participative workshop: towards the development of sustainable tourism in the Highlands of Jujuy

**Abra Pampa
11 - 12 Abril, 2011**

FINAL REPORT

Organizer and moderator: The Soul of the Andes, Andean Cat Alliance and GECM (Universidad Nacional del Sur)



Objectives:

- Build bonds among sustainable tourism stakeholders, creating a network of individuals and institutions interested in sharing experiences.
- Exchange information, to favor cooperation among the institutions involved in the development of sustainable tourism in the Highlands of Jujuy province (Argentina), with emphasis in the Greater Vilama region and the communities of Liviara Cusi Cusi and Lagunillas del Farallón.
- Contribute to the establishment of a plan to develop a sustainable and conservation-friendly tourism in the Highlands of Jujuy.

PARTICIPANTS

The workshop was attended by 21 delegates, representing 3 NGOs, 1 native women association, 2 provincial government and 3 national government institutions, and 3 local communities.

Mauro Lucherini, Juan Reppucci, Cintia Tellaeché – “The Soul of the Andes”, Andean Cat Alliance; Universidad Nacional del Sur; CONICET

Hector Tentor, Pablo M. Rioja, Sebastian Haedo, Pablo Bahna – Fundación PRO Jujuy NOA (the organization currently in charge of advising the community tourism projects in Cusi Cusi, Lagunillas del Farallón and Liviara)

Rosario Quispe – Asociación WARMI SAYAJUNQO

Francisco M. Cornell – Secretaria de Turismo y Cultura de Jujuy

Ivana Guerra – Dirección Provincial de Políticas Ambientales y Recursos Naturales de Jujuy.

Juan Antonio Temporetti – Delegación NOA Administración Parques Nacionales (National Park Agency, APN).



Bibliography cited

- Acosta G., Cossíos D., Lucherini M. and Villalba L.. 2008. *Leopardus jacobita*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. <http://www.iucnredlist.org/apps/redlist/details/15452/0>
- Cossíos D., Lucherini M., Ruiz-García M. & Angers B. Between high-altitude islands and high-altitude corridors: the population structure of the Andean cat. Submitted to *Animal Conservation*.
- Bennett M., Walker S., Cossios D., Iriarte A., Lucherini M., Pliscoff P., Sillero-Zubiri C., Villalba L. & Marino J. Conservation implications of bioclimatic constraints to Andean cat distribution. Submitted to *Diversity and Distributions*.
- Gardner B., Reppucci J., Lucherini M. & Royle J.A. 2010. Spatially-explicit inference for open populations: estimating demographic parameters from camera-trap studies. *Ecology* 91: 3376-3383.
- Lucherini M., Luengos Vidal E. & Merino M.J. 2008. How rare is the rare Andean cat? *Mammalia* 72: 95-101.
- Lucherini M. and Merino M.J. 2008. Human-carnivore conflicts in the high-altitude Andes of Argentina. *Mountain Research and Development* 28: 81-85.
- Lucherini M., Reppucci J.I., Walker R.S., Villalba M.L., Wurstten A., Gallardo G., Iriarte A., Villalobos R. & Perovic P. 2009. Activity pattern segregation of carnivores in the High Andes. *Journal of Mammalogy* 90:1404-1409.
- Marino J., Lucherini M., Villalba L., Bennet M., Cossios D., Iriarte A., Perovic P. & Sillero-Zubiri C. 2010. Highland cats: Ecology and conservation of the rare and elusive Andean cat. Pp. 581-596 in D. Macdonald and A. Loveridge, Editors. *The biology and conservation of wild felids*. Oxford University Press, Oxford, UK.
- Napolitano C., Bennett M., Johnson W.E., O'Brien S.J., Marquet P.A., Barria I., Poulin E. & Iriarte A. 2008. Ecological and biogeographical inferences on two sympatric and enigmatic Andean cat species using genetic identification of faecal samples. *Molecular Ecology* 17: 678-690.
- Perovic P., Walker S. & Novaro A. 2003. New records of the Endangered Andean mountain cat in northern Argentina. *Oryx* 37: 374-377.
- Reppucci J., Gardner B. & Lucherini M. *in press*. Estimating detection and density of the Andean cat in the high Andes. *Journal of Mammalogy*.
- Tellaeche C. 2010. Análisis de hábitos alimenticios de dos especies de felinos simpátricos (*Leopardus jacobita* y *Leopardus colocolo*). Graduation thesis. Universidad Nacional del Sur, Argentina.
- Walker R.S., Novaro A., Perovic P., Palacios R., Donadio E., Lucherini M., Pia M. & López M.S. 2007. Diets of three species of Andean carnivores in high-altitude deserts of Argentina. *Journal of Mammalogy* 88: 519-525.

Address list and web links

The Soul of the Andes webpage: www.elalmadelosandes.org.ar

NGO Huellas webpage (containing information on our project): www.huellas.org.ar

Andean Cat Alliance (AGA) webpage: www.gatoandino.org

Wildlife Conservation Network (WCN, containing additional information on AGA): www.wildnet.org

Darwin Initiative project on the high Andes project webpage: www.wildcru.org/research/research-detail/?theme=&project_id=43

High Andes Flamingo Conservation Group (GCFA) webpage: www.flamencosandinos.org

Distribution list

Copies of this report can be obtained at no cost writing to:
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