# WILD FELIDS DENSITIES IN MOUNTAIN ECOSYSTEMS OF COSTA RICA:

## *differential abundances and methodological issues.*

**Jose F. Gonzalez-Maya** (1,2) **Diego Zarrate** (2), **Catalina Amaya** (2) **& Jan Schipper** (1,3)

**1** Proyecto de Conservación de Aguas y Tierras, Las Alturas, Coto Brus, Costa Rica jfgonzalezmaya@gmail.com
**2** ProCAT Colombia, Calle 127 b # 45-76, Bogotá, Colombia. procatcolombia@gmail.com
**3** IUCN - Global Mammal Assessment. Virginia, USA. J.schipper@conservation.org

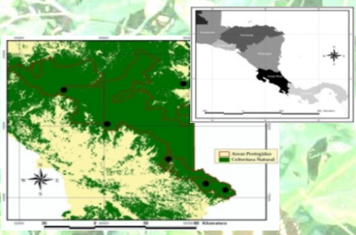
### INTRODUCTION

Population density and abundance is one of the main aspects of basic ecology, and the key to conservation planning for critical species such as wild felids. The estimation methods and standardization between sympatric species is then one of the most critical and influential parameters to make inferences about ecology, and posterior conservation biology.

Here we present the first comprehensive study about jaguar (*Panthera onca*), puma (*Puma concolor*) and ocelot (*Leopardus pardalis*) densities in Mountain ecosystems for the area and the region, and the methodological influence on ecology and conservation.

### MATERIALS AND METHODS

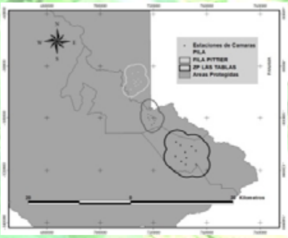
Talamanca region is located between Costa Rica and Panama. Its considered the most important forest remnant forest patch in CR and one of the key for the region, and for the Mesoamerican Corridor.



Camera-trapping samplings on an elevational gradient were established during 2006 and 2007. Samplings were placed following Gonzalez-Maya et al. (2008), and capture-recapture models were used to estimate populations. Mean maximum distance moved (MMDM) was used to build buffers for density estimation, using data from the same sampling and both years together. Using a potential habitat analysis for the area (Schipper et al. 2005) total potential populations were estimated.

### RESULTS

A total of 941 pictures were obtained from both years, covering 19,6, 3,74 and 75,65 km2 for 1500, 2000 and 1200-2000 masl respectively.



A mean density of 3,49 , 14,60 and 10,76 ind/100km2 was estimated for jaguars, pumas and ocelots respectively (Table1,2,3,4,5,6).

**Table 1.** Jaguar density calculations at 1500m

| Model | Buffer | Distance | Area | Abundance | Density |
|---|---|---|---|---|---|
| Mo | 1/2 mmdm | 2750 | 92,6 | 4 | 4,32 |
| | mmdm | 5700 | 185,2 | 4 | 2,16 |
| Mh | 1/2 mmdm | 2750 | 92,6 | 5 | 5,40 |
| | mmdm | 5700 | 185,2 | 5 | 2,70 |
| **MEAN** | | 4225,00 | 138,9 | | 3,64 |
| **SD** | | 2085,97 | 65,4 | | 1,54 |

**Table 2.** Jaguar density calculations at 1200- 2000m

| Model | Buffer | Distance | Area | Abundance | Density |
|---|---|---|---|---|---|
| Mo | 1/2 mmdm | 2310 | 332,85 | 8 | **2,40** |
| | 1/2 06-07 mmdm | 2065 | 297,71 | 8 | 2,69 |
| Mh | 1/2 mmdm | 2310 | 332,85 | 13 | **3,91** |
| | 1/2 06-07 mmdm | 2065 | 297,71 | 13 | 4,37 |
| **MEAN** | | 2187,50 | 315,28 | | 3,34 |
| **SD** | | 173,24 | 24,85 | | 0,94 |

**For all tables:** Model: Capture-recapture, Buffer: ½ mmdm: same sampling-1/2 06-07: both years data, Distance: m, Area:km2, Abundance: Ind., Density: ind/100km2

**Table 3.** Puma density calculations at 1500m

| Model | Buffer | Distance | Area | Abundance | Density |
|---|---|---|---|---|---|
| Mo | 1/2 mmdm | 1300 | 39,7 | 7 | **17,63** |
| | 1/2 06-07 mmdm | 1677,3 | 52,46 | 7 | 13,34 |
| Mh | 1/2 mmdm | 1300 | 39,7 | 8 | **20,15** |
| | 1/2 06-07 mmdm | 1677,3 | 52,46 | 8 | 15,25 |
| **MEAN** | | 2232,98 | 74,20 | | 12,11 |
| **SD** | | 925,92 | 36,77 | | 5,31 |

**Table 4.** Puma density calculations at 2000m

| Model | Buffer | Distance | Area | Abundance | Density |
|---|---|---|---|---|---|
| Mh | 1/2 mmdm | 760 | 11,36 | 5 | 44,01 |
| | 1/2 06-07 mmdm | 1677,3 | 27,6 | 5 | 18,12 |
| Mb | 1/2 mmdm | 760 | 11,36 | 3 | 26,41 |
| | 1/2 06-07 mmdm | 1677,3 | 27,6 | 3 | 10,87 |
| **MEAN** | | 1827,98 | 33,32 | | 17,94 |
| **SD** | | 1093,73 | 25,32 | | 12,77 |

**Table 5.** Puma density calculations at 1200-2000m

| Model | Buffer | Distance | Area | Abundance | Density |
|---|---|---|---|---|---|
| Mo | 1/2 mmdm | 1300 | 147,47 | 33 | **22,38** |
| | 1/2 06-07 mmdm | 1677,3 | 136,7 | 33 | **24,14** |
| Mh | 1/2 mmdm | 1300 | 147,47 | 36 | 24,41 |
| | 1/2 06-07 mmdm | 1677,3 | 136,7 | 36 | 26,34 |
| **MEAN** | | 2232,98 | 199,06 | | 18,91 |
| **SD** | | 925,92 | 66,58 | | 5,91 |

**Table 6.** Ocelot density calculations at 1200-2000m

| Model | Buffer | Distance | Area | Abundance | Density | SE |
|---|---|---|---|---|---|---|
| Mo | mmdm | 3910,0 | 186,4 | 9 | 4,83 | |
| | 1/2 mmdm | 1955,0 | 97,6 | 9 | 9,22 | 2,7 |
| Mh | mmdm | 3910,0 | 186,4 | 12 | 6,44 | |
| | 1/2 mmdm | 1955,0 | 97,6 | 12 | 12,30 | 4,33 |

Based on the potential habitat models proposed by Schipper et al. (2006) for the area, we extra-polated the absolute density in four forms (based on differential MMDM) of estimations getting the results for the entire region potentially (Table7).

**Table 7.** Density extra-polation to the entire area for puma and jaguar

| Species | Sampling | Density (ind/100km2) | Potential habitat (km2) | Expected Population |
|---|---|---|---|---|
| Jaguar | Smallest | 5.4 | 8260 | 446.0 |
| | Biggest | 3.91 | 8260 | 323.0 |
| | Most Conservative | 2.4 | 8260 | 198.2 |
| | Least Conservative | 5.4 | 8260 | 446.0 |
| Puma | Smallest | 17.63 | 8260 | 1456.2 |
| | Biggest | 22.38 | 8260 | 1848.6 |
| | Most Conservative | 17.63 | 8260 | 1456.2 |
| | Least Conservative | 44.01 | 8260 | 3635.2 |

### DISCUSSION

Estimated densities were relative good for all the species compared with previous studies in other areas. Differences among densities of sympatric felid species were representative, indicating a healthy ecosystem, capable of retain populations of all the species, including potential competitors such as jaguar and puma. The variation among the estimations is related with elevation: for pumas, high elevations seem to be better habitats; the differences among means are not very high, however SD are relatively high for each estimation. The overall results indicates that densities are not homogeneous across the area, and elevation is important for each species.

The most important aspect to consider according to our results is that depending on the methodological and analysis decisions, the final results are quite different, where the construction of buffers to estimate effective sampling areas can change since it does not necessarily represents an accurate estimate of actual home ranges. These variations have strong implications for conservation planning, since the numbers can change significantly affecting national, and local policies for protection of these species, and endangerment assessments will not reflect the real situation for the species, with also great implications for other species, because felids are commonly used as surrogates for biodiversity conservation.

### ACKNOWLEDGEMENTS

We would like to thank WCS, Las Alturas and ProCAT for the funding of the project. Fernando Castañeda, Addison Fisher and all the staffl of Las Alturas and ProCAT for their support and assistance. Leo Maffei and John Polisar for the support.

### REFERENCES

González-Maya, J., Finegan, B., Schipper, J. & Casanoves, F. 2007. Densidad absoluta y conservación de jaguares en Talamanca, Costa Rica. Serie Técnica. The Nature Conservancy. San José, Costa Rica. 49 p.

•Schipper, J.; Scott, M.; Carrillo, E.; Bosque–Perez, N.; Harvey, C.; Waitts, L. 2005. Habitat-based conservation planning in Talamanca (Costa Rica): a survey and assessment of neotropical felids and their prey. Poster. 8th World Wilderness Congress. Alaska, US.