

**Habitat and Distribution Modelling for the Horned Lark *Eremophila alpestris*  
in the Altiplano Cundiboyacense (Colombia) with Remote Sensing  
and Geographic Information Systems**

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**SUMMARY STATEMENT**

**Aims**

This undergraduate thesis project aims to locate sites with populations of Horned Lark (*Eremophila alpestris peregrina*) in the Altiplano Cundiboyacense (Colombia), by means of a habitat model devised with geographic information systems (GIS), employing data from field surveys, satellite imagery, maps and aerial photographs. The project expects to map the current distribution of the bird and describe its habitats in several scales. Finally, it aims to assess the risk of extinction for the bird according to the IUCN criteria, incorporating environmental conditions, population sizes, habitat area, and land use and human practices. Guidelines and suggestions for appropriate conservation measures for the species in the area are expected to be produced.

**Background**

The Altiplano Cundiboyacense is a series of high altitude basins located in the Eastern Andes of Colombia, comprising the upper watersheds of the rivers Bogotá, Suárez and Chicamocha in the departments (provinces) of Cundinamarca and Boyacá, in an area of approximately 18,000 km<sup>2</sup>. Three major plateaus and several other smaller ones evolved from quaternary lake deposits, which originally formed in depressions when the uplifting of the Eastern Andes occurred in the late Tertiary. Today, these high plateaus, at altitudes of 2500-2600 meters over sea level and surrounded by mountains of up to 4000 meters, are the most densely populated areas in Colombia. The capital Bogotá, with over 7 million inhabitants, lies to the south of the Altiplano, while several other cities like Tunja, Sogamoso, Chiquinquirá, Zipaquirá, Facatativá and dozens of smaller towns are scattered throughout the whole area.

The Altiplano is a climatic island of relatively dry weather comparing to the outer slopes of the Andes that surround it, mainly because the latter ones receive a direct influence of the mountain currents and moisture coming from lower altitudes, while the Altiplano receives these but filtered with the rain shade of the surrounding mountains. Nevertheless, considerable climatic variation exists around the area, with rainfall values ranging from 600 to 1500 mm annually. Due to its equatorial latitude (4-5° North), mean temperature values have very little variation throughout the year with the mean being 14°C at 2600 m. However, temperature values drop steadily with altitude and daily variations are considerable: 8-9°C on average.

The Altiplano has been densely inhabited by humans since pre-Columbian times, mainly because of its benign weather and rich flat soils suitable for agriculture, and later, for cattle raising and urban expansion. As a result, the area has been widely transformed ecologically and there are several threatened ecosystems, such as the Andean dry and subhumid forest and

high altitude wetlands. There are several endangered species of plants and animals in the area, some of them endemic to the Altiplano, especially those of wetlands and dry enclaves.

The Horned Lark *Eremophila alpestris* is a widely distributed bird in Eurasia and North America, whose subspecies *peregrina* is an isolated population in the Altiplano Cundiboyacense, being the southernmost population of the species and the only representative of the *Alaudidae* (Lark) family in the Neotropics. The Horned Lark in Colombia is representative of regional semiarid habitats and is currently classified as an endangered species, as it has suffered a marked population decline, presumably due to urbanisation and the expansion of the Kenyan kikuyo grass (*Pennisetum clandestinum*), introduced to the Altiplano in 1928. The Horned Lark's local habitat, mostly flat short-grassed and barren fields and lake shores, is very scarce today in the Altiplano. In North America, although the species is abundant, evidences signal a population decline due to the disappearance and alteration of grassland ecosystems. In 2001, only 6 places in the Altiplano were known to have living populations of the Horned Lark, with total numbers adding less than 80 individuals. In order to carry out conservation measures for the subspecies, it became of prime importance to know its current distribution and assess its population status. The Instituto Alexander von Humboldt, a biodiversity research institute, supported this project financially to carry out these tasks.

### **Project phases :**

#### *1. Description of sites with registers of Horned Lark and assessment of habitat variables:*

The 6 sites with recent registers of living Horned Lark populations were visited and described by measuring several habitat variables (vegetation height, species and cover; slope, altitude, soil characteristics, geomorphology, aridity index, bird species sharing habitat). Horned Lark individuals were counted, and possible threats were also measured and described: grazing, presence of dogs, noise, people traffic and activities, accessibility, land use. The information gathered was compared for the different sites to select indicator variables for Horned Lark habitat areas, which would be useful for building the habitat model in phase 2.

#### *2. Habitat modelling for the Horned Lark using remote sensing and GIS:*

Four indicator variables were selected to generate a spatial model that would predict potential habitat areas for the Horned Lark. The variables selected due to their high predictability of Horned Lark habitat were: vegetation cover (mixed grassland and bare soil), aridity index (subhumid-semiarid climate), soil type (those with limitations to root growth), and slope (highest potential in flat areas).

With the use of 3 Landsat TM and ETM images from 1997 and 2000, a raster cover showing potential habitat areas according to land cover was produced by means of classifying the images with unsupervised and supervised classification procedures. Soil maps were digitised; an aridity index (Real Evapotranspiration /Potential Evapotranspiration: RET/PET) surface model was created using values from weather stations scattered throughout; and a slope map was generated from a Digital Elevation Model. (See Images). These four raster images, each covering 215 x 215 km, were standardised in terms of habitat potentiality for the Horned Lark, according to the data gathered from the field surveys and literature regarding the species. Finally, the layers were combined in a multi-criterion evaluation module, generating a raster image of potentiality in a scale of 0 to 255, which was further reclassified to values from 0 to 8, 8 being the highest potential, and 0 being none (See map of Habitat Potential).

The software packages used were Autocad 2000, ArcView 3.2, ArcInfo 8.0 and Idrisi 32. Satellite images were obtained from the Global Land Cover Facility, University of Maryland.

*3. Site visits and search for the Horned Lark (Currently underway):*

The areas with highest potential (6 to 8) according to the habitat model, were further surveyed with aerial photographs and are being visited in selected samples to verify the presence of the Horned Lark, with the aid of binoculars and playback recording. If the species is found, individuals are counted and the habitat is further described as in Phase 1.

*4. Evaluation of risk of extinction and proposal of conservation measures (Pending):*

Once the field phase is completed, the information regarding the possible threats for the survival of the Horned Lark in different areas will be assessed to arrive to a general measure using the criteria given by the IUCN, thus filling the gap in the national list of endangered species, where the Horned Lark is classified as Data Deficient. In addition, a series of conservation measures will be proposed to be carried out by local communities and governments, NGOs, land owners, conservation groups, etc.

## **Results**

The habitat model devised has effectively predicted the distribution of the Horned Lark in the Altiplano. Up to June 2002, more than 25 previously unknown Horned Lark populations have been found in high potential areas according to the model. One of those populations is the largest known for the area (65 individuals). At a greater scale, it has been found that the habitat for the Horned Lark maintains uniformity in the vegetation structure of a mixture of barren ground and low herbaceous vegetation, while species composition is of much less importance.

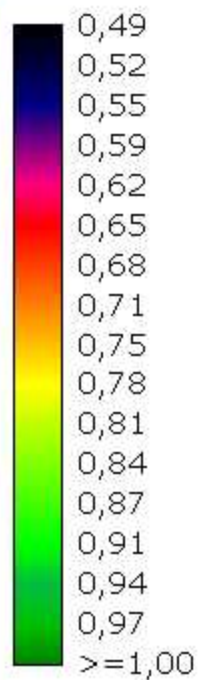
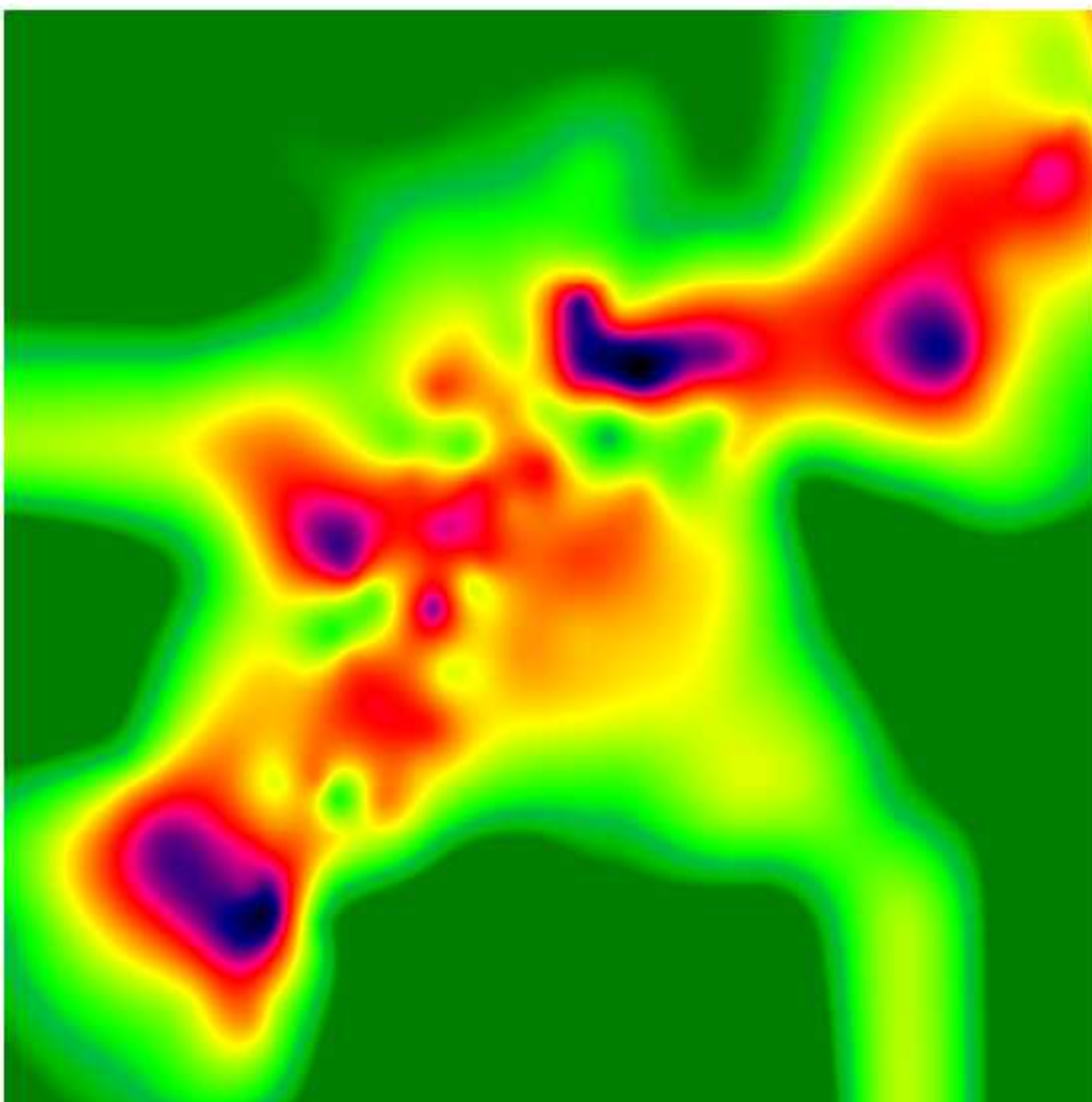
Regarding the threats affecting the species, local peasants have seen the decline of the species in recent years; they blame the excessive use of pesticides in cereal and potato crops because it's common for them to find dead birds after spraying. However, they say they have no choice but to use pesticides to prevent crops from being destroyed by plagues and diseases. Additionally, dogs and crop machinery seem to be nest predators and destroyers, while grazing seems to be favourable for the species.

## **LIST OF PROPOSED ACTIONS**

Hopefully, the results of this project will contribute to the conservation of the Horned Lark in Colombia, so that this bird can assure its place in more sustainable rural landscapes of the Altiplano Cundiboyacense. I propose several measures to achieve this goal:

- Create reserves to protect specific areas with large populations of the Horned Lark, closing them off to dogs, machinery, excessive people transit; but opening them for educational programs and birdwatching.
- Support programs for low-chemical agriculture in designated areas.
- Create a monitoring program to evaluate the change in different Horned Lark populations to evaluate any positive or negative trends.
- Carry out education campaigns with local people to raise awareness for the species and the need for protection of its habitat, establishing the connection between the bird and its surroundings, and the ethical duty to preserve it.

# Aridity Index (RET/PET)



50 Kilometers

50000.00

North



Figuera Lagoon

Tota lake

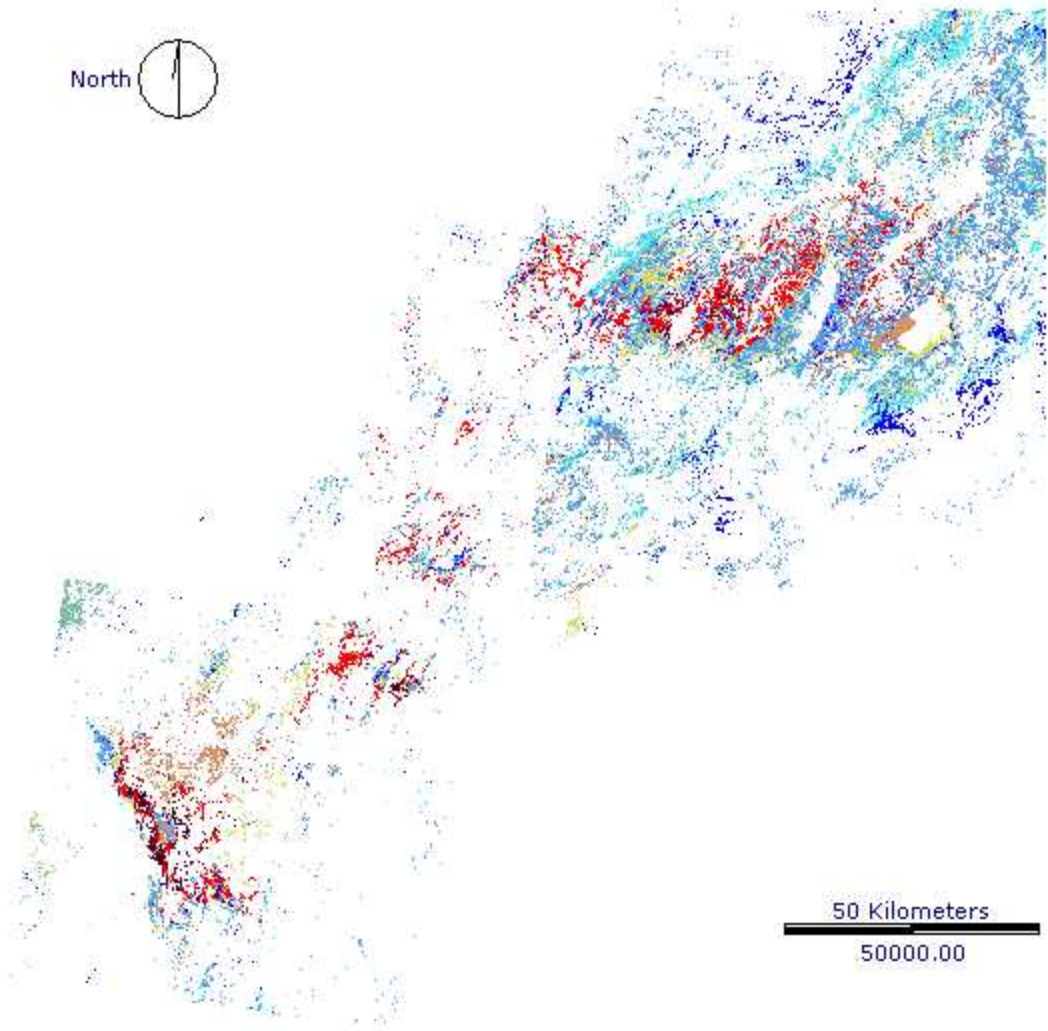
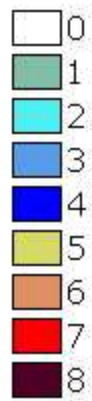
Bogota

50 kilometers

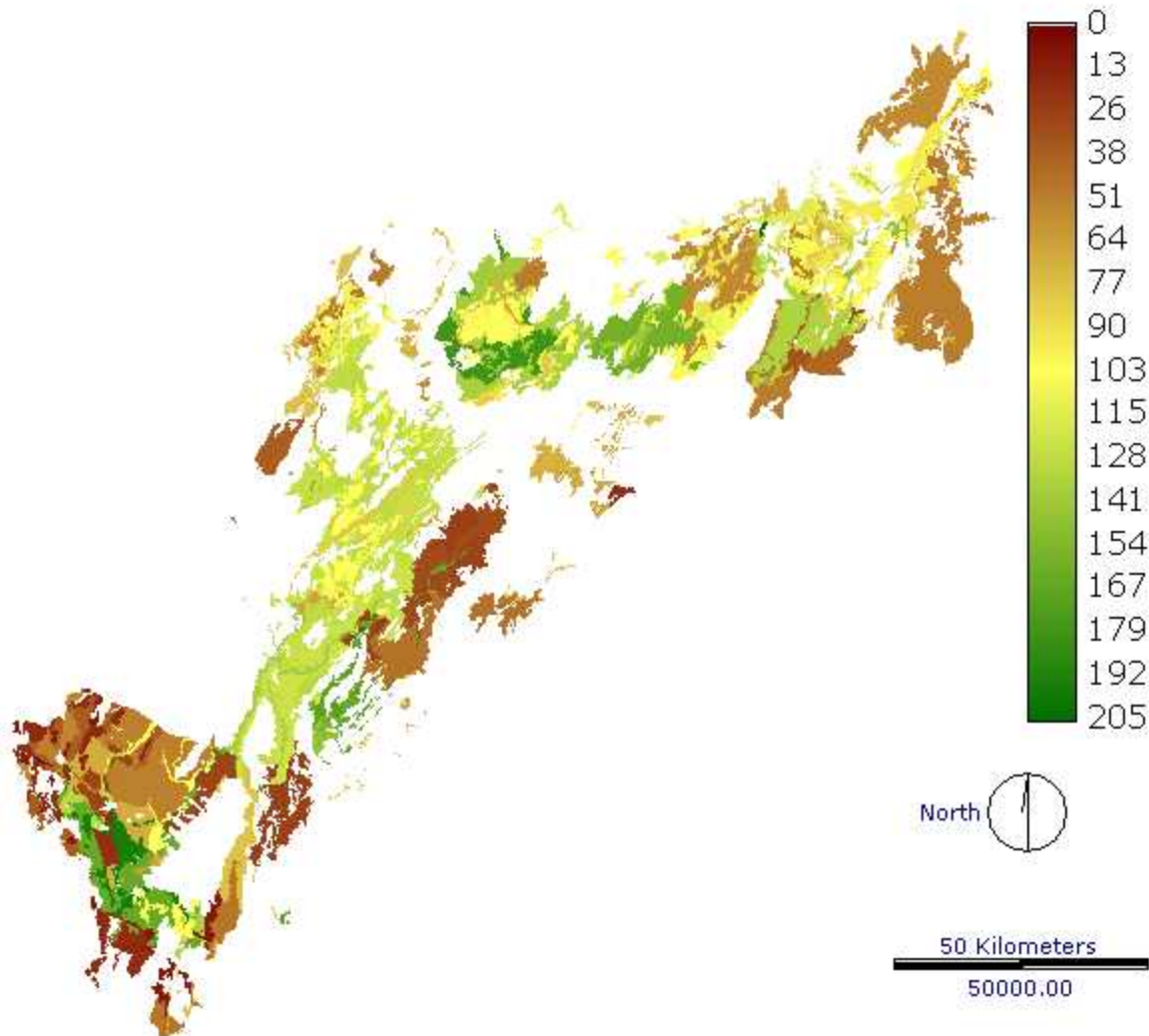
50000.00



# Habitat Potentiality for Horned Lark



# Soil Potential for Horned Lark



# Terrain slope (°)

