Scarab Beetles of Southern Ecuador: Distributional Patterns, Threats, and Conservation Strategies

Aura Paucar-Cabrera*, Daniela Román-Cáceres, Helena España, Aini Chamba-Barco, Xavier Rojas-Ruilova and Vinicio Escudero

Museo de Zoología LOUNAZ, Universidad Nacional de Loja, Ecuador.. *Corresponding author: aurapaucar@gmail.com

ABSTRACT

Scarab and dung beetle (Dynastinae, Rutelinae and Scarabaeinae) diversity and distributional patterns were studied in Loja and Zamora Chinchipe provinces. Effects on scarabs from deforestation, human expansion, and agricultural and livestock activities in southern Ecuador were evaluated. Results showed that the biggest threats on the 233 scarab species registered in the area are: deforestation, forest degradation (fires, soil erosion), improper livestock management (pesticides and veterinary products), light pollution, and lack of awareness about ecosystem services provided by insects. Proposed solutions are aiming to address these problems in three aspects: landscape management, research, and environmental education.

METHODOLOGY

Study Area: Southern Ecuador: Loja and Zamora Chinchipe provinces (Fig. 1).. Ecosystems: dry forests, foothill forests, cloud forests, Andean shrub, paramo, tropical rain forest.

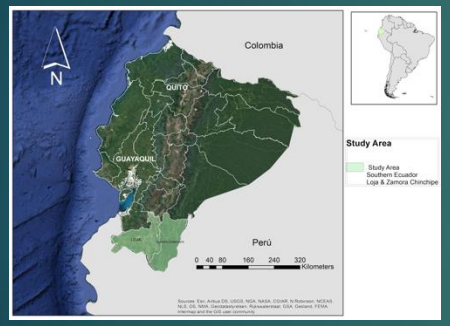


Figure 1. Loja and Zamora Chinchipe provinces in southern Ecuador.

Distribution data:
- 7527 specimens at 7 national and 12 international museums
- Collected in 13 locations
- Catalogs
- Analysis of human land use and soil change

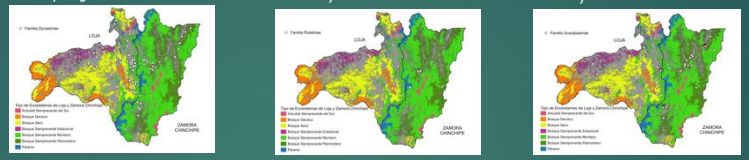
Results from the LOUNAZ Museum studies on ecology and conservation:
light pollution effects; interviews about livestock management; fire effects and landscape degradation; analysis of gut microbiota of dung beetles and soil along disturbance gradients; complementary bibliographic data.

RESULTS

Diversity and distribution

For southern Ecuador, 233 species of Dynastinae, Rutelinae and Scarabaeinae were registered. With a representation of the 30% of species in Ecuador (Paucar-Cabrera, 2005; Ratcliffe et al., 2020).

2a) Dynastinae 2b) Rutelinae 2c)Scarabaeinae



Figures 2 a-c. Dynastinae and Scarabaeinae have a higher number of locations where they were registered. Dynastinae with higher representation in Andean valleys above 1800 m; Scarabaeinae mainly in lowlands. Rutelinae have few records, however, it was interesting that in several records they were found in dry forests. Among the genera with wider distribution were: *Ancognatha*, *Cyclocephala*, *Golofa*, *Anomala*, *Platycoelia*, *Dichotomius*, *Deltochilum*, and *Onthophagus*. Among the genera registered in more remote areas were: *Gnathogolopha*, *Chlorota*, *Macraspis*, *Ontherus*, and *Sylvicanthon*.

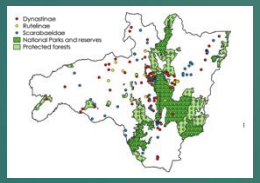


Figure 3 illustrates that most collecting records over the decades have occurred outside national parks. This trend highlights both a potential information gap and the vulnerability of scarab beetles, as they are predominantly found in agricultural zones, pasturelands, and urban areas in southern Ecuador

Conservation data

-Scarab beetles in southern Ecuador are threatened by multiple anthropogenic pressures. Artificial light pollution from LED lights and vehicles significantly affects nocturnal subfamilies, particularly Rutelinae and Dynastinae. Agricultural expansion and livestock management have led to habitat loss through deforestation and landscape homogenization, affecting all scarab groups but especially dung beetles (Scarabaeinae). These impacts are intensified by the indiscriminate use of agrochemicals, anti-parasitics, and antibiotics, along with soil degradation through compaction. Fire disturbance poses another significant threat, causing population changes in Scarabaeinae through altered resource availability and landscape modification, while affecting Rutelinae and Dynastinae through changes in soil conditions and organic matter availability. The slow recovery of burned areas, combined with altered microclimates and reduced organic matter content, further impacts beetle communities. Climate change exacerbates these pressures by increasing drought frequency and fire risk.

-Additional threats include mining activities, habitat fragmentation creating hostile urban and rural surroundings, competition from introduced species, and soil sealing (Wagner et al., 2020). These threats acting together require integrated conservation strategies to protect scarab beetle diversity in the region.

PROPOSED STRATEGIES

Conservation strategies for scarab beetles in southern Ecuador require a comprehensive plan that includes **landscape management, research, and education.**

Landscape management: the primary focus should be the transformation of anthropogenic areas into friendly biological corridors considering the connectivity needs of small organisms:

- In rural areas: soil restoration (integration of organic matter, use of soil microbiota), forest patches that connect to natural areas, implementing sustainable livestock practices (rotational grazing, non-persistent veterinary products in designated areas, manual weeding). These practices could be implemented through pilot farms.
- In urban areas: rewilding initiatives to provide refuge, feeding resources, and nesting sites; reduction of soil sealing; and use of wildlife-friendly lighting systems.

Research efforts should focus on ecosystem services that explore the potential of scarab beetles and their microbiota for both soil restoration and sustainable livestock management.

Finally, an essential component is **environmental education** highlighting the ecosystem services provided by scarab beetles and their consequential economic benefits. Success of these initiatives depends on engaging decision-makers and ensuring their active participation in conservation efforts.

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