

Big Cat Adaptation in the Mesoamerican Biodiversity Hotspot

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Introduction

The Mesoamerican Biodiversity Hotspot, part of the Neotropical ecological region, comprising Central America (Costa Rica, Belize, El Salvador, Nicaragua, Honduras, Guatemala and the northern half of Panama) and southern Mexico, is defined as a hotspot, because it is an area “featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat” [1]. Species and habitat loss has occurred as rainforest is converted to urban and farmed areas and mixed vegetation mosaics, due to urbanization, population increase, agricultural intensification, civil wars, deforestation, land use conflicts and inept conservation policy [2-14]. The new landscapes and increased human proximity favor small animals to the detriment of large carnivores such as the jaguar and cougar. Few studies have modeled the survival probability of large carnivores in this area, rooted in the behavioral characteristics of these animals across their wider ranges [15].

Contrasts between the Jaguar and Cougar

The jaguar (*Panthera onca*, Linnaeus 1758) and cougar (*Puma concolor*, Linnaeus 1771) are decisively the largest carnivorous mammals in the Mesoamerican region, distant competitors being the much smaller ocelot (*Leopardus pardalis*, Linnaeus 1758) and coyote (*Canis latrans*, Say 1823). Crucially, the comparatively large and possibly dangerous jaguars and cougars conflict with people in valued spaces, to the extent that both species are now extinct in El Salvador, one of the more environmentally degraded countries in Central America [16,17]. Jaguars are much less studied than lions, tigers and leopards, and those in South America are more popular than the Central American populations [18,19]. The more studied and widely ranging cougar is judged as less dangerous to people and more elusive than the larger jaguar [20].

Forest, with water proximity, gentle slopes and no human settlements is the favored habitat of both jaguars and cougars [21-27]. However, compared with the more versatile cougar, the jaguar is more restricted to tropical and sub-tropical forest at lower altitudes [28-31]. Jaguars are highly mobile, sensitive to human presence, have low population densities in large ranges (up to 1000 kms²) and unpredictable behavioral patterns [32-34]. The cougar has a much wider range, and adapts more easily to shared land cover with larger carnivores and people, and reacts even more variably to human presence and modified land cover [35]. Jaguars and cougars avoid competition in shared land cover; the jaguar takes larger prey and the cougar favors smaller, more variable prey [36-39]. However, both species may kill livestock, either due to a scarcity of natural prey or individual behavior. This may lead to human action [40-42]. Consequently, allegedly problem cats have been hunted and killed [43-45]. However, assessments of the differences between jaguars and cougars, and intra-species behavior in adaptation to the degradation of

Mesoamerica is difficult, as the few behavioral studies in this and other regions have not contributed a utilitarian, comparative model of contrasting inter- and intra-species behavior.

Animal Adaptation in Theory

One possible model of big cat adaptation, that includes intra-species behavioral variation, may be derived from the flexible framework of animal geography, some strands of which model animals as subjects with active abilities (more similar to people) rather than as mechanistic, generalized objects in human life spaces. This format is better placed than classical ecology to record and explain adaptive carnivore behavior, especially as individual, “problem” cats are a critical issue [46-49]. This active ability or actancy refers to arguably human-like behavior, making free choices in response to different events [50]. Although risking criticism of anthropomorphization, this advantageously enables comparative investigation of the individualized adaptation strategies of animals (inter- and intra-species) in degraded land cover and allows investigation of occurrences of individualized behavior [51]. These subjectivities may be neglected or undetected by the more positivist sciences of zoogeography and animal ecology; emphasis on these may also provide a stronger link with relevant human geographies of wildlife [52-59]. Embedded in this approach is a stronger theoretical uncovering of unique animal behavioral subjectivity connected to strands of cultural human geography, a hypothesis of shared actancy between people and animals and the juxtaposition of these with quantitative ecology [60,61].

The Way Forward

Currently, the big cats of the Mesoamerican Biodiversity Hotspot are among the more threatened members of their species. In other parts of the Americas, the jaguar is rare and declining, but the cougar is holding its own in some areas [62]. More knowledge of jaguar and cougar behavior across their respective ranges, based on a synthesis of individualized adaptation, inter-species generalization, habitat dynamics and human behavioral variations is plainly needed for ameliorative action. However, a common thread that links the disparate issues is needed. More studies must be added to the patchwork of big cat conservation and the likelihood of success is conditional on the breadth and flexibility of the approach. In this regard, an animal geography approach as described above offers a viable but untested integrative framework. Forward to the battle!

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