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Jaguarundi four ways: a comparison of range-wide distribution and habitat association estimates from four occupancy model extensions

Understanding the range-wide distribution and habitat associations of carnivores is critical for the effective conservation of ecosystems, particularly in the face of ongoing habitat change and degradation. Yet many carnivores remain understudied, especially those that are not charismatic megafauna or umbrella species. Range-wide analyses often require combining disparate datasets from multinational research groups providing another obstacle to these analyses. Jaguarundi (Puma yagouaroundi), a felid mesocarnivore, is an understudied and elusive species that ranges broadly from southern North America through South America.

We used a camera trapping dataset amassed from multiple research partners and for the most part not originally targeted at the species to assess environmental covariates that influence jaguarundi occurrence. Our dataset was compiled from 178 unique survey projects spanning 13 countries and 19 years. The temporal and spatial scale of each survey varied substantially, so collectively, the dataset did not satisfy standard single-species, single-season occupancy model assumptions and simultaneously did not support fitting of more complex dynamic occupancy models. Many extensions to occupancy models have been developed to relax assumptions and to evaluate datasets covering broad temporal and spatial scales, however the benefits and drawbacks for each of these methodologies are not easily evaluated.

Here, we explore similarities and differences of the estimated influence of a suite of remotely-sensed environmental covariates on jaguarondi occurrence assessed through four occupancy model frameworks: (1) a standard single-season occupancy model with relaxed assumptions (estimating site use), (2) a 'stacked design' occupancy model with a random effect for site, (3) a temporal auto-logistic occupancy model with occurrence dependent on the previous time step, and (4) a continuous-time, multi-temporal scale occupancy model. While some covariates (distance to road, distance to water, distance to developed area) were consistently significant among all or several frameworks, other covariates related more specifically to forest or vegetation cover (gross primary productivity, NDVI, EVI, forest cover) varied in significance among models. For conservation practitioners using complex and aggregated datasets, evaluating several model implementations may provide a fuller assessment of range-wide species distributions and habitat associations.