MEXICO DISSERTATION/THESIS PROJECT

ME67 Primate abundance and distribution patterns in relation to forest structure and ancient Mayan agroforestry

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The Calakmul Biosphere Reserve is an UNESCO World Heritage Site of Culture and Nature due to the forest of outstanding biodiversity that surrounds multiple ancient Maya ruins sites, including the city of Calakmul that contained up to 150,000 people during the height of its power between 250BC – 900AD. The total area covered by the reserve is 1,200,000 hectares, but the vast majority of the land surrounding the reserve is also forest. The tropical semi-deciduous forest in Calakmul Biosphere Reserve (CBR) largely consists of low to medium forest with limited fruit production, with pockets of high forest containing large fruiting trees. Permanent water bodies are rare in CBR due to the geologic characteristics that cause rapid filtration of the rain (García-Gil *et al*. 2002). However, low-lying terrain allows the accumulation of water, and creation of temporary lakes, locally known as *aguadas*. These aguadas are filled by direct rainfall combined with water flowing across the forest floor during the peak of rainy season. In addition, there is a steady increase in mean annual precipitation from the north to the south of the reserve that has a notable effect on tree species composition and forest structure. Consequently, the forest is not uniform and thus abundance and distribution of primates is expected to vary considerably throughout the reserve.

The limited distribution of high forest appears to be closely related to the location of Ancient Mayan ruin sites and aguadas. Over 2,000 years ago the Mayans cultivated large fruiting trees such as Ramon (*Brosimium alicastrom*) as a food supply and other fruiting trees such as Chicozapote (*Manilkra zapota*) and Mora (*Maclura tintoria*) where cultivated for extraction of resins and dyes, but also produce abundant fruit. These cultivated trees were generally planted near water sources (aguadas) and irrigated to enable them to grow as large as possible. Remnants of these forest gardens are still found today adjacent to ruin sites and result in areas of forest with high fruit production containing trees that are notably larger than elsewhere in the forest (Ross & Rangel, 2011). These large fruiting trees are a major attraction for primates, and both howler and spider monkeys tend to me concentrated in these areas (Estrada et al., 2004).

There are two species of primate in CBR, Geoffroy's spider monkey (*Ateles geoffroyi*) and the black howler monkey (*Alouatta pigra*) and Operation Wallacea monitoring data has indicated that they are not evening distributed across the reserve and occur in high densities in some areas while being virtually absent from others. There are big concerns that existing density estimates of the endangered species of spider monkey and howler monkey of primate in Calakmul are wildly incorrect because the forest is not uniform, and these primates show a strong habitat preference for high forest containing large trees. As high forest only occurs in distinct patches in Calakmul, previous density estimates based on a small number of transect surveys in a specific area of the reserve followed by extrapolation for the entire reserve are likely to have overestimated the population size. Consequently, further investigation in to the habitat preferences of these primates and distribution of forest types in the reserve is urgently required. The aim of the primate monitoring project is therefore to investigate the relationship between habitat characteristics, water distribution and vicinity to Mayan ruins and the abundance and distribution of primates.

Methods

Data collection will be carried out in 5 different locations with the Calakmul Biosphere Reserve (Figure 1). These camp locations have been chosen due to their accessibility during the wet season and because they cover the full geographical and vegetation range of the reserve. Each camp will contain four 2km long transect lines for data collection that have been mapped using a GPS unit. Five sample sites for habitat surveys will be located along each transect line at 500m intervals, giving rise to 100 sample sites across the 5 research camps in the reserve. Each sample site will consist of a 20m x 20m area adjacent to the transect line. These sample sites will be marked and the GPS location recorded.

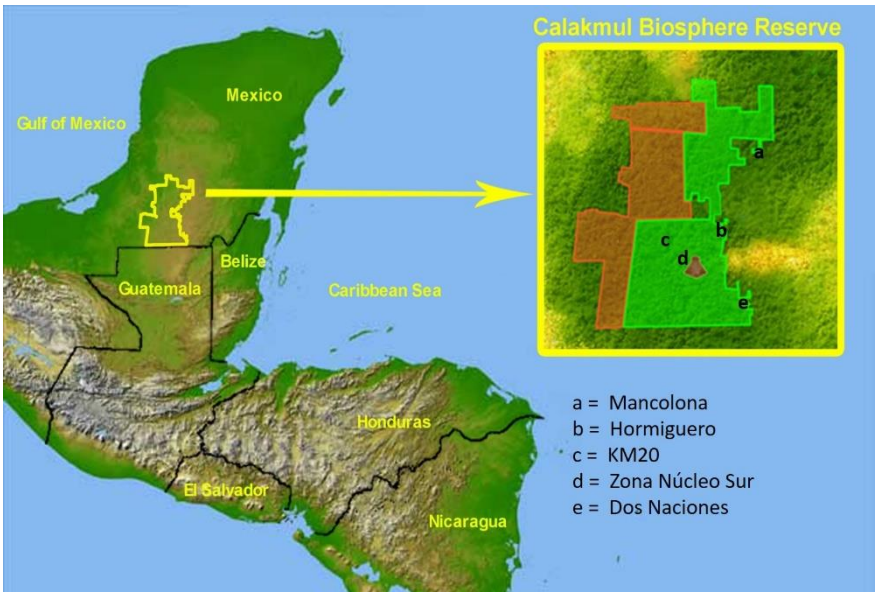

Figure 1: Location of research camps in Calakmul

Primates will be surveyed along line transects (that are not placed with any pre-determined knowledge of the distribution of the animals: Peres, 1999), using distance sampling (Buckland et al., 2001). The entire length of the transect line will be walked by small groups of 3-4 observers walking quietly and slowly (500-1,000 m/hr), starting at 6.30am when the majority of animals are most active and are easiest to detect. Each time an animal is encountered the species, whether the animals was seen or heard, number of individuals (visual sightings only), perpendicular distance from the individual to the transect line, habitat, time, distance travelled transect along the transect line and weather conditions will be recorded. Each line must be surveyed on four separate occasions.

The survey transects are distributed across a wide range of forest habitat types and each transect contains a number of 20m x 20m habitat survey plots. In each of these plots, the distance to water and Mayan ruins is recorded, saplings and understory vegetation are measured, and for each tree, the DBH will be measured, the status of the tree (live/dead) will be recorded, and the species will be identified. Using tree species IDs, each tree will be assigned to a one of two groups (top 20 fruiting tree species in the reserve or all other tree species). Primate distribution in relation to habitat will be assessed using the same transect data combined with opportunistic sightings of primates along transects. Floristics predictors of primate distribution can then be determined by linking each primate

sighting to the nearest habitat plot providing a corresponding set of habitat variables for each primate record suitable for statistical modelling.

Recommended Reading

Arroyo-Rodríguez, V. and Dias, P.A.D., 2010. Effects of habitat fragmentation and disturbance on howler monkeys: a review. American Journal of Primatology: *Official Journal of the American Society of Primatologists*, 72(1): 1-16.

Buckland, S.T., Andersen, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., & Thomas, L. 2001. *Introduction to Distance Sampling: Estimating Abundance of Biological Populations*. Oxford: Oxford University Press.

Dunn, J.C., Cristóbal-Azkarate, J. and Veà, J.J., 2009. Differences in diet and activity pattern between two groups of *Alouatta palliata* associated with the availability of big trees and fruit of top food taxa. American Journal of Primatology: *Official Journal of the American Society of Primatologists*, 71(8): 654-662.

Estrada, A.J., Luecke, L., Van Belle, S., Barrueta, E. & Rosales-Meda, M. 2004. Survey of black howler (*Alouatta pigra*) and spider (*Ateles geoffroyi*) monkeys in the Mayan sites of Calakmul and Yaxchilan, Mexico and Tikal, Guatemala. *Primates* 45: 33–39.

Gonzalez-Kirchner, J.P., 1999. Habitat use, population density and subgrouping pattern of the Yucatan spider monkey (*Ateles geoffroyi yucatanensis*) in Quintana Roo, Mexico. *Folia Primatologica*, 70(1): p.55.

Peres, C.A. 1999. General guidelines for standardizing line-transect surveys of tropical forest primates. *Neotropical Primates* 7(1): 11-16.

Ross, N.J. & Rangel, T.F. 2011. Ancient Maya agroforestry echoing through spatial relationships in the extant forest of NW Belize. *Biotropica* 43(2): 141–148.

Scherbaum, C. and Estrada, A., 2013. Selectivity in feeding preferences and ranging patterns in spider monkeys *Ateles geoffroyi yucatanensis* of northeastern Yucatan peninsula, Mexico. *Current Zoology* 59(1): 125-134.