

A Multi-Scale Approach to Space Use: Habitat Disturbance Alters Behavior, Movement and Energy Budgets in Sloths (*Bradypus variegatus*)

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Abstract : Fragmentation and changes in the structural composition of tropical forests - as a result of intensifying anthropogenic disturbance - are increasing pressures on local biodiversity. Species with low dispersal abilities have some of the highest extinction risks in response to environmental change, as even small-scale environmental variation can substantially impact their space use and energetic balance. Understanding the implications of forest disturbance is therefore essential, ultimately allowing for more effective and targeted conservation initiatives. Here, the impact of different levels of forest disturbance on the space use, energetics, movement and behavior of 18 brown-throated sloths (*Bradypus variegatus*) were assessed in the South Caribbean of Costa Rica. A multi-scale framework was used to measure forest disturbance, including large-scale (landscape-level classifications) and fine-scale (within and surrounding individual home ranges) forest composition. Three landscape-level classifications were identified: primary forests (undisturbed), secondary forests (some disturbance, regenerating) and urban forests (high levels of disturbance and fragmentation). Finer-scale forest composition was determined using measurements of habitat structure and quality within and surrounding individual home ranges for each sloth (home range estimates were calculated using autocorrelated kernel density estimation [AKDE]). Measurements of forest quality included tree connectivity, density, diameter and height, species richness, and percentage of canopy cover. To determine space use, energetics, movement and behavior, six sloths in urban forests, seven sloths in secondary forests and five sloths in primary forests were tracked using a combination of Very High Frequency (VHF) radio transmitters and Global Positioning System (GPS) technology over an average period of 120 days. All sloths were also fitted with micro data-loggers (containing tri-axial accelerometers and pressure loggers) for an average of 30 days to allow for behavior-specific movement analyses (data analysis ongoing for data-loggers and primary forest sloths). Data-loggers included determination of activity budgets, circadian rhythms of activity and energy expenditure (using the vector of the dynamic body acceleration [VeDBA] as a proxy). Analyses to date indicate that home range size significantly increased with the level of forest disturbance. Female sloths inhabiting secondary forests averaged 0.67-hectare home ranges, while female sloths inhabiting urban forests averaged 1.93-hectare home ranges (estimates are represented by median values to account for the individual variation in home range size in sloths). Likewise, home range estimates for male sloths were 2.35 hectares in secondary forests and 4.83 in urban forests. Sloths in urban forests also used nearly double (median = 22.5) the number of trees as sloths in the secondary forest (median = 12). These preliminary data indicate that forest disturbance likely heightens the energetic requirements of sloths, a species already critically limited by low dispersal ability and rates of energy acquisition. Energetic and behavioral analyses from the data-loggers will be considered in the context of fine-scale forest composition measurements (i.e., habitat quality and structure) and are expected to reflect the observed home range and movement constraints. The implications of these results are far-reaching, presenting an opportunity to define a critical index of habitat connectivity for low dispersal species such as sloths.

Keywords : biodiversity conservation, forest disturbance, movement ecology, sloths

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