Temporal activity patterns suggesting niche partitioning of sympatric carnivores in Borneo, Malaysia

ABSTRACT

To propose proper conservation measures and to elucidate coexistence mechanisms of sympatric carnivore species, we assessed temporal activity patterns of the sympatric carnivore species using 37,379 photos collected for more than 3 years at three study sites in Borneo. We categorized activity patterns of nine carnivore species (one bear, three civets, two felids, one skunk, one mustelid, one linsang) by calculating the photo-capturing proportions at each time period (day, night, twilight). We then evaluated temporal activity overlaps by calculating the overlap coefficients. We identified six nocturnal (three civets, one felid, one skunk, one linsang), two diurnal (one felid, one mustelid), and one cathemeral (bear) species. Temporal activity overlaps were high among the nocturnal species. The two felid species possessing morphological and ecological similarities exhibited clear temporal niche segregation, but the three civet species with similar morphology and ecology did not. Broad dietary breadth may compensate for the high temporal niche overlaps among the nocturnal species. Despite the high species richness of Bornean carnivores, almost half are threatened with extinction. By comparing individual radio-tracking and our data, we propose that a long-term study of at least 2 or 3 years is necessary to understand animals' temporal activity patterns, especially for sun bears and civets, by camera-trapping and to establish effective protection measures.