

## Conflating “co-occurrence” with “coexistence”

Carter et al. (1) argued that coexistence is practical at fine spatial scales based on temporal segregation between tigers and people in and around Chitwan National Park, Nepal. The authors presented their coexistence model as an alternative to the widely held principle that long-term tiger conservation requires extensive areas where human-use is excluded. We believe that this study makes a fundamental logic error by conflating “co-occurrence” with “coexistence.” Their data demonstrate spatial co-occurrence conditioned on temporal separation, an unsurprising finding. Coexistence, the relevant interspecific dynamic process, has not been demonstrated and requires long-term data they did not collect.

The conclusion of human–tiger coexistence is based on three main research findings. First, similar tiger densities occur “inside” and “outside” Chitwan National Park. Second, the occurrence of tigers at camera locations is unrelated to human use. Third, the co-occurrence of tigers and humans at camera locations are temporally separated.

Inferences from the authors’ first research finding are suspect because the selected sites are small and straddle the park boundary where neither represents (i) a core area, or (ii) an area of human presence and associated disturbance that limits survival of tigers. The area outside (45 km<sup>2</sup>) is intensively managed for ecotourism by buffer-zone communities and is ecologically no different from the site selected to represent the inside area. Separate density estimates for the two adjacent sites assume geographic closure during the study period, an assumption that is violated. Inferences from the authors’ second finding are inconsistent across human-use covariates. For example, the positive relationship between detection probability of tigers and distance to villages suggests avoidance of humans by tigers. The authors’ third research finding is a well-known aspect of tiger biology. Multiple studies from disturbance-free habitats using both radio-telemetry and camera traps clearly show a peak in tiger activity at night (e.g., ref. 2) corresponding with activity period of prey species.

The inferences of Carter et al. (1) contrast with those from a recent study (3), which used occupancy modeling at an ap-

propriate geographic scale to infer that tiger populations in Nepal are primarily confined to protected areas. Additionally, the authors failed to cite other relevant studies. For example, they refer to Gurung et al. (4) to argue that forest restoration in the buffer area has enabled increase in density of tigers, but disregard the central theme of this study, which reports a 10-fold increase in human casualties in the same period (1998–2006). Moreover, contradicting the claims of the authors, documented poaching data (5) suggests that 23–30 tigers were poached between 2005 and 2009 from Chitwan. Given this additional information, it is untenable to conclude that tiger–human coexistence has been achieved in this landscape.

Studies that investigate the limits to shared use of the landscape by tigers and humans are essential to effective conservation. However, that research must be firmly grounded in a robust sampling design that reflects tiger ecology. We are particularly concerned that this study, which has received extensive media coverage, may compromise efforts of range countries and conservation organizations to achieve tiger conservation in human-dominated landscapes.

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