

Accommodating missing non-detections in presence-only data to estimate abundance by spatial capture-recapture methods

Schemes that collect opportunistic data often generate presence-only (PO) data, potentially causing biases in the estimation of abundance or distribution. A possible solution is to use supplementary information to predict where searching with non-detection might have been likely.

We used data from a spatial-capture-recapture (SCR) study of plains zebra (*Equus quagga*), Telperion Nature Reserve, South Africa, to compare 5 different analyses to estimate population abundance. We generated detections by driving a set route daily over 10 days, photographing zebras to identify individuals, and recording the locations of encounters, sighting distances and the travel path of the survey team. Concurrently, we recorded encounters with non-target species blue wildebeest (*Connochaetes taurinus*), common eland (*Taurotragus oryx*) and red hartebeest (*Alcelaphus buselaphus caama*).

“Search-path” analysis (1) associated detections with locations along the search path and described the detection process using a hazard function, producing an estimate of 1123 (95% CRI: 993, 1268) animals. For analyses 2–5, we divided the study area into a grid of 1-km cells and treated the centroids as detectors whose locations were associated with detections or non-detections, and each used a different approach to define active cells or detectors (those associated with detections or non-detections) plus a half-normal model to describe the observation process. “Search-path-grid” analysis (2) defined active cells by the location of the search path and estimated abundance at 808 (723, 887). “PO-grid” analysis (3) used zebra detections alone and estimated 1000 (885, 1112) animals. “PO-roads-grid” analysis (4) used locations of tourist vehicle routes for non-detections and estimated abundance at 691 (628, 765). “PO-nontarget-grid” analysis (5) used locations of the non-target species as non-detections and estimated 992 (876, 1132) zebras.

All methods that used the grid approach produced abundance estimates that were lower than for the search-path analysis, sometimes by a substantial amount. Further work with data simulation will be necessary to compare the degree of bias between the methods. Such studies can inform the use of PO data in SCR estimation, particularly in the context of projects that use opportunistically-collected data.