

**Abstract:**

Population indices based on visits to detection stations commonly are used to monitor wildlife populations. Inferences about populations are based on 1 of 2 measures: (1) change in the proportion of stations visited at least once or (2) change in the cumulative number of visits by unique individuals. The functional relationships between index responses and population density is poorly understood and can lead to misinterpretation of index data when an incorrect functional relationship (e.g. linear) is assumed. We created a flexible simulation environment to study the response of detection-based population indices under a wide variety of conditions meant to reflect species life history and study design. Proportional indices exhibited non-linear saturating responses to changes in population density while cumulative indices responded linearly. Shapes of responses were functions of home range sizes, individual detection probabilities, and spatial arrangement of animals and sampling stations. Non-linear relationships of proportional indices lead to under-estimation of mean population density when data are aggregated from multiple detection stations deployed in a heterogeneous landscape. Cumulative indices have significant statistical advantages over proportional indices including smaller sample sizes required to detect density change, linearity, consistent index responses across a wide range of densities, and ability to aggregate data to meet minimum sample size requirements. Our simulation provides a flexible tool for the interpretation of station-based population indices.

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