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The fourth dimension in animal movement – the effect of temporal resolution in habitat selection analyses

Understanding habitat selection of animals is important in ecology and conservation, allowing us, for example, to predict space-use of animals, to evaluate reasons for human-wildlife conflicts, and to design appropriate conservation measures such as movement corridors. Common statistical tools for assessing habitat selection are resource selection analysis (RSA) and step selection analysis (SSA). Typically, these approaches use animal location data from tracking systems that rely on animal-borne devices acting as signal transmitters or receivers. The weight limits of such devices according to species' body mass also limit battery power. Therefore, sampling schemes often balance temporal resolution and total deployment time on a case-by-case basis, leading to highly variable temporal resolutions of data sets across studies. However, theoretical considerations of discrete-time movement models (random walks) indicate that these are sensitive to changes in temporal resolution, potentially leading to varying results (and subsequent interpretation) of analyses solely based on the data's sampling rate. As the backbone of SSA is a random-walk model, it is thus important to understand the extent of this sensitivity in real settings. Here, we present a study where we evaluated the sensitivity of SSA to temporal resolution of movement data, comparing it to RSA. We applied classical RSA and SSA with case-control design, as well as a likelihood-based fit of the full movement model underlying SSA, and tested all models with both simulated and empirical data with different temporal resolutions. As expected, we found that overall SSA is more sensitive to temporal resolution than RSA. However, surprisingly, the sensitivity was much stronger for categorical than continuous-valued environmental variables. In contrast, RSA appeared more sensitive to the domain of availability for sampled control locations and more so for the continuous-valued variables. Our results show that SSA and RSA differ remarkably in their sensitivity to model assumptions, and that both methods should be applied with caution. We also demonstrate how this sensitivity scales up to predictive space-use maps derived from the SSA/RSA results, which are typical tools for conservation decision making.