

MODELING UTILIZATION DISTRIBUTIONS IN SPACE AND TIME

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Van Winkle's (1975) concept of the utilization distribution (UD) has seeded important progress in home-range studies, where it forms the quantity of interest when modeling frequency of animal occurrence in two-dimensional space. However, it lacks generality. We extend the definition of the UD to encompass the four dimensions of space and time. We then extend the application of kernel home range estimation methods to enable estimation of UD's in this higher-dimensional space. In particular, our extension of the product kernel estimator incorporates a new kernel appropriate for circularly distributed covariates, like day of year. Using Monte Carlo simulations, we examine the performance of temporally dynamic UD models. Empirical application of such models is illustrated by estimating the UD's of bighorn sheep (*Ovis canadensis*) in the Many Glacier area of Glacier National Park, Montana. For this application, we model UD's in three dimensions that include geographic (x,y) coordinates and day of year.