

**Distance and density estimators of home range:  
Defining multi-nuclear cores by nearest neighbor clustering.**

Kenward, R. E., Clarke, R. T., Hodder, K. H. and Walls, S. S. 2001.  
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Methods used to estimate home ranges from point locations are based either on densities of locations or on link distances between locations. The density-based methods estimate ellipses and contours. The other class minimizes sums of link distances, along edges of polygons or to range centers or between locations. We propose a new linkage method, using nearest-neighbor distances first to exclude outlying locations and then to define a multinuclear outlier-exclusive range core (OEC) by cluster analysis. The assumption behind exclusion of outliers, that movements inside and outside range cores involve different activities, was supported by data from radio-tagged Common Buzzards (*Buteo buteo*). We compared the new method with other techniques by using location data from each of 28 goshawks, 114 buzzards, 138 gray squirrels, and 14 red squirrels. Range structure statistics from OECs showed marked differences between species in numbers and extent of core nuclei. Range analysis displays illustrated relationships of range area with age categories, food supply, population density, and body mass within species. The OECs gave highly significant results in three of five within-species tests, perhaps because animal movements in these cases were affected by coarse-grained habitat boundaries. When movements were likely to have been influenced by diffuse social interactions and foraging for scattered prey, the most significant results were from density-based estimators, especially kernel contours that had been optimized by least-squares cross validation. We recommend use of both density and linkage estimators of home range until a basis for a priori choices has been established.