'Mixing dynamics': Quantifying population mixing rate from individual movements using the squared displacement modelling approach

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Abstract: It has recently been pointed out (Morales et al. 2010) that to properly include the effects of movement on population dynamics, it is necessary to quantify how individual movements affect the mixing rate of a population and how this varies under environmental change and between population with a different stage structure. In fact any single movement event of an animal leads by definition to the displacement away from the point of departure, but over longer temporal scales often a stationary distribution emerges, whereby animals restrict their movements within confined spaces. Different behaviours and life-history events can lead to the emergence of different confined movement patterns over multiple temporal scales. Here I develop a theoretical framework to quantify the dynamics of stationarity and diffusivity in animal movements and show how a recent nonlinear hierarchical modelling approach (Börger & Fryxell 2012), based on the squared displacement statistic, can be used to fit the models to movement data over multiple scales (from annual to lifetime temporal scales) and derive estimates of population mixing rate from individual data. I use simulations to evaluate the robustness of the approach to missing data and location error and exemplify the inclusion in population dynamic models.

References

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