131

Bayesian Inference for Animal Movement: Rigorously Approximating Continuous-Time Models

By modelling the movement of animals, we may glean information on how inter-species, intra-species, and environmental interaction affects their behaviour. This aids greatly with assessing the ecological impact of invasive species and anthropological environmental change. It is common for statistical ecologists to model this movement as a discrete-time process, typically a Markov chain with a state-space defined by location and by a finite number of behavioural states. However, a discrete-time approach may be problematic when faced with datasets having irregular observations or analyses on contrasting time scales.

Modelling animal movement in continuous time accounts for these problems. However, as of yet, biologists have been slow to adopt this approach. This is in part due to the nature of fitting exact continuous-time models to large datasets, which is extremely computationally demanding and therefore infeasibly slow. In this research, we explore and develop methods of formulating models in continuous time and approximating them rigorously such that fitting them becomes competitive with models in discrete time. One existing approach involves limiting the number of behavioural switches that may occur between any two observations; we will discuss the strengths and weaknesses of that work, and describe some current work aimed at both improving the approximation and speeding up computation.

By improving the efficiency of fitting continuous-time models of movement, we aim to make them more accessible to biologists and therefore better understood and more widely used in the scientific community. This may result in a greater number of more appropriate movement models which may have a wider impact on conservation efforts and the wider field of statistical movement ecology.