Integrating movement ecology with popuation dynamics: Approximate Bayesian computation approach

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Keywords: movement ecology; population dynamics; spatial ecology; approximate bayesian computation

Abstract: Statistical approaches for modeling animal movement and (spatial) population dynamics are developed largely independently from each other, even though fundamentally these two phenomena are tightly linked to each other and interact with each other. Population dynamics are ultimately caused by indivdidual-level phenomena (births, deaths, and movement), and individual-level phenomena are in terms influenced by the state of the population (e.g. density-dependence in births, deaths and movements).
We introduce a computational framework based on Approximate Bayesian computation (ABC) for analysing models combining movement ecology and population dynamics. ABC algorithms offer flexibility in formulating the model as they are based on simulating the model and likelihood evaluations are not needed. This is especially advantageous with many complex models in movement ecology, for which likelihood computation is not possible or would require costly numerical techniques. An important aspect of the framework is also the capability to utilize efficiently different types of data that contain complimentary information about the underlying biological processes. We illustrate the framework with simulated and real data.