271

Modeling the Feedback Between Movement and Thermoregulation in Ectotherms with Hidden Markov Models

The thermoregulation process of the Podarcis muralis, or the common wall lizard, is a constant cost-benefit analysis working towards the lizard's optimal body temperature while conserving energy expenditure. We collected 12 lizards to study their movement and thermoregulation process in a lab setting by conducting 2-hour thermal preference trials in a 1m thermal gradient arena. Position data was extracted from video footage at one second intervals for each lizard using the Python based automated movement tracking software, Tracktor. The movement data was analyzed using two different extensions of the hidden Markov model (HMM). The first approach included lizard body temperature and substrate temperature as covariates in the state switching dynamics. The second method is a novel approach for animal movement analysis using an extension of HMMs which incorporates a feedback mechanism between the behavioural states and the thermoregulation process. We allow for the rate at which the lizards regulate their body temperature to be a function of both substrate temperature and the underlying behavioral state, while maintaining body temperature as a covariate in the state-switching dynamics of the HMM. Incorporating this feedback mechanism is of ecological significance as the movement behaviour of ectotherms can affect their thermoregulation process. The analysis conducted is fully reproducible using the R package lizardHMM which was developed for the purpose of this study.