Handling time varying environmental conditions when analysing acoustic telemetry data

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Abstract: Acoustic telemetry using fixed receiver stations is an increasingly popular method for assessing residency, home range, and habitat utilisation of aquatic animals. Data are collected as presences of individuals instrumented with electronic acoustic transmitters. Because of sound attenuation the probability of detecting a tagged animal depends on the distance to the receiver station. It is furthermore known that temporal changes in local environmental conditions cause the detection probability to also depend on time. Despite acknowledging its existence, the spatio-temporal variation in detection probability is rarely explicitly accounted for in the data analysis. This is unfortunate as ignoring varying detection conditions increases the chance of making erroneous conclusions when interpreting results. Here we present a method for detecting temporal variability in detection conditions and for adjusting the detection probability accordingly. The method utilises the detection efficiency of reference data as a proxy for detection conditions and does therefore not require access to local environmental information such as current speed or water column stratification etc. Using the established framework, we illustrate the benefits of integrating detection condition data into a model for estimating detailed movement and home range. This serves as an example of how analytical methods can be altered to realistically propagate temporal variation in detection efficiency of acoustic telemetry data to temporal variation in the uncertainty of model results.