263

Comparing statistical methods to estimate sound production rates based on animal borne tag data

Passive acoustic monitoring (PAM) is a promising approach for monitoring and estimating abundance of many visually cryptic species, in particular those inhabiting areas that are difficult for humans to access, like marine mammals. One of the specific methods available is cue counting, where a density of sounds per unit time and area is converted into animal spatial density via a cue rate. While it seems simple to estimate a cue rate, several challenges arise in practice, from how to collect a sample of animals to how to record the data of interest. Assuming we can instrument a representative sample of animals with sound recording tags, the job is done. Or is it? Here we use a very large data set to compare several possible methods for estimating cue rates. The data come from 120 tagged sperm whales, collected at 8 locations over 13 years, with tag durations from 0.3 to 36 hours, including over 6 million vocalizations and 85 million depth measurements. The cue rate estimation methods compared are: (1) using the raw number of sounds divided by the tag duration, (2) using means and weighted means across tags, (3) modelling the number of cues per time unit in a traditional regression modelling approach, (4) a temporal point pattern, where the sound production intensity is modeled directly, and (5) a Hidden Markov model approach, where first we model behavioral states and then estimate cue rates conditional on those behavioral states. Having the same goal, the different statistical approaches have implications on the estimated cue rate variability and on how one might use relevant covariates to predict cue rates for other times and places beyond the specific tags considered. The next survey might be for a place (and certainly will be for a time) these tags where not collected at. We discuss these aspects in the context of using cue rates to estimating animal abundance in a PAM framework.