

EoAR Mixture Models: Pooling Information from Multiple Sites to Estimate Bat Fatality at Wind-Power Facilities

Even though agricultural production generates biodiversity degradation, ecological communities also provide valuable services such as the regulation of insect pests on crops by their natural enemies. Generating electricity in wind farms reduces the use of coal and natural gas; however, each new installed turbine increases the mortality of birds and bats. Estimating the true fatality rate from collision or barotrauma is challenging due to the low probability of detecting a dead bat. Only a fraction of the area that might contain carcasses is logged, scavengers may remove carcasses before starting the search, and searchers often miss carcasses on the ground. The statistical consequence is that carcasses are often not reported, although fatalities actually did occur. The objective of this work is to obtain accurate estimates of the number of dead bats at all sites using only as input the number of carcasses found at each site, without the need to consider other post-construction monitoring data. To achieve this objective, we extend the Binomial N-Mixture EoAR model proposed by McDonald et al. 2021 by including random variation between sites. We do this either as random variation in the detection probability or as random variation in bat mortality. The model can be further extended by introducing spatial correlation in the random effects. Results based on simulations show that our model: can be fit to data from scenarios with low number of fatalities; on average both mean and median estimates have minimum bias and approach the true value as sample size increases; credible intervals achieve a coverage probability close to their nominal level. The methods will be applied to data from post-construction monitoring of wind farms in Iowa, USA.