258

Point Processes for Leopard Shark Aggregation Patterns

Leopard sharks (Triakis semifasciata) are highly vulnerable to overharvesting due to their low fecundity and long gestation periods. They have been observed to aggregate nearshore in shallow warm waters to increase physiological functions but at the survival cost of predation by other marine mammals. It is hypothesized that a desirable temperature envelope in shallow water may not be enough to drive aggregation there unless conditions can only be found in that shallow water. Novel data on leopard sharks have been collected via UAV (unmanned aerial vehicle) surveys of Emerald Bay, California, USA. Taking "snapshots" of the dynamic environment, we can estimate the locations of sharks in the bay. We address the questions of what temperatures sharks tend to select for relative to a range of temperatures, and if there could be spatial autocorrelation after accounting for temperatures. We fit a joint log-Gaussian Cox Process (LGCP) model to replicates of flights, included as a random effect to account for variability among replicates caused by different conditions on different flights. We analyse the spatial distribution of leopard sharks in relation to environmental covariates of temperature and tide levels. To account for any spatial autocorrelation unexplained by the covariates, a spatially structured random effect is included. Any remaining variation across grid cells is accounted for by an unstructured random effect. We use the integrated nested Laplace approximation (INLA) approach to fit and compare models by the deviance information criterion (DIC) and create visualizations using the leaflet package to map the random effects and 95% credible intervals for the predicted intensity of each flight. Our estimates indicate statistical significance of both covariates, with more leopard sharks tending to occur in areas of relatively warmer water temperatures and higher tide levels. A distinct cluster was identified in the Eastern region outside of the favourable environmental conditions, suggesting potentially other covariates driving aggregation. This analysis has implications for conservation management of leopard sharks by understanding their habitat selection which has become of increasing concern given rising ocean temperatures and climate change altering the locations of the favourable habitat.