Challenging the predator-prey overlap metrics in spatial density: a simulation approach

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Understanding the interactions between marine species and human activities is critical to implement conservation measures. In the Bay of Biscay, common dolphin (Delphinus delphis) by-catches during winter have increased in recent years but the underlying causes remain largely unknown. An hypothesis is a change in spatial distribution with common dolphins occurring closer to the coast to feed on small pelagic fish stocks such as sardines and anchovies, leading to increased interactions with fisheries. We developed a simulation framework to investigate the spatio-temporal overlap between predator (dolphins) and prey (small pelagic fish) with the ultimate aim of shedding light on the mechanisms behinds dolphins by-catch. Our framework includes two modelling approaches. First, we built a simulation model of predator-prey distribution where different parameters values can be associated to different spatial interactions between simulated populations of predator and prey. In this simulation model we represent the density distribution of dolphin as the sum of the spatial variations in prey at local and global scales, the spatial variation in dolphin not determined by predation on small pelagic fish, and a spatial random effect. Then, we used this model as an estimating model on observed data of small pelagic fish and dolphins in the Bay of Biscay. Our simulation-estimation approaches allowed us to investigate the sensitivity of various predator-prey overlap metrics and conclude about the ecological mechanisms underlying dolphins by-catch. Our results show that the distribution of small pelagic fish has shifted from offshore to inshore over the last five years and that the distribution of dolphins has followed the distribution of their prey, increasing the probability of interaction with small pelagic fish fisheries.

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