

Estimating spatial, temporal and individual variability in dolphin cumulative exposure to boat traffic using spatially-explicit capture-recapture methods

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Abstract: Appropriate management of the effects of human activities on animal populations requires quantification of the rate at which animals encounter stressors. Such activities are heterogeneously distributed in space, as are the individual animals in a population. This will result in a heterogeneous exposure rate, which is also likely to vary over time. A spatially-explicit analysis of individual exposure is therefore required. We applied Bayesian spatially-explicit capture-recapture models to photo-identification data to estimate the home range of each well-marked individual in a protected coastal population of bottlenose dolphins. Dolphins perceive boat traffic as a risk that can disturb their activities. Model results were therefore combined with the estimated distribution of boat traffic to quantify how exposure rates varied in time and space. Variability in exposure between individuals was also investigated using a mixed-effects model. The cumulative exposure of individuals to boat traffic varied between summers, depending both on the overall usage of the study area and the degree to which individuals moved around their activity centres. Despite this variability, the relative exposure in different parts of the study area was stable, and regions of higher risk could be identified. There were marked inter-individual differences in the amount of time dolphins were predicted to spend in the presence of boats, and individuals tended to be consistently over- or under-exposed across summers. Our study offers a useful framework to describe the temporal, spatial and individual variation in exposure to anthropogenic stressors when individuals can be repeatedly identified over time. It provides opportunities to map exposure risk in space and understand how this evolves in time at both individual and population level. The outcome of such modelling can be used as a robust evidence base to support management decisions.