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Statistical power to detect abundance changes in distance sampling

Monitoring programmes are used to obtain local density and abundance estimates. However it is uncertain to what extent they are effective in detecting changes in abundance when they occur. To evaluate and optimise monitoring efforts at a range of numerical, temporal and spatial scales statistical power analysis is particularly useful. Here, we used a single platform line transect survey data to estimate detection function of Harbour Porpoises (Phocoena phocoena) in three Special Areas of Conservation, Ireland. Using generalised mixed additive model estimates with a zero-inflated distribution and detection offsets, we simulated data with known properties and with a given local abundance decline from 0% (no change, baseline) to 80%. Simulations incorporate: abundance change, zero-inflation, detection function, daily and transect-level variability. For each simulated dataset, a distance function was fitted from which abundance was calculated and compared with a baseline of no change. Finally, the significance of the slope over time was used to calculate the power to detect change in abundance as a function of survey design. High power was achieved only at considerable abundance decline, e.g. 30% in one of the areas. Interestingly, higher survey frequency or increased number of survey days and transects improved detection power only marginally. This could be due to the high variability in the data. This simulation-based approach allows to estimate power to detect abundance changes under different scenarios over a specified time period and can facilitate survey design for early detection of abundance declines.