Mixture models for estimating population abundance using spatially non-random commercial fisheries data

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Abstract: Reliable population abundance estimates are crucial for sustainable exploitation of fisheries resources as well as for monitoring impacts on vulnerable fisheries bycatch species such as sharks and rays. Using detailed haul-by-haul catch observations from an onboard fishing vessels observation program we compared two mixture models for estimating absolute population abundances. A crucial issue for these data is that not all individuals present will be caught by the fishing gear. This is commonly referred to as catchability and will tend to increase between-observations variability, e.g. between-hauls variability, and lead to excess zeros, given population density is sufficiently low. Assuming individuals are randomly distributed in space, we compared a hurdle model and a zero-inflated Poisson (ZIP) model for abundance and catchability estimation. To account for spatial trends and the non-random (preferential) nature of the observation locations, we used spatial grids where grid cell size decreased with increasing number of observations. Time trends were estimated by including period and grid cell as a factor for the non-zero model components. As the fishing method influences catchability, fishing method was included as an explanatory variable for the zero-components. The results were compared for several shark and ray species in European waters.