Survey design evaluation of a new multispecies bottom trawl survey in the US Chukchi Sea

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The US Chukchi Sea is a dynamic region with climate change and commercial activities affecting the marine ecosystem as well as the Arctic coastal communities that rely on healthy ecosystems. In anticipation for more frequent ecosystem monitoring in the region, it is urgent for there to be robust planning and research on the best means to flexibly allocate limited survey resources. We evaluated three types of survey designs (simple random, stratified random, and systematic) and two types of standard bottom trawl gear (otter and beam trawl). First, we fitted spatiotemporal distributions for 10+ representative demersal fish and invertebrate taxa using the VAST R package. We then simulated taxon densities from the spatiotemporal distributions and calculated design-based estimates of abundance and precision under the three survey designs across a range of sampling effort. Modest increases in precision were gained from stratifying the survey design when compared to a simple random design. There were often strong tradeoffs between the precision and bias of the systematic estimates of precision across species. We did not find inconsistencies in the bias of the estimated abundance indices across designs but sample precisions were slightly negatively biased, with the systematic designs being the most biased. The stratified random design provided the most consistent, reliable, and precise estimates of abundance indices and is likely to be the most robust to changes in survey effort.