Evaluating potential changes to the US Chukchi Sea bottom trawl survey design via simulation testing

Zack S. Oyafuso (corresponding author, [zack.oyafuso@noaa.gov](mailto:zack.oyafuso@noaa.gov)),

Lewis A.K. Barnett, Margaret C. Siple, Daniel W. Cooper, Stan Kotwicki

NOAA Alaska Fisheries Science Center

Groundfish Assessment Program

NOAA National Marine Fisheries Service

Alaska Fisheries Science Center

7600 Sand Point Way NE

Seattle, WA 98115

The US Chukchi Sea consists of the Arctic waters off the northwest of Alaska and is a naturally dynamic ice-driven ecosystem. The impacts from climate change are affecting the Arctic marine ecosystem as well as the coastal communities that rely on healthy marine ecosystems. In anticipation of increased ecosystem monitoring in the area, there is an opportunity to evaluate the best means of continued surveying of the Chukchi Sea, an area that is sampled less comprehensively compared to other regions in Alaska. This analysis focused on standardized NOAA-NMFS-AFSC bottom trawl surveys (otter and beam trawls) and three types of survey designs: simple random, stratified random, and systematic. First, spatiotemporal distributions for 15 representative demersal fish and invertebrate taxa were fitted using the VAST R package. We then simulated spatiotemporal taxon densities to replicate the three survey design types to evaluate design-based estimates of abundance and precision across a range of sampling effort. Modest increases in precision were gained from stratifying the design when compared to a simple random design with either similar or lower levels of uncertainty and bias of the precision estimates. There were often strong tradeoffs between the precision and bias of the systematic estimates of coefficient of variation across species and gear type. 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 the survey design. This analysis is intended to provide the template for how we could change the bottom trawl survey designs in the Chukchi Sea and potentially other survey regions in Alaska going forward and will be important when integrating new survey objectives that are more ecosystem-focused.