

# INCORPORATING SPATIAL STRUCTURE: REFINING FISHERIES MANAGEMENT

## WHEN BIOLOGY AND MANAGEMENT DON'T ALIGN

Pacific herring spend most of their time in large schools in the open ocean, and return consistently in early spring to known bays and stretches of coastline to spawn. The level of connectivity between these individual sub-stocks is unknown. Harvest rules are usually based on how herring appear to be doing as a whole population, across multiple sub-stocks, without accounting for this spatial structure, as information about individual sub-stocks is rarely available. This mismatch in scale between biology and management can have consequences for the effectiveness of management rules and sustainability of herring populations.

## MODELING SPATIAL STRUCTURE FOR PACIFIC HERRING

The Ocean Modeling Forum compared a stock assessment model, based on Pacific herring in British Columbia, to ask how biomass estimates are affected by getting the spatial structure of the population wrong. Several hypothetical approaches to the sub-stocks were tested, including ignoring them, grouping them in different combinations, and identifying each independently.

The results showed that models that ignore the sub-stock spatial structure perform the worst, highlighting the need to include spatial structure in stock assessment models as well as exercises to explore alternative management strategies.



Image: Nicholas Steinberg

## RECOMMENDATIONS

Making the correct assumption about population structure of fish is vital. For herring, models showed the lowest management risk is associated with assuming independent sub-stocks of fish. Including spatial structure in stock assessments, or in evaluations of management strategies for spatially-structured fish populations, reduces error and improves estimation.

Punt, A. E., et al. (2018). When are estimates of spawning stock biomass for small pelagic fishes improved by taking spatial structure into account? *Fisheries Research*, 206, 65–78.

Voss, R., et al. (2018). Quantifying the benefits of spatial fisheries management – An ecological-economic optimization approach, *Ecological Modelling*, Elsevier, vol. 385(C), pages 165–172.

