Evaluating Smooth Sheet Bathymetry for Determining Trawlable and Untrawlable Habitats," Project #13-017

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Biennial bottom trawl surveys in the Gulf of Alaska (GOA) and Aleutian Islands (AI) provide fishery independent estimates of catch per unit effort, abundance, and biological parameters used in stock assessments for managed fisheries and species in the North Pacific. Not all bottom types or oceanographic conditions accommodate the bottom trawl survey method. The bottom trawls can only be towed on smooth and unconsolidated seafloors, so whether trawl stations are "trawlable" or "untrawlable" becomes a major factor limiting the sampling frame of the survey. In the AI, much of the seafloor consists of rock, pinnacles, and steep drop-offs and stations are resampled from a limited pool of previously sampled stations. In GOA, about half of all stations have been visited and about 20% were found to be untrawlable. Having prior and complete knowledge of trawlable areas would clearly define the survey frame for bottom trawl surveys and could become the basis for defining a survey of untrawlable habitats with acoustic or visual survey tools.

We wanted to evaluate whether hydrographic smooth sheets which are charts contains original soundings and seafloor observations could be used to predict whether areas the survey have not visited are trawlable or untrawlable. These charts are electronically available from the National Ocean Service through the National Geophysical Data Center. They contain many more observations than are found on nautical charts, but they require extensive validation for analytical use (Figure 1, http://www.afsc.noaa.gov/RACE/groundfish/bathymetry/). The reprocessed sheets may offer a data source to identify untrawlable habitats from criteria and approaches from focused seafloor studies. We wanted to identify criteria to predict untrawlable habitat from smooth sheet data, test these criteria with a predictive model with known areas of rocky habitat and unsuccessful bottom trawls, and assemble and interpret existing smooth sheet data into a map of untrawlable habitat that can be evaluated in future surveys and studies.

We applied digitized coverages of National Ocean Service (NOS) hydrographic smooth sheet soundings and seafloor observations to evaluate and physical attributes associated with habitat suitable to bottom trawl surveys in GOA (Figure 2). We used random forest methods to evaluate the relative importance of a suite of benthic terrain (depth, slope, rugosity, and substrate composition) and oceanographic predictors (bottom currents) on whether an area was accessible to bottom trawl gear. To do this, we used records of unsuccessful bottom trawls where the net was torn or the vessel was stopped by underwater obstructions. We calculated the approximate position of the trawl and matched the trawl path with the underlying seafloor features. We examined the marginal importance of each physical predictor and quantified the response gradient, then applied a piecewise regression to determine threshold values (Figure 3). Confidence bounds for threshold values and indices of threshold strength (e.g., monotonicity, bimodality) and diagonality (e.g., influence of multiple predictors) were developed. We then developed preliminary, predictive maps of trawlable habitat on the basis of these thresholds. Using available data, preliminary results indicate that untrawlable habitat was associated with increased depth, slope, rugosity, bottom current and coarser sediments at the scale of both discrete tow paths and aggregate survey stations. Distinct thresholds were noted in rugosity, slope, and depth range within the survey area. Preliminary maps of critical thresholds suggest different suites of variables will constrain the probability a successful trawl in different areas of the system (Figure 4). A draft manuscript is in progress detailing the finding of the random forest methods and results.

We are still comparing and modeling the thresholds to independent assessments of trawlability obtained during survey operations. These comparisons between survey stations and actual towpaths suggest smooth sheet data are useful in predicting trawlable habitat at coarse scales, but reflects low resolution beyond nearshore or highly transited areas.

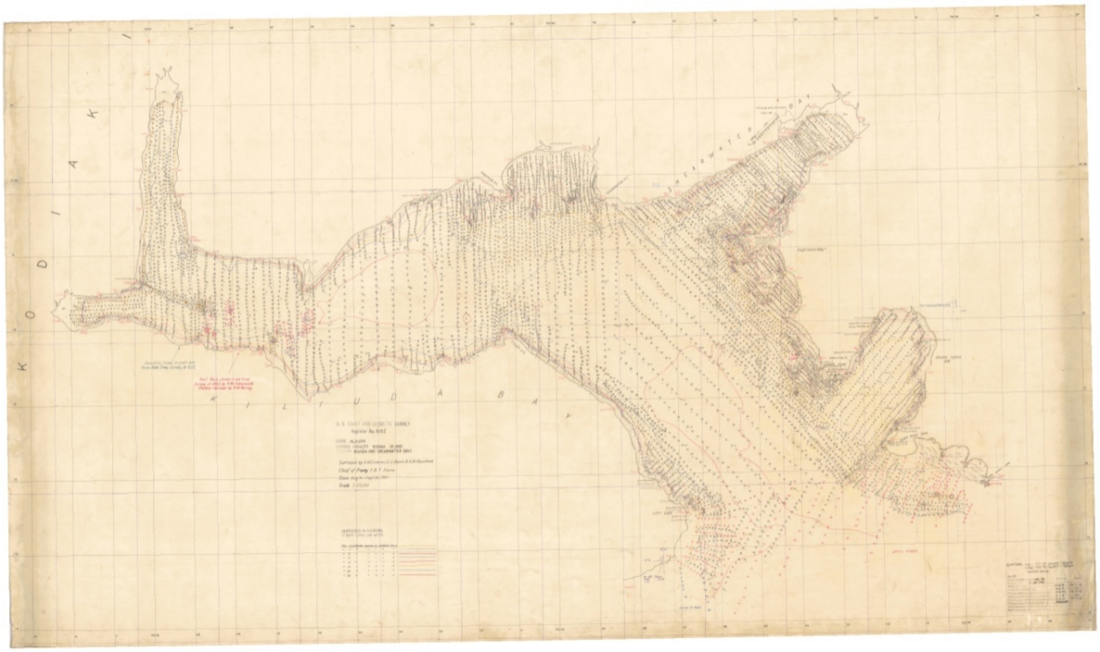

Figure 1. Hydrographic smooth sheet of Kiliuda Bay, Alaska.

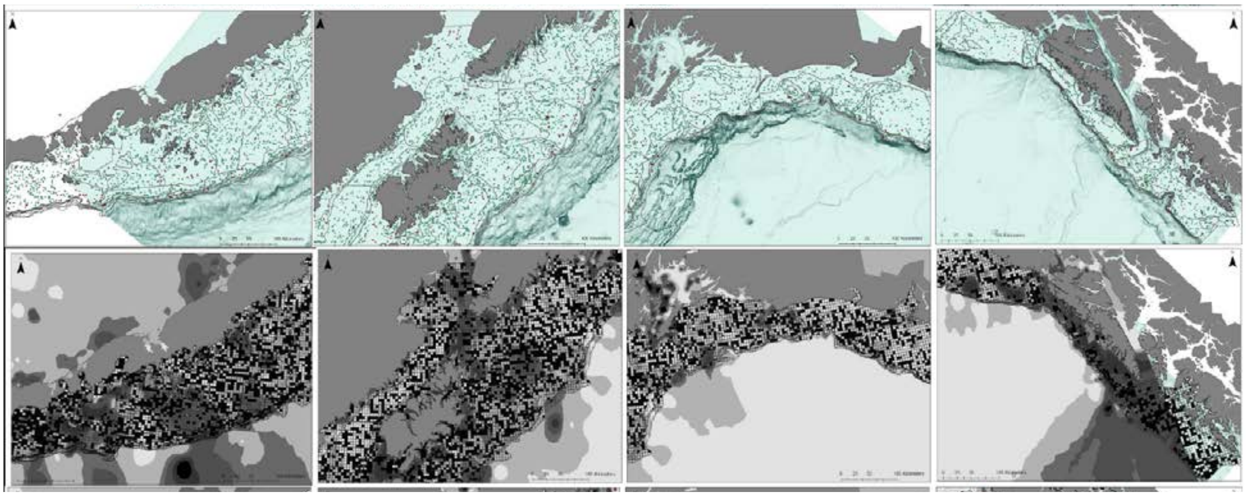

Figure 2. Arc GIS raster surface layers of RACE bottom trawl survey strata. Upper Panel-survey strata and past stations; Lower Panel-=trawlable/untrawlable survey grid cells.

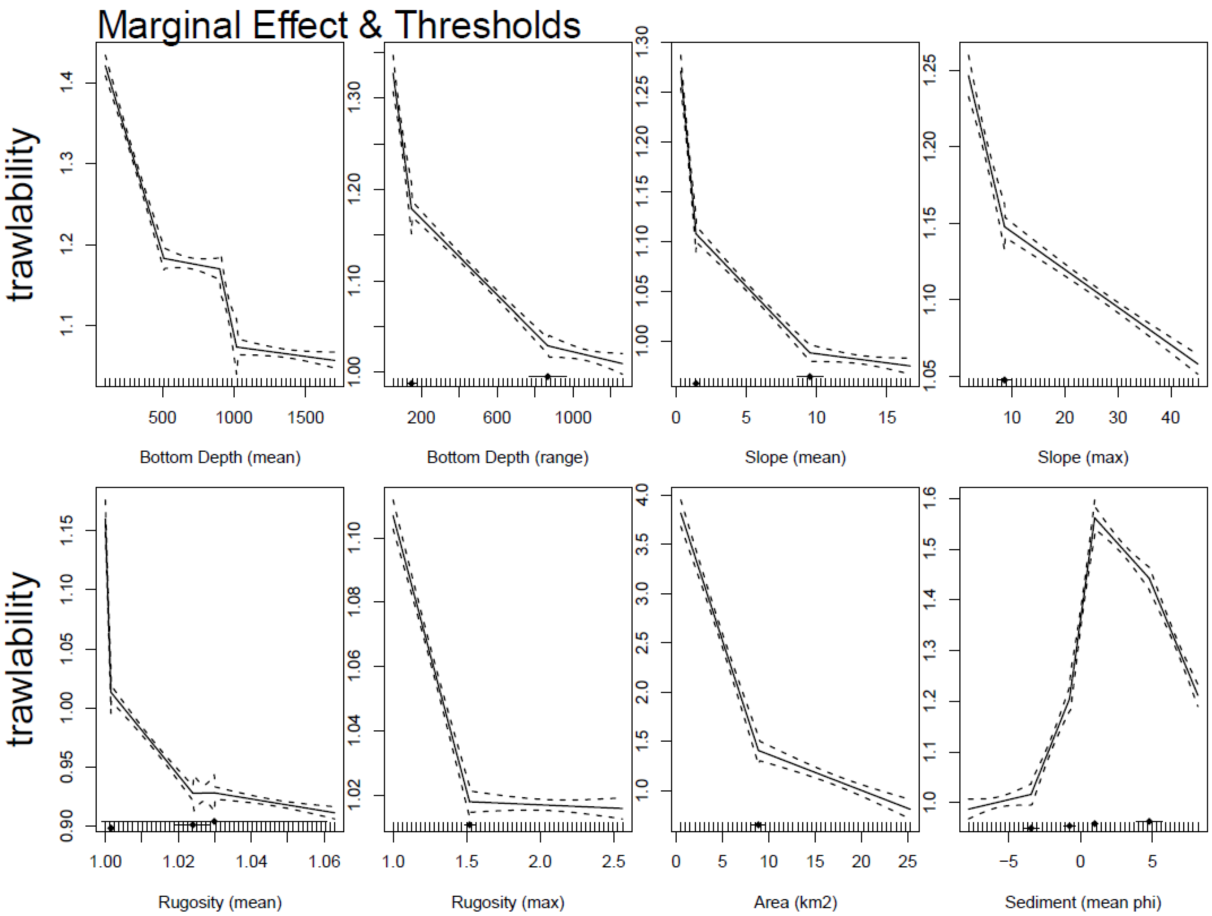

Figure 3. Preliminary segmented regression fit to determine profiles (solid line) and confidence intervals (dashed line) for predictive surfaces of predictor variables as well as point estimates and confidence bounds for threshold breakpoint values in trawlability.

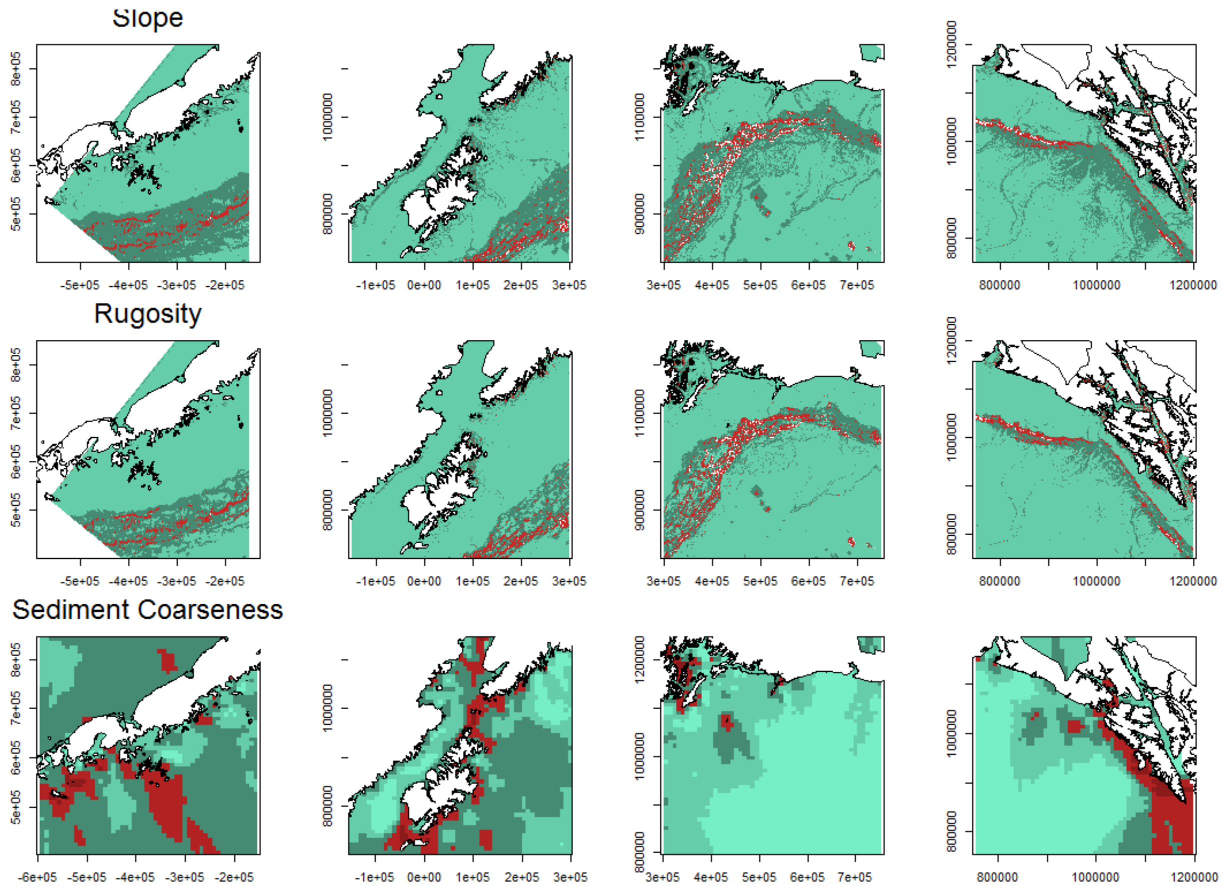

Figure 4. Preliminary predictive maps for trawlable and untrawlable habitat, given individual threshold responses to predictor variables.