Characterizing Trawlable and Untrawlable Substrate Using Single Beam Echo Sounder Data to Improve Estimation of Commercial Groundfish Abundance

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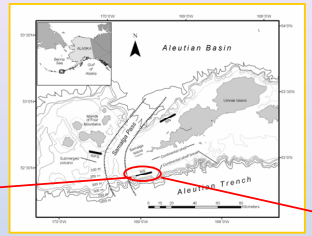
The Problem

Biennial trawl surveys conducted in the Gulf of Alaska by the National Marine Fisheries Service (NMFS) are a primary data source for estimation of commercial groundfish abundance. A perennial issue in the accurate estimation of groundfish biomass using trawl surveys is the unknown (but presumed large) amount of the continental shelf that is untrawlable using standard survey gear. If the amount of untrawlable area could be determined, groundfish biomass estimates would be improved, reducing uncertainty in stock assessments.

Step 1.

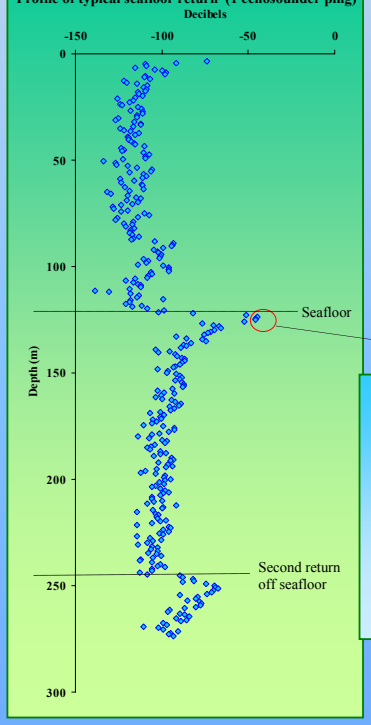
We collected single beam echo sounder data (ES60, 38 kHz) from a NMFS bottom trawl survey vessel along four transects (~1 km length) previously classified as trawlable or untrawlable based on the absence or presence of large boulders and cobbles on the seafloor. The substrate was directly observed and classified from video-tape captured on a towed camera sled. The transects were located at depths ranging from 115-140 m along a relatively flat bench.



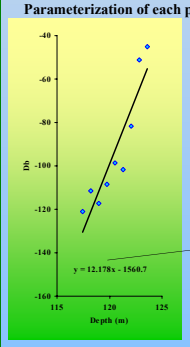
Step 2.

Three simple models estimated the shape of the echo sounder seafloor reflection by measuring the slope of the initial rise when the sound hits the seafloor, the peak amplitude and tail characteristics.

Profile of typical seafloor return (1 echosounder ping)

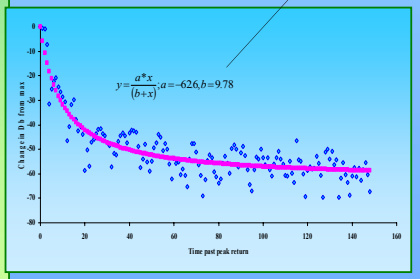


Parameterization of each ping



Data extracted from each ping

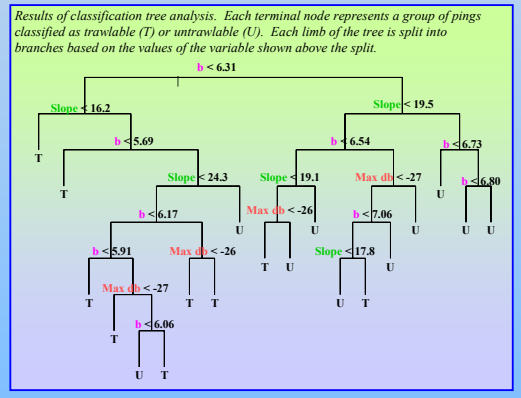
Ping #	Slope	Max db	b	Trawlable or untrawlable
1	12.2	-45.6	9.78	U
2	10.8	-27.4	6.22	T
.				
.				

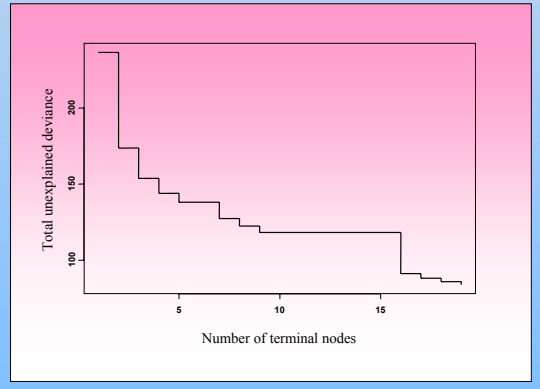


Step 3.

A classification-tree model was fit to the data from three transects (#1-3), and the resulting model was fit to data collected at the fourth transect (#4) as a test

Results of classification tree analysis. Each terminal node represents a group of pings classified as trawlable (T) or untrawlable (U). Each limb of the tree is split into branches based on the values of the variable shown above the split.





Positive Outcomes?

- ❖Accurate predictions of trawlable or untrawlable for 90% of the original data set
- ❖Accurate predictions of trawlable or untrawlable for 75% of the test data set
- ❖New data are easily added, parameterized and analyzed using this method
- ❖Cheap to collect the data on existing survey platforms

Potential Drawbacks?

- ❖Only a small set of the types of trawlable and untrawable substrates were examined
  - → Flat boulder and cobble fields or flat bare sand substrates
- ❖Calibration of echosounders is needed to apply data analysis methods across vessels
- ❖This is a simplistic method for a very complex problem

Acknowledgements

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Future Directions

- Combine this approach with ancillary depth data collected from the echo sounder (such as local slope and rugosity) that also affect trawlability
- Groundtruth observations in other areas on other substrates
- Examine alternative analysis methods

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