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Assessing benthic impacts of raised groundgear for the Bering Sea pollock fishery

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Abstract

U.S. federally managed fisheries are directed to minimize bycatch and adverse impacts of fishing on Essential Fish Habitat (EFH) while maintaining commercially viable catch efficiencies of target species.

Alaska pollock fishery operations are moreover increasingly constrained by efforts to avoid bycatch (salmon, halibut and crab) and the rising cost of fuel.

The fishery's limitations have prompted this inter-institutional, inter-disciplinary research team to work on programmatically developing less impactful trawls to capture pollock near the seafloor and minimize adverse impacts on EFH.

Alaska Fishery Science Center and industry cooperative research has provided evidence that raising trawl groundgear above the seabed via widely spaced bobbins reduces direct seafloor contact area, crab mortality and flatfish bycatch, and maintains fishing performance for pollock. Thus, similar lifting devices will be tested.

Background

Problems to Address

1) North Pacific fisheries lack a quantitative analysis of habitat impacts by trawl gear to the component-specific level.
2) Alaska pollock fishery lacks regulation authorizing the use of pelagic trawls with component modified footropes.

Goal

To tow multiple pelagic trawl configurations varying the lifting components on the footrope, then quantify the habitat impacts using the swept area seabed impacts (SASI) model introduced by Grabowski et al. in New England. The New England Fisheries Management Council adopted this model and established that *fishing gear conservation engineering* can substantially reduce adverse effects while maintaining target catch, and is preferred over area closures and reducing fishing effort (NRC 2002).

The gear modifications to raise the footrope emanate from recent bottom trawl research by C. Rose and the Alaska Fisheries Science Center. The research provided evidence that multiple lifting devices and groundgear configurations reduced benthic contact, bycatch and habitat impacts, with little to no effect on pollock capture.

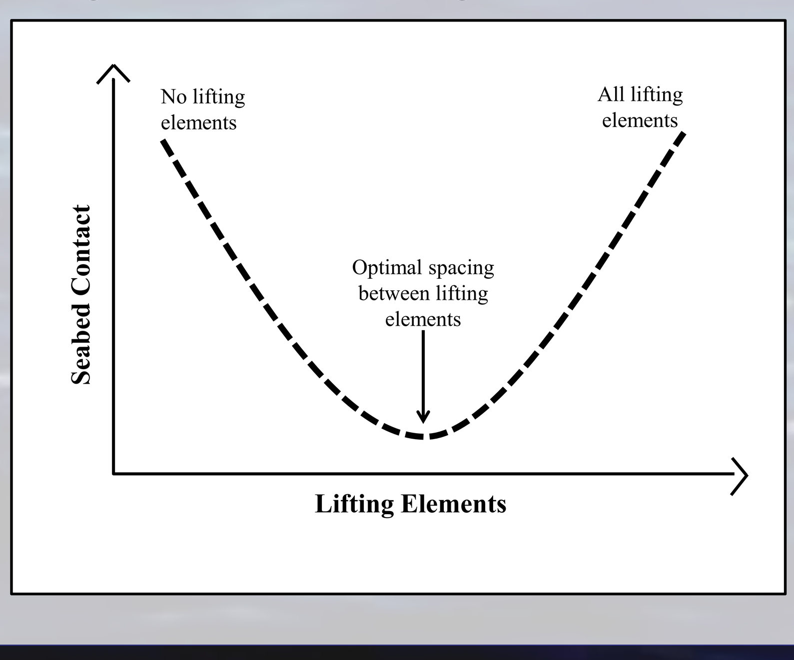
Conceptual Model

Seabed Contact = Impact

Lifting elements on trawl groundgear will reduce total seabed contact and therefore reduce impacts to vertical biological and geological seabed structures.

Most advantageous lifting element height and spacing?

No spacing ≈ no lifting elements. Too much spacing = sag between lifting elements ≤ no lifting elements.



Aim

Test multiple configurations of lifting elements, varied by spacing and height, to identify optimal combination.

Optimal = lowest impact

Impact = contact + susceptibility

Methods

Study Site

An area approximately 2NM x 3NM located about 130NM NNW of Dutch Harbor. Review of VMS records indicate several large areas with little to no towing since 2002.

Control Gear

Commercial pelagic trawl used by the *F/V* Great Pacific in the Bering Sea pollock fishery: Swan wide-body, long-wing design.

Groundgear Configuration Variables

Footrope Material

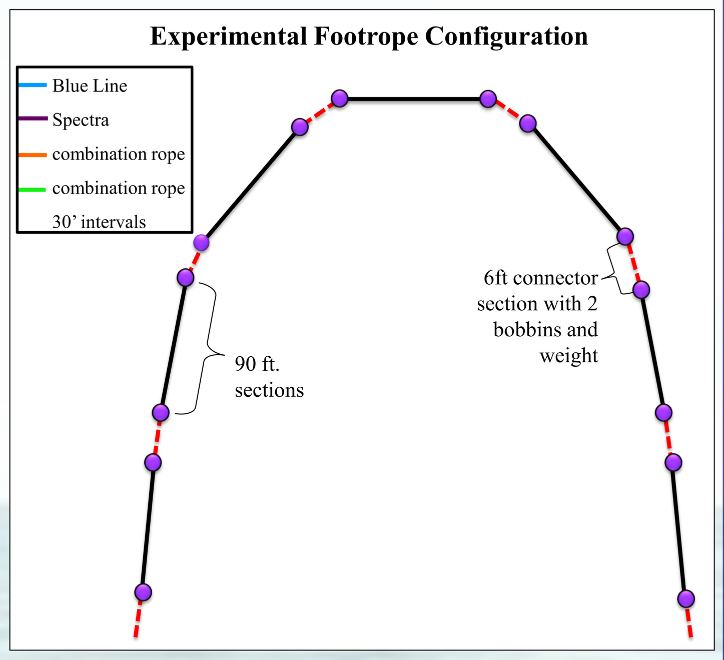
- 90' Combination
- 90' Combination lifted every 30'
- 90' Blue line
- 90' Spectra line with nylon jacket

Seafloor Clearance

- 2-3" Clearance (weights only)
- 4" Clearance (10" bobbin)

Spacing Between Bobbins

- Varied between 30' and 90'



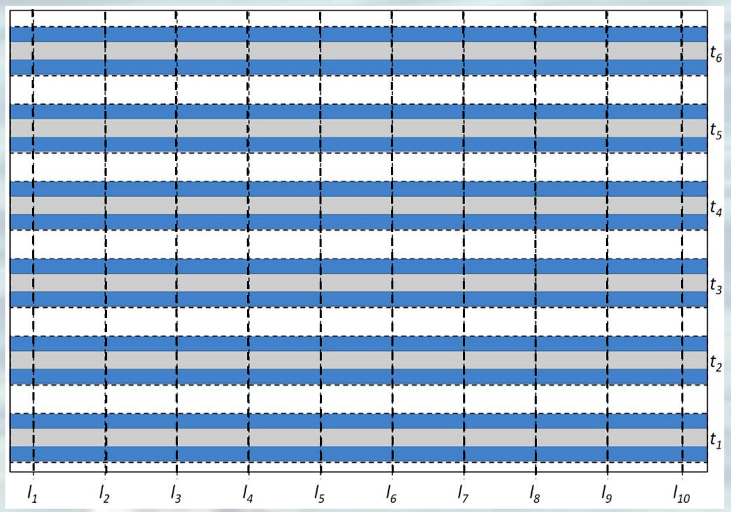
Above: configuration of the experimental footrope with seven interchangeable 90' sections, 10" bobbins and 6' connectors.

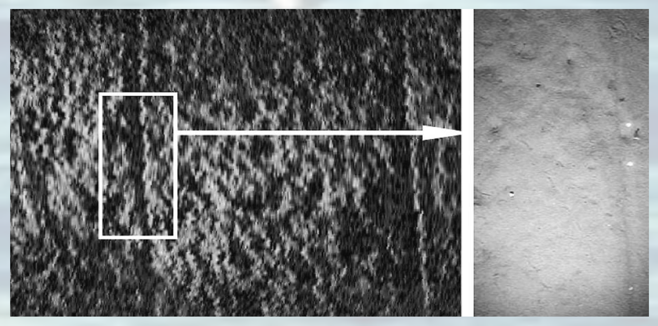
Fieldwork (18 days)

Experimental Tows: 14 test configurations towed parallel ($t_{1\text{-}14}$) 0.2 NM apart, with fishing behavior held constant.

Interim Period: 4 days

Sonar and Video Tows: DIDSON sonar and video transects ($l_{1\text{-}10}$) across the experimental tow tracks. Areas between experimental tow tracks will be used as controls in impact analysis.





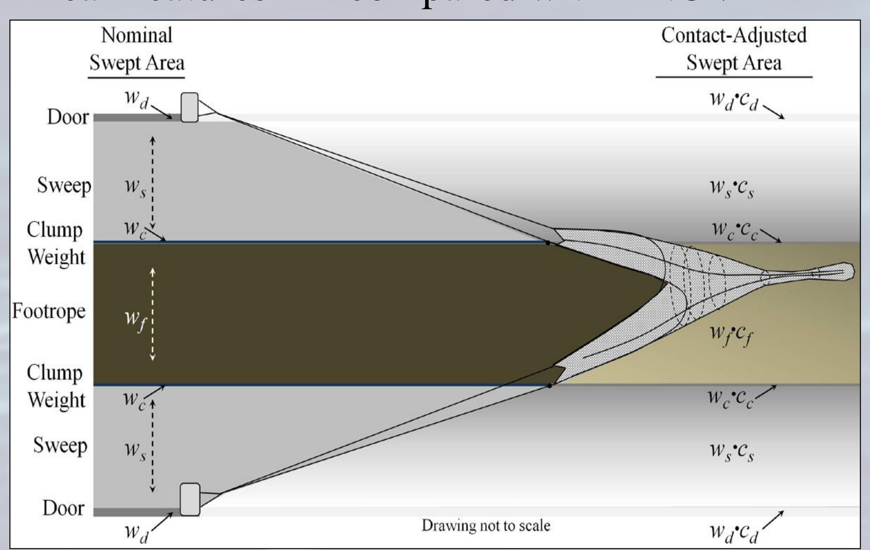
Above: (Left) DIDSON sonar image of bobbin track. *(Right)* Still image of track.

Above: Diagram of trawl tows 1 through 6 (t_1-t_6) and sonar/camera sled sampling lines 1 through 10 (l_1-l_{10}). Grey represents the footrope, blue the sweeps and clump weights and white between-tow control areas.

Data Analysis

Impact in Track vs. Control Area

Mean features m^{-2} compared with ANOVA



Swept Area Equations

Nominal

$$A = d_t\left[(2 \cdot w_c) + (2 \cdot w_s) + (2 \cdot w_{fw}) + (w_{fc})\right]$$

Contact Adjusted

$$A_c = d_t\left[(2 \cdot w_c \cdot c_c) + (2 \cdot w_s \cdot c_s) + (2 \cdot w_{fw} \cdot c_{fw}) + (w_{fc} \cdot c_{fc})\right]$$

Susceptibility Adjusted

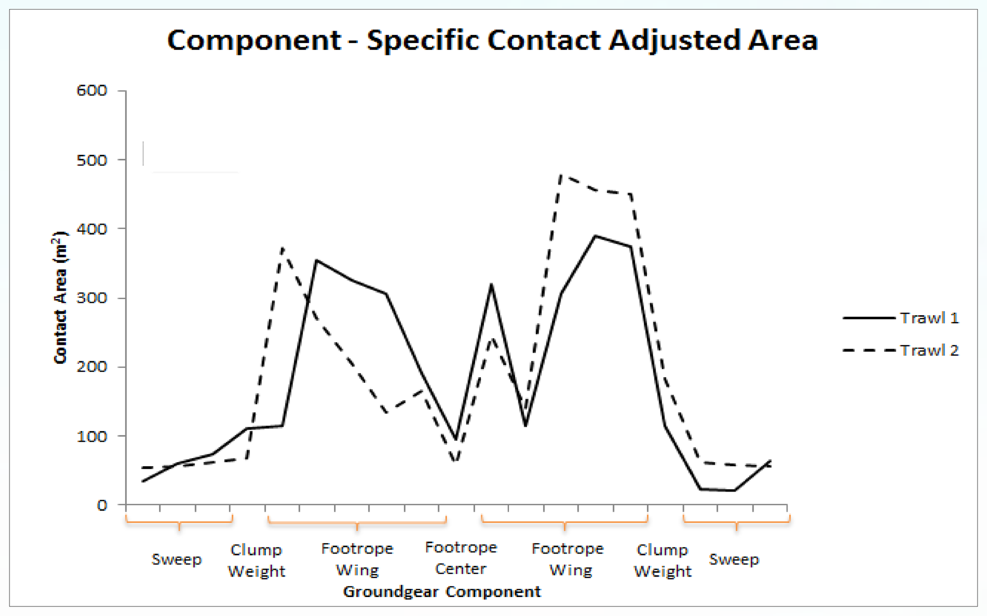
$$A_s = d_t\left[(2 \cdot w_c \cdot s_c) + (2 \cdot w_s \cdot s_s) + (2 \cdot w_{fw} \cdot c_{fw}) + (w_{fc} \cdot s_{fc})\right]$$

Swept Area Comparison: Each configuration ($A > A_c > A_s$)
Nominal Swept Area (A) = gear width x tow length
Contact Adjusted Swept Area (A_c) = A adjusted for actual contact
Susceptibility Adjusted Swept Area (A_s) = A_c adjusted for habitat feature impact

Discussion

Expected Outcomes

Quantitatively identify the optimal configuration(s) of footrope material, bobbin height and spacing to minimize groundgear contact and impacts on geological and biological structures.



Trawl profile and swept areas comparisons used to identify optimal configuration(s)

Trawl profile with area adjusted for component contact plotted for each lifting element and combined as groundgear component. Trawl profiles made for contact adjusted and susceptibility adjusted swept areas *(not shown).*

We expect that raised groundgear will have significantly less seabed contact thus less impact on geological and biological structures than the nominal area swept might otherwise indicate.

Application

•Quantitative framework to compare gear modifications based on benthic impact
-necessary tool for North Pacific Fisheries Management Council (NPFMC) to evaluate regulatory changes allowing the use of modified gear

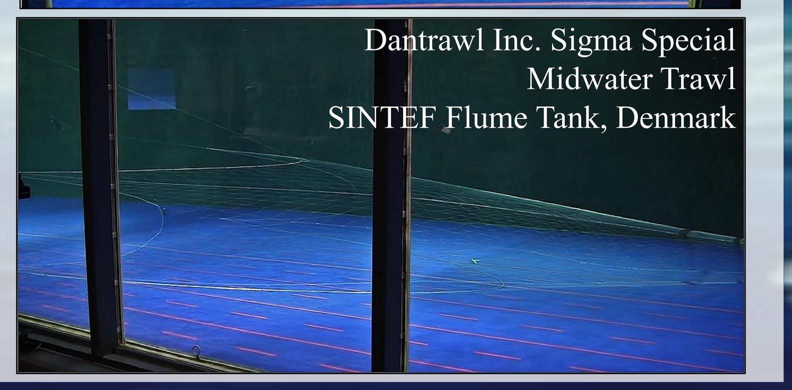
•Swept Area applied in the Fishing Effects model of the upcoming 2015 EFH Review

•Improved knowledge of fishing gear and seabed contact characteristics

•Improved tool to harvest pollock near the seafloor with less impact

•Strengthened gear conservation and engineering research benefitting the Alaska pollock fishery

•Model approach for other regional fishery management councils



Dantrawl Inc. Sigma Special Midwater Trawl SINTEF Flume Tank, Denmark

(Above) Raised sweeps with widely spaced disks.

Acknowledgements

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