Brad Harris, Ph.D.

Fisheries Aquatic Science & Technology Laboratory - Alaska Pacific University
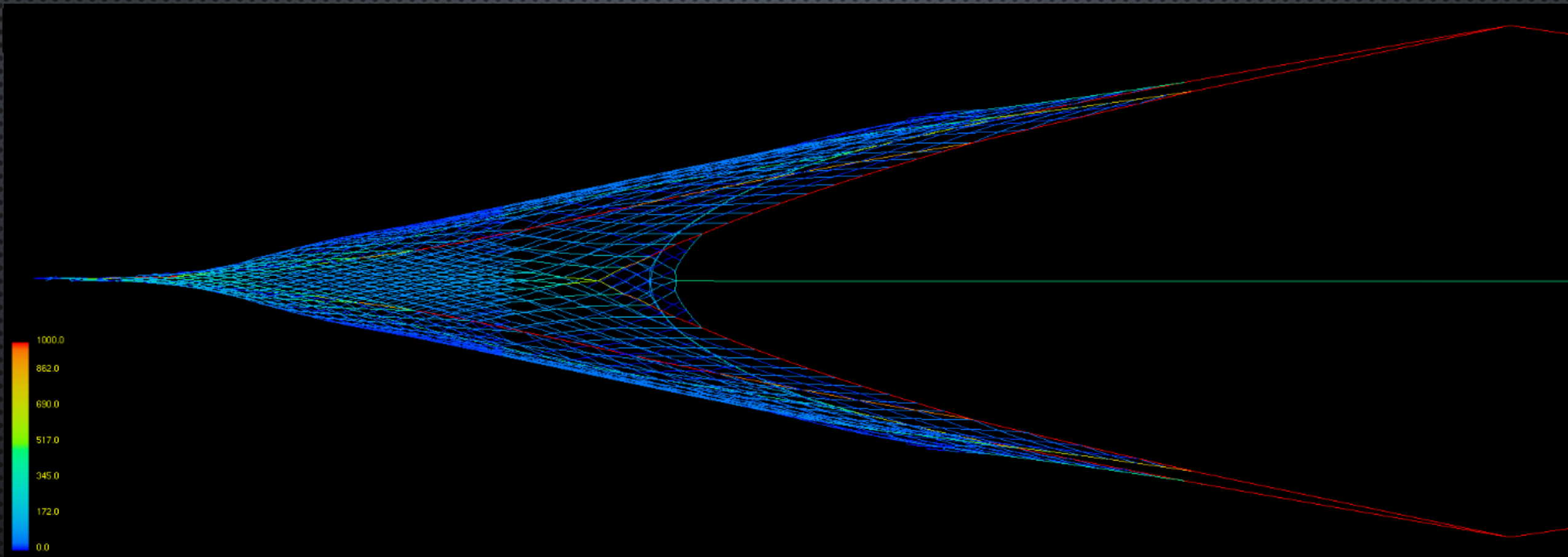
FISHING EFFECTS MODEL

- **Fishing Effects Model** is a decision-support tool. It employs spatially-explicit Vessel Monitoring System (VMS), Observer data, **gear dimensional and contact information** and literature-based habitat impact information to:

- Quantify and visualize fishing activity.

- Estimate fishing footprint and bottom contact.

- Estimate cumulative impacts of fishing on Essential Fish Habitat.

February 2024 - B1 Fishing Gear Research

FISHING EFFECTS MODEL – NEXT

Gear tables

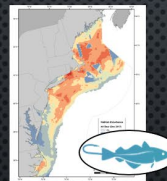| GearID	Gear	Fishery
2	trawl	GOA Pollock Pelagic Trawl
3	trawl	GOA Slope Rockfish Pelagic Trawl
5	trawl	GOA PCod Bottom Trawl Inshore
11	trawl	GOA Slope Rockfish Bottom Tra
23	trawl	BS Pollock Pelagic Trawl (incl N
24	trawl	BS Pollock Pelagic Trawl
42	trawl	BS Pcod Bottom Trawl
47	trawl	BS Yellowfin Sole Bottom Trawl
57	trawl	AI Pcod Bottom Trawl
61	trap	BSAI Pcod Pot
68	longline	BSAI Pcod Longline
72	trap	BS Pcod Jig

Catch-in-Areas DB
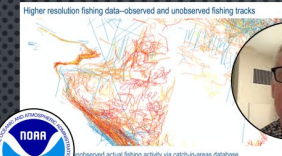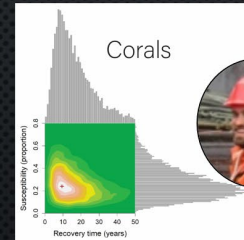
Habitat Impacts
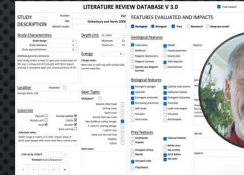
FEM.NE

Habitat Recovery

Corals

Updates - Underway
- *Fishing*
  - Catch-in-Areas
  - Footprint & Bottom Contact

- *Habitat Effects*
  - Species
  - Life stage
  - Stock area
  - Fishery

Upgrades - Future
- *Scenario -Exploration*
  - Response to changes - regs, environment, fish, markets

- *Gear – Fishery Species Interactions*
  - Catch/ Discard Performance
  - Unobserved Fishing Mortality

FISHING EFFECTS MODEL

- **Fishing Effects Model** is a decision-support tool. It employs spatially-explicit Vessel Monitoring System (VMS), Observer data, **gear dimensional and contact information** and literature-based habitat impact information to:

- Quantify and visualize fishing activity.

- Estimate fishing footprint and bottom contact.

- Estimate cumulative impacts of fishing on Essential Fish Habitat.

APPENDIX 2 GEAR PARAMETERS

Table A2.1. The gear parameter table provides the metrics used in the Fishing Effects model for each gear type, listed by fishery. Vessel types are either catcher vessels (CVs) or catcher-processors (CPs), and the definitions for gear type and target species and other species caught and retained can be found here. Contact adjustments are reported as either a range (low to high) or single metric if they were the same.

Fishery	Vessel type	Area	Gear	Target Sp.	Other Sp.	Vessel Length (ft)	Season	Depth Range (fath.)	Nominal Width (m)	Contact Adjustment
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	B	≥90	115	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	B	60-90	109	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	125-151	B	<60	96	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	151-300	A	≥90	132	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	151-300	A	60-90	124	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	151-300	A	<60	106	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	151-300	B	≥90	163	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	151-300	B	60-90	154	0.2 - 0.6
BS Pollock Pelagic Trawl	CV	BS	PTR	P	B, all others	151-300	B	<60	137	0.2 - 0.6
BS Pollock Pelagic Trawl	CP	BS	PTR	P	B, all others	all	A	≥90	142	0.7 - 0.9
BS Pollock Pelagic Trawl	CP	BS	PTR	P	B, all others	all	A	60-90	133	0.7 - 0.9
BS Pollock Pelagic Trawl	CP	BS	PTR	P	B, all others	all	A	<60	114	0.7 - 0.9
BS Pollock Pelagic Trawl	CP	BS	PTR	P	B, all others	all	B	≥90	175	0.8 - 1
BS Pollock Pelagic Trawl	CP	BS	PTR	P	B, all others	all	B	60-90	166	0.8 - 1
BS Pollock Pelagic Trawl	CP	BS	PTR	P	B, all others	all	B	<60	147	0.8 - 1

FISHING EFFECTS MODEL

- **Fishing Effects Model** is a decision-support tool. It employs spatially-explicit Vessel Monitoring System (VMS), Observer data, **gear dimensional and contact information** and literature-based habitat impact information to:

- Quantify and visualize fishing activity.

- Estimate fishing footprint and bottom contact.

- Estimate cumulative impacts of fishing on Essential Fish Habitat.
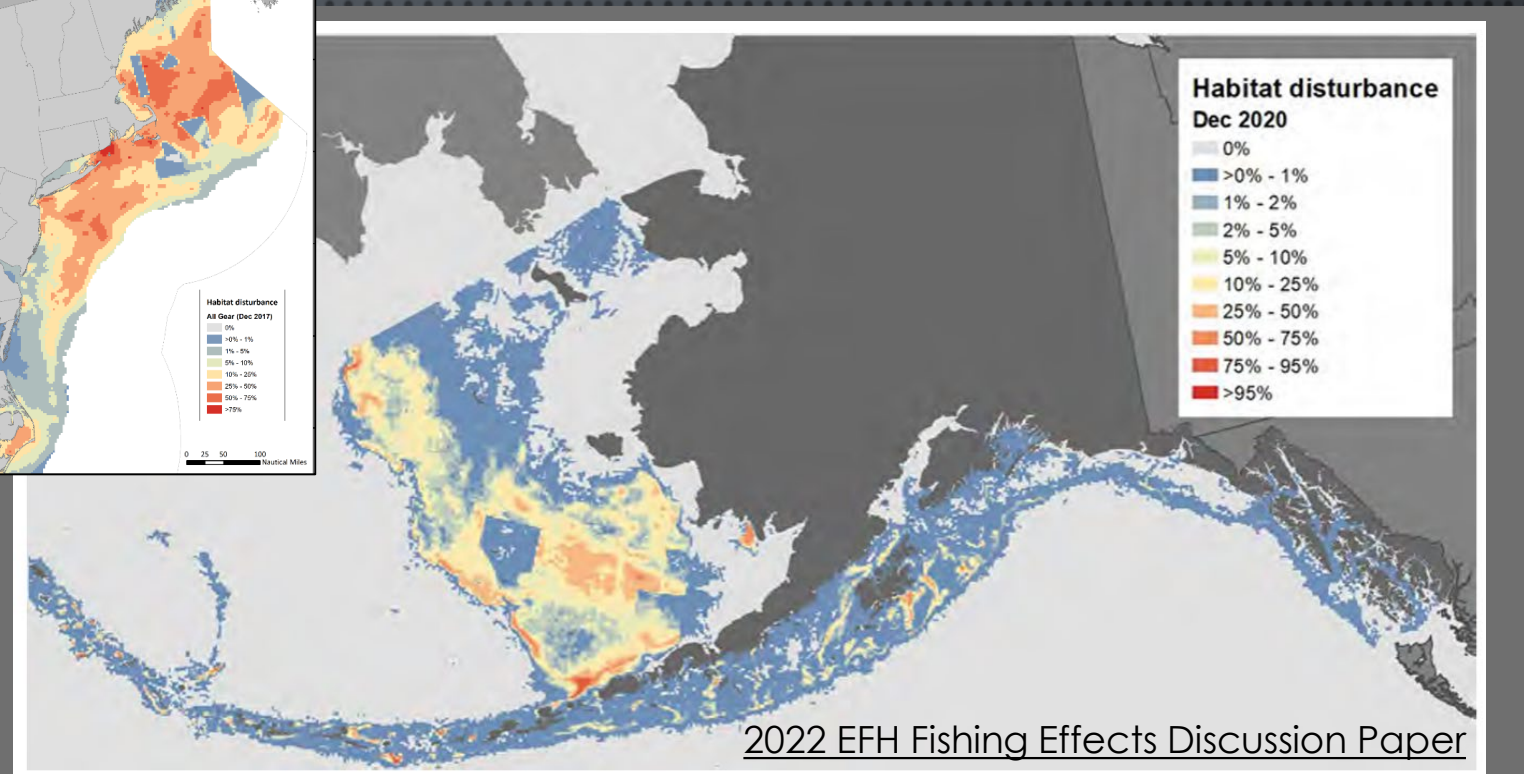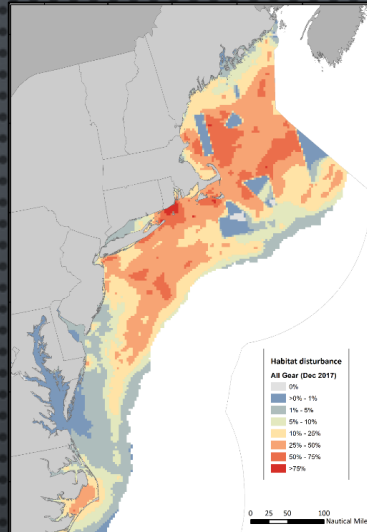
2022 EFH Fishing Effects Discussion Paper

Funding: NMFS ARO Hab Div., NPFMC, NEFMC, Atkinson Foundation (Cornell Univ.)

Science Publications: Grabowski et al., 2014, Smeltz et al., 2019, Smeltz 2023

Student Research: Alaska Education Tax Credit Program (APA, AKSC, APICDA)

Management Peer Reviews: NEFMC SSC (4+), NPFMC SSC (4), more coming …

Management Publications: NEFMC. 2011, 2020, Simpson et al., 2017, Zaleski et al., 2024, Bachman et al., 2025, and more….

- GEAR INNOVATION INITIATIVE (GII) -

Purpose

Improve Understanding of Pollock Gear and Fishery → Foundation for Innovation

- *What gear is currently used in BSAI and GOA pollock fisheries?*
- *How is this gear implemented in pollock fishing?*
- *When, where and how much is this gear fished?*
- *When, where and how much is this gear in contact with the bottom?*

Improve Fisheries Management Decision Support → Fishing Effects Model

- *Gear Tables*
- *Fishing footprint*
- *Bottom contact*
- *Benthic habitat disturbance*
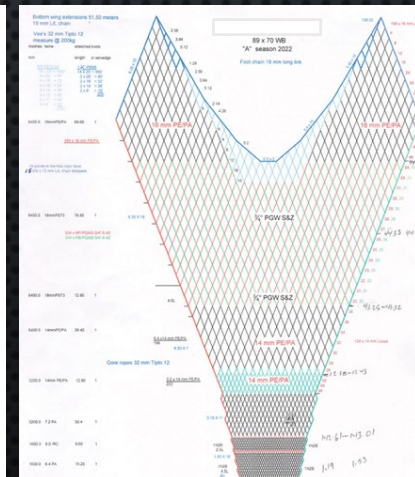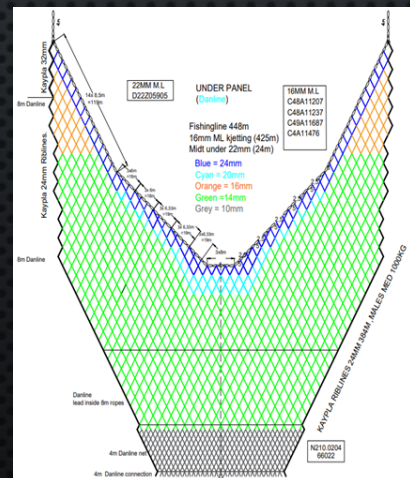- *Non-habitat species interactions (e.g., crab).*

Study Framework
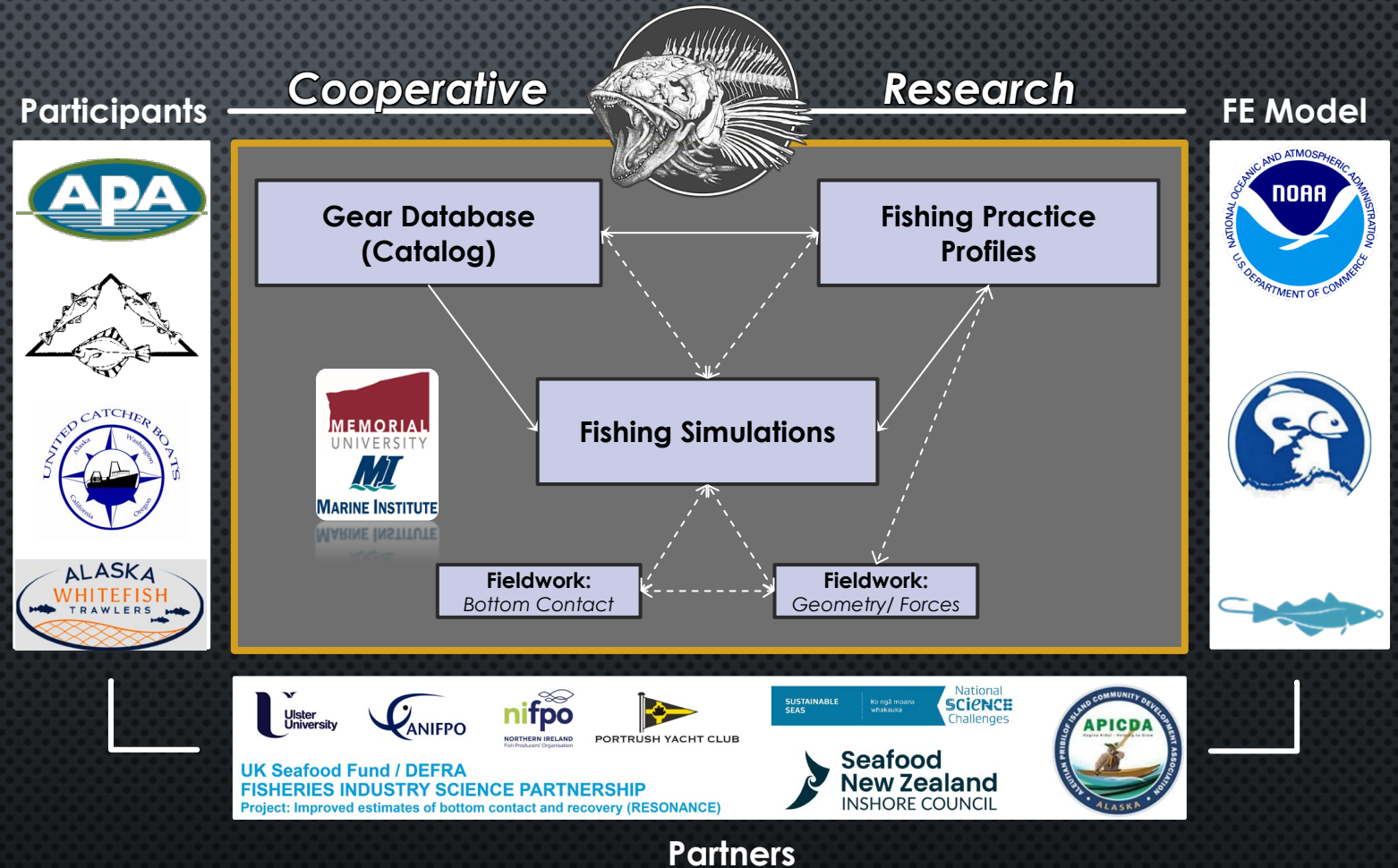
Gear Catalog Structure:

Each trawl is assigned a unique ID used to reference its components.

- **Design** – *Including <u>individual</u> net plan.*

- **Materials** *(e.g., footrope chain dimensions)*

- **Configuration** *(e.g., doors, bridle length, and set back)*

- **Modification** *(e.g., salmon excluders)*

- Catalog Structure Guidance

- Information Quality Control

ID_trawl	Year	Company	Vessel	Trawl	Doors
1	2023			Egersund 1128	Thyboron Type 32 VF
2	2023			Egersund 1512	Thyboron Type 32 VF
3	2023			Egersund 1824	Thyboron Type 32 VF
4	2023			Egersund 1128	NETS Series 2000 V-shaped
5	2023			Egersund 1512	NETS Series 2000 V-shaped
6	2023			Egersund 1632	NETS Series 2000 V-shaped
7	2023			Egersund 1920	NETS Series 2000 V-shaped
8	2023			Egersund 1512	NETS Series 2000 Straight
9	2023			Swan 1280	NETS Series 2000 Straight
10	2023			Egersund 1920	NETS Series 2000 Straight
11	2023			Swan 1056	ThyboronType 32 VK
12	2023			Swan 1280	ThyboronType 32 VK
13	2023			Swan 1900	ThyboronType 32 VK
14	2023			Swan 1056	NETS Series 2000 V-shaped
15	2023			Swan 1280	NETS Series 2000 V-shaped
16	2023			Swan 1900	NETS Series 2000 V-shaped
17	2023			Swan 89 x70 Wide Body	NETS 14 m^2 Series 2000 V shaped door
18	2023			Swan 1280 x 5	Thyboron 14 m^2 Bluestream
19	2023			Swan 1056	Thyboron ?
20	2023			Swan 1280	Thyboron ?
21	2023			Swan 1900	Thyboron ?
22	2023			Swan 89X70	Thyboron-Bluestream T-22vk / 14m
23	2023			Swan 1280 Regular web	Thyboron-Bluestream T-22vk / 14m
24	2023			Swan 1280 Helix web	Thyboron-Bluestream T-22vk / 14m
25	2023			Swan 2000 Helix web	Thyboron-Bluestream T-22vk / 14m
26	2023			Swan 1280	Thyboron-Bluestream Type 32 standard 12.5
27	2023			Hampidjan Gloria Wide Body 1312m	Thyboron-Bluestream Type 32 standard 12.5
28	2023			Hampidjan Gloria Long Wing 1056m	Thyboron-Bluestream Type 32 standard 12.5
29	2023				
30	2023				
31	2023				

Confidential

Comp_Vess_Gear | Doors | Bridles | Weight Chains | Footrope | Nom and adj width | FEM_Table | +
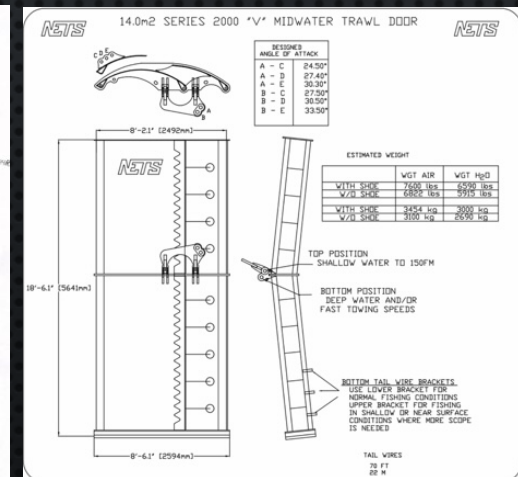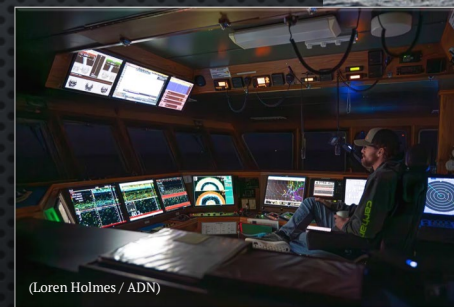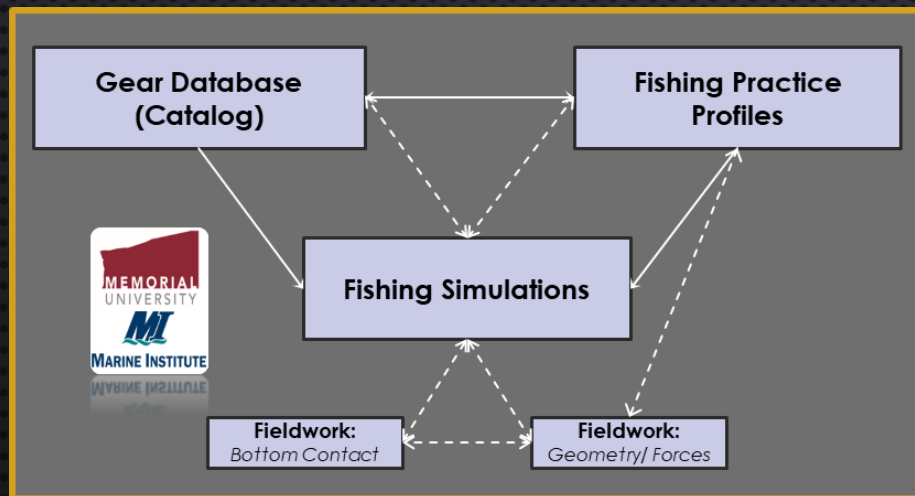
Fishing Practice Profile: *Set of operator-controlled parameters/ *targets that influence the <u>vertical location</u>, and <u>geometry</u> of the trawl.*

- Speed (k)
- Warp length (m, fa)
- Headline Scope (ratio)
- Wing weight (kg)
- Bridle length (m, fa)

- Setback (m, fa)
- Door roll (deg)
- *Headline depth (m, fa)
- *Vert. opening (m, fa)
- *Wing spread (m, fa)
- …

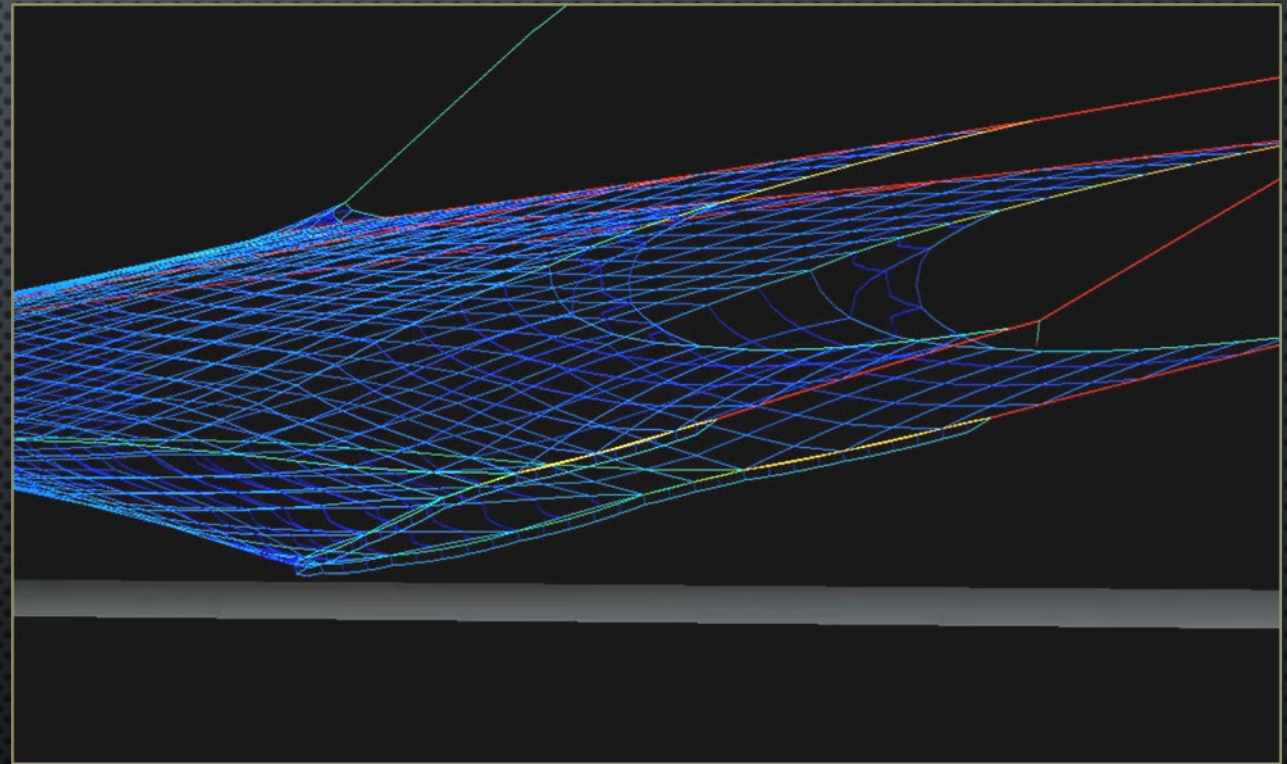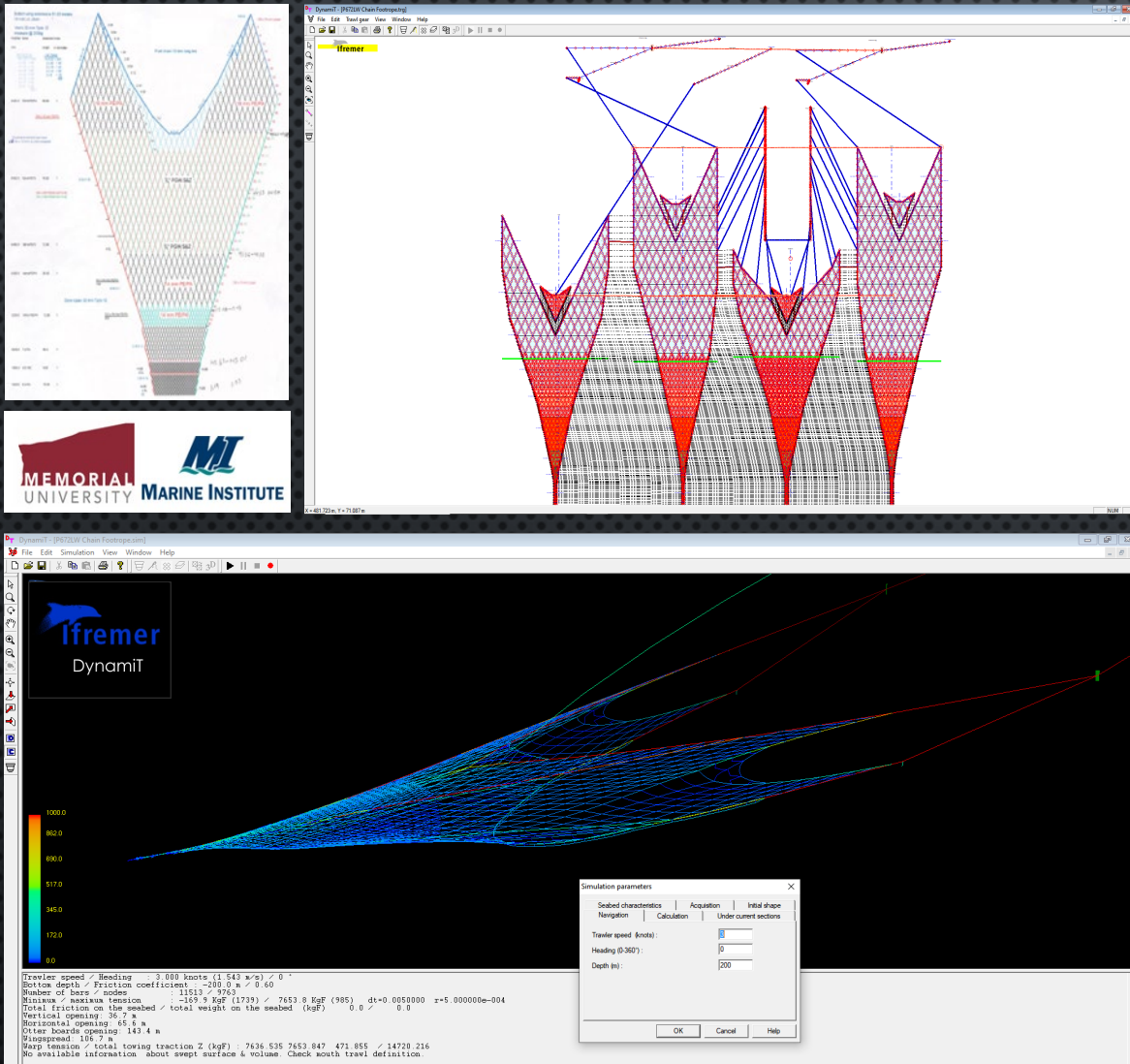Gear Database (Catalog)

Fishing Practice Profiles

MEMORIAL UNIVERSITY
MI MARINE INSTITUTE

Fishing Simulations

Fieldwork: *Bottom Contact*

Fieldwork: *Geometry/ Forces*

(Loren Holmes / ADN)

Gear Plan + Cataloged Specifications + Fishing Scenario
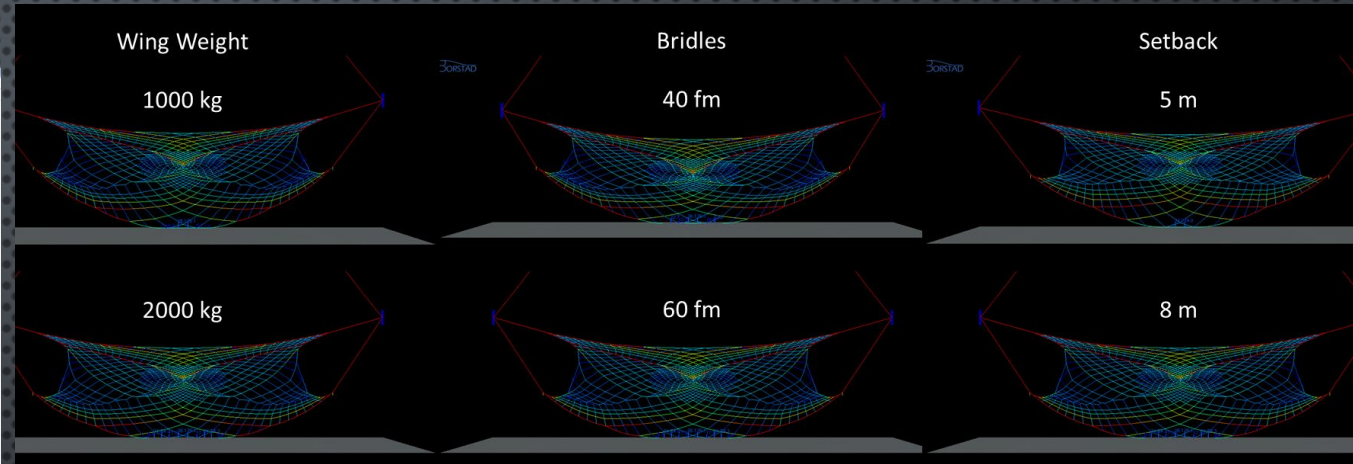→ *Geometry, Horizontal / Vertical Forces, Seabed Contact*
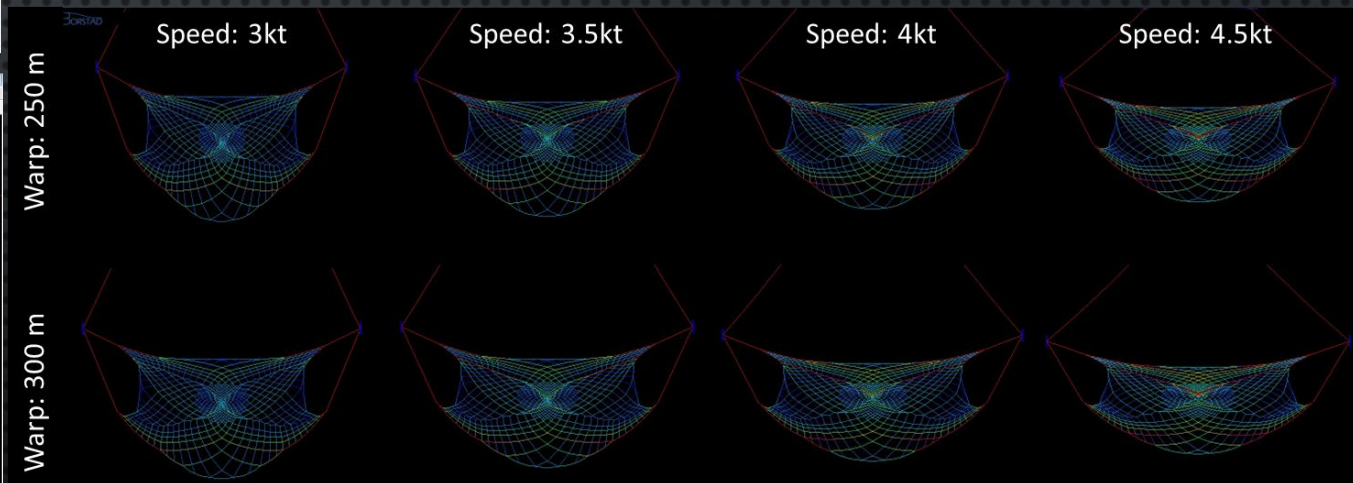
- FISHING GEAR MODELS AND SIMULATIONS -

Gear Plan + Cataloged Specifications + Fishing Scenario
→ *Geometry, Horizontal / Vertical Forces, Seabed Contact*
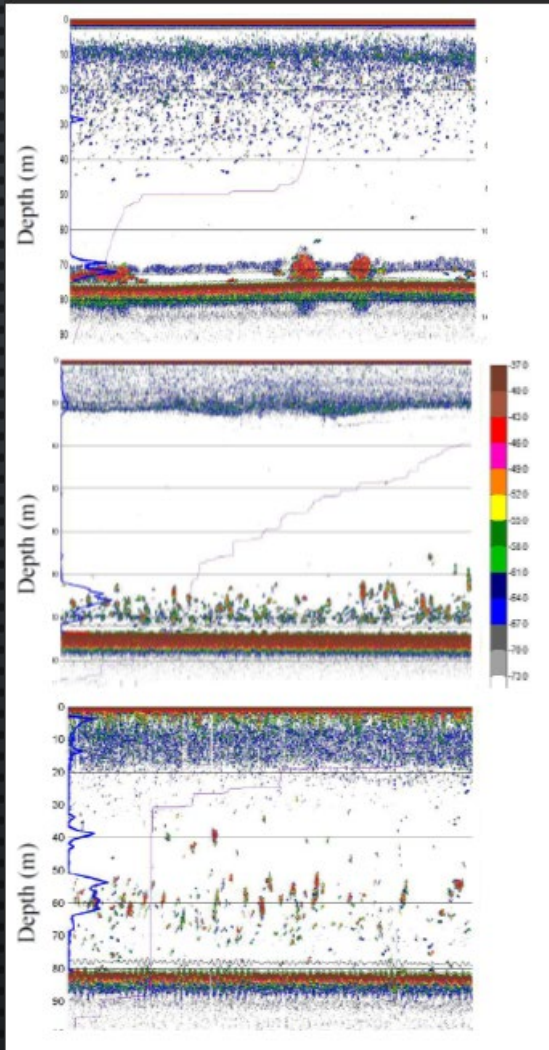

Rigging Effects

Wing Weight	Bridles	Setback
1000 kg	40 fm	5 m
2000 kg	60 fm	8 m
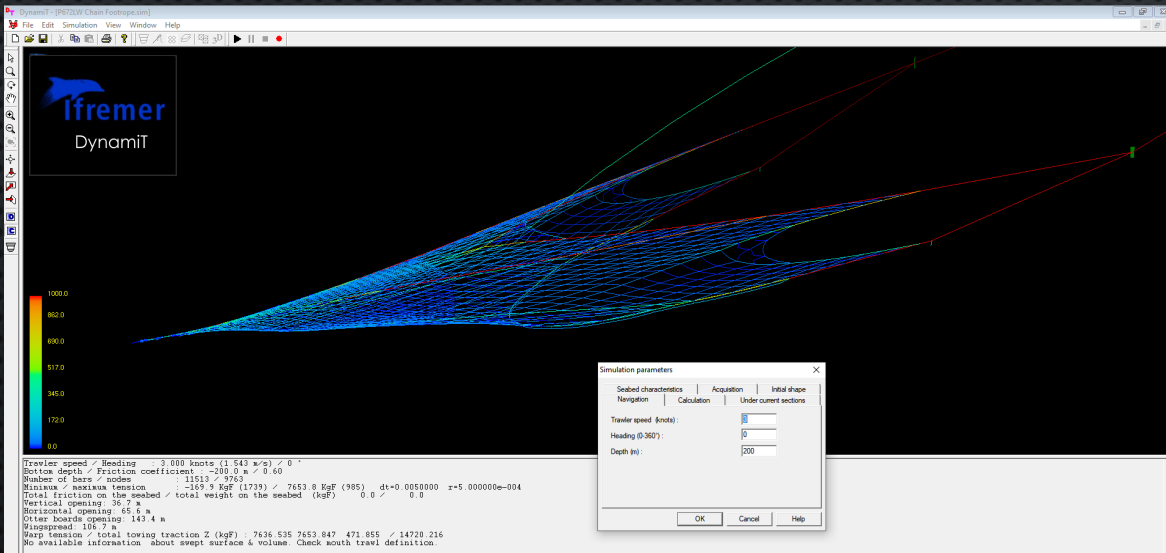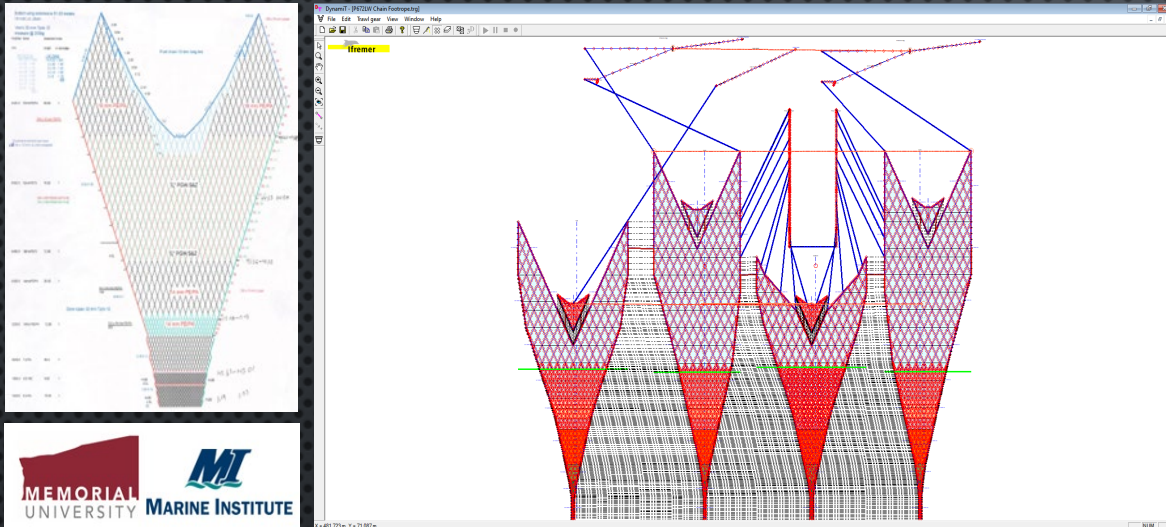
Fishing Practice Effects

	Speed: 3kt	Speed: 3.5kt	Speed: 4kt	Speed: 4.5kt
Warp: 250 m				
Warp: 300 m				

Simulations generate expected geometry and forces under realistic rigging and fishing practice iterations

Pollock Vert. Distribution

Pollock Survey Gear

A. Bottom Trawl Survey

B. Bottom Trawl Survey

C. Bottom Trawl Survey
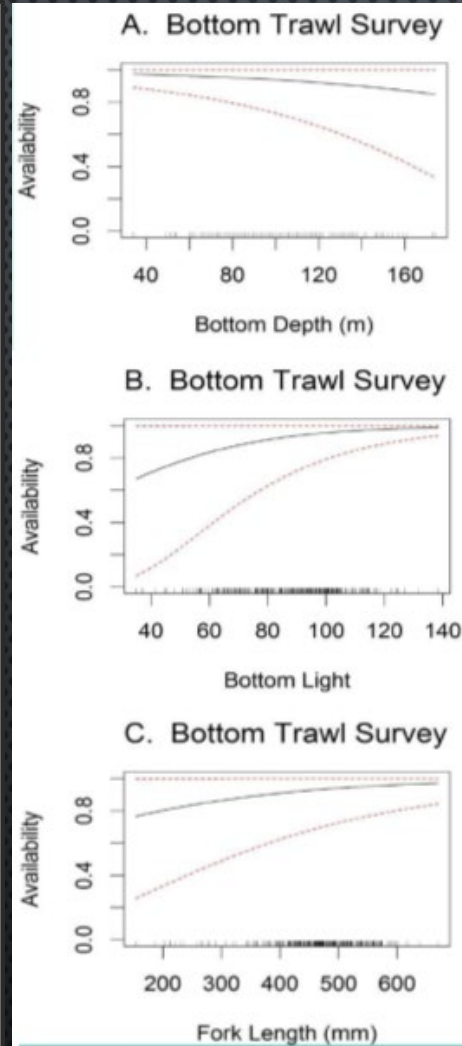
Pollock *availability* to the survey bottom trawl (3m height)
- High *availability* (80 -100%) in shelf waters (40 – 180m),
- Higher *availability* for large than small pollock,
- *Availability* decreases and becomes more variable in deeper waters and under low-light conditions
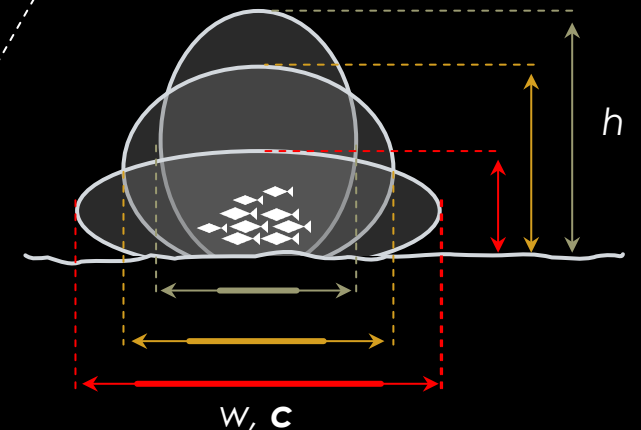
Gear Geometry and Vertical Location Matters

Pelagic trawl shape & location controlled by fishing practices and can vary substantially

Headline Height
→ Pollock CPUE
→ Size/ age comp
* PSC encounters

h
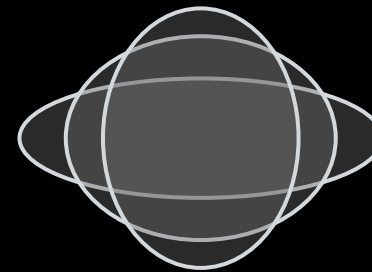
- Scope (Wire: Depth)
- Speed
- Doors
- Wing Weights

w, **c**

Width (w) → Footprint
Footprint + Headline **Height** (h) → Contact (**c**)
(Contact = % of footprint)

North Pacific Research Board Proj. #1507
Kotwicki et al., 2013. CJFAS, 70: 208–219.
Kotwicki et al., 2015. ICES J. Mar. Sci. 72: 1425-1439.

- Gear specifications and haul-level fishing practice data

- **Realized** trawl geometry and forces (net mensuration sensors).

- Construct matching simulation

- **Compare simulated and realized trawl geometry and forces**

EXAMPLE

Vessel Name

A Season

Trawl in use: ☐ Swan 1056 ☐ Egersund 1512 ☑ Swan 1280 ☐ Other:_____

Doors in use: ☑ Thyboron type 22 VK ☐ Other:_____

Rigging:

Bridle length: ___35___ fathoms/meters/feet

Setback length: ___15___ fathoms/meters/feet

Wing Weights per side: ___2000___ lbs/kg

Haul Information:

Haul Number: (Match to logbook #) 120	Date: 03/04/25

	Start time: 1230	Start Lat/Lon (dd.dddd): 54.4300 N 167.0977 W	
	Bottom Depth: 48 fathoms	Vessel Speed: 3.5 knots	Main wire payout: 90 fathoms
	Headrope Height: 38 fathoms	Door Spread: 95 fathoms	
Start of haul	Vertical Opening: 10 fathoms	Fishing circle width **IF AVAILABLE**: 75 fathoms	
	Seastate: 5 (on Beaufort Scale)	Notes:	
	Tension on winches **IF AVAILABLE**: 10100 kgf	towing into/with/cross current	

	Time of entry: 1300		
	Bottom Depth: 50 fathoms	Vessel Speed: 3.4 knots	Main wire payout: 93 fathoms
	Headrope Height: 39 fathoms	Door Spread: 93 fathoms	
In tow entry	Vertical Opening: 11 fathoms	Fishing circle width **IF AVAILABLE**: 73 fathoms	
	Seastate: 4	Notes:	
	Tension on winches **IF AVAILABLE**: 10120 kgf		

Gear Database (Catalog)

Fishing Practice Profiles

Fishing Simulations

Fieldwork: *Bottom Contact*

Fieldwork: *Geometry/ Forces*

MEMORIAL UNIVERSITY MI MARINE INSTITUTE

SUSTAINABLE SEAS: FISHERIES INSHORE NEW ZEALAND (FINZ)

FISHING INDUSTRY SCIENCE PARTNERSHIP (FISP)

Wilson, O.L., Restrepo, F., Bowman, B., Lawson, C., Smith, S., Burch, R., and Harris, B.P (2023). Quantifying and reducing interactions between commercial fishing gear and the seabed in New Zealand, March 2023.
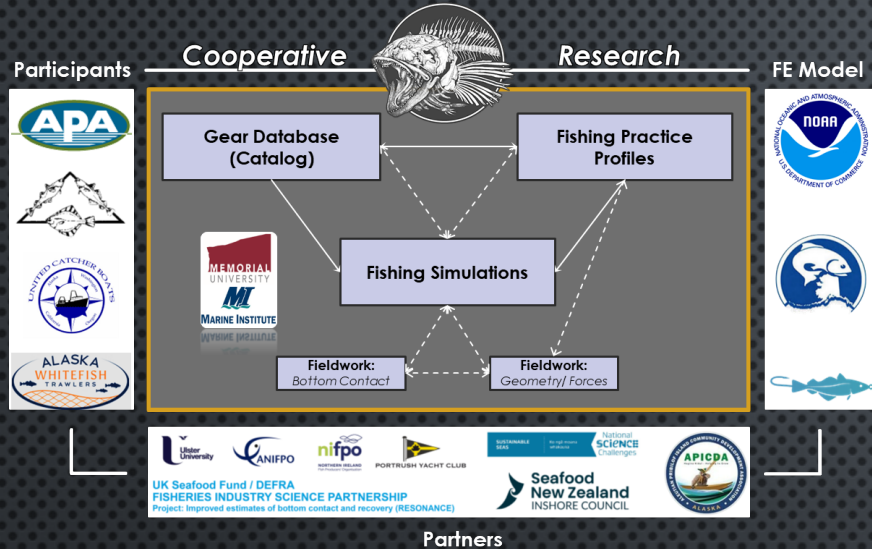

McGonigle, C., Syms, C., Harris B.P ., Sethi, S.A., Restrepo, F., Dooly, G., Weir, A., Hunter, W.R., O'Loughlin, R., Collier, B., McBride, B., McBride, M. (2025). Improved estimates of bottom contact and recovery. Final report FISP Project 335540, FISP10B-2-2.
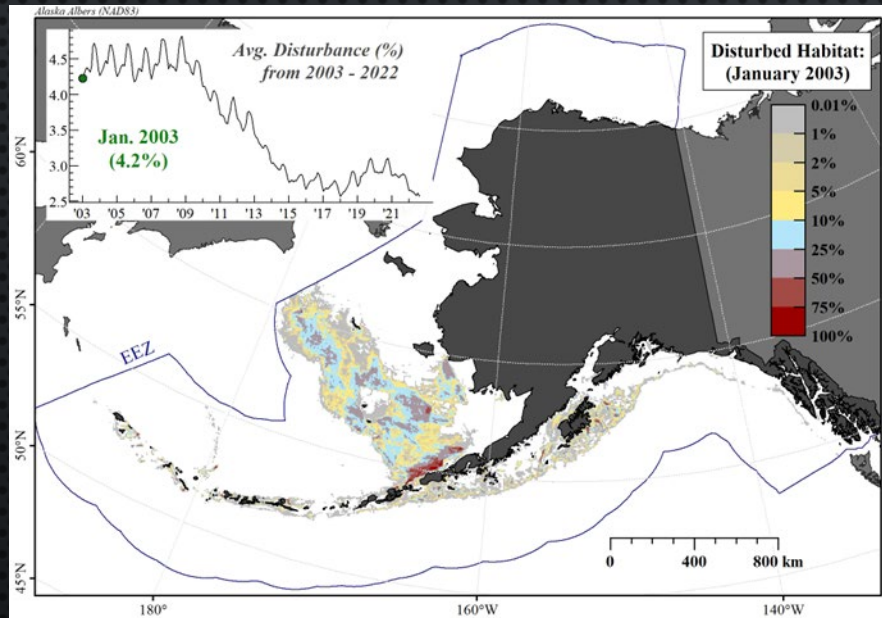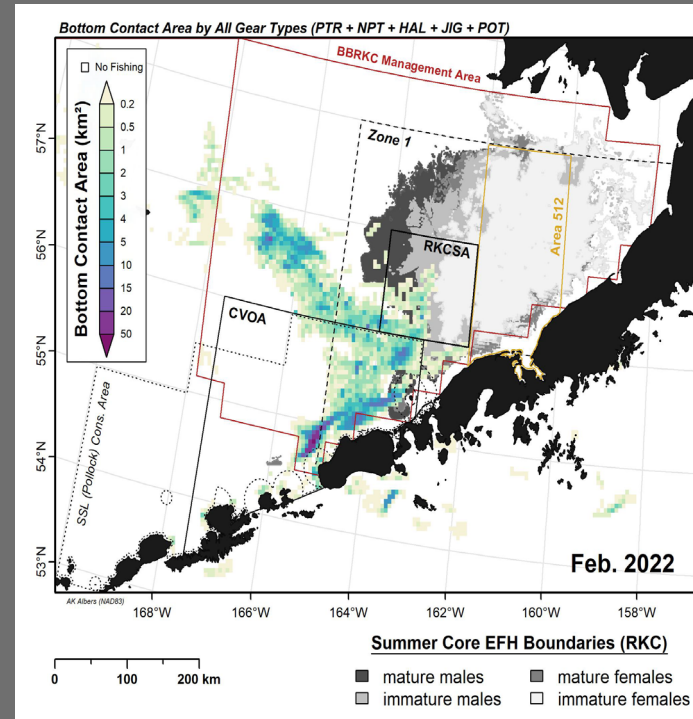
GEAR INNOVATION INITIATIVE

Participants

Cooperative   Research   FE Model

Gear Database (Catalog)

Fishing Practice Profiles

Fishing Simulations

Fieldwork: *Bottom Contact*

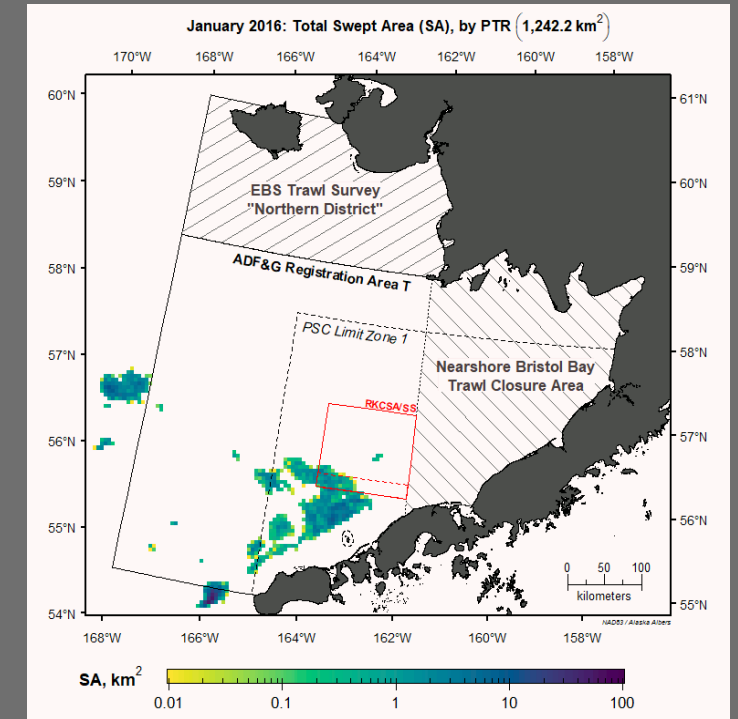Fieldwork: *Geometry/ Forces*

Partners

- Building a Foundation for Gear Innovation
  - 3 Fleets, 119 Vessels, 266 Trawls, 129 Door sets

- Improving Precision and Accuracy of the NPFMC's Fishing Effects Decision Support Tool

Fishing Effects Model

Fishing Footprint

Bottom Contact

GEAR INNOVATION INITIATIVE

Cooperative Research

Participants

FE Model

Gear Database (Catalog)

Fishing Practice Profiles

Fishing Simulations

Fieldwork: *Bottom Contact*

Fieldwork: *Geometry/ Forces*

Partners

- Building a Foundation for Gear Innovation
  - 3 Fleets, 119 Vessels, 266 Trawls, 129 Door sets

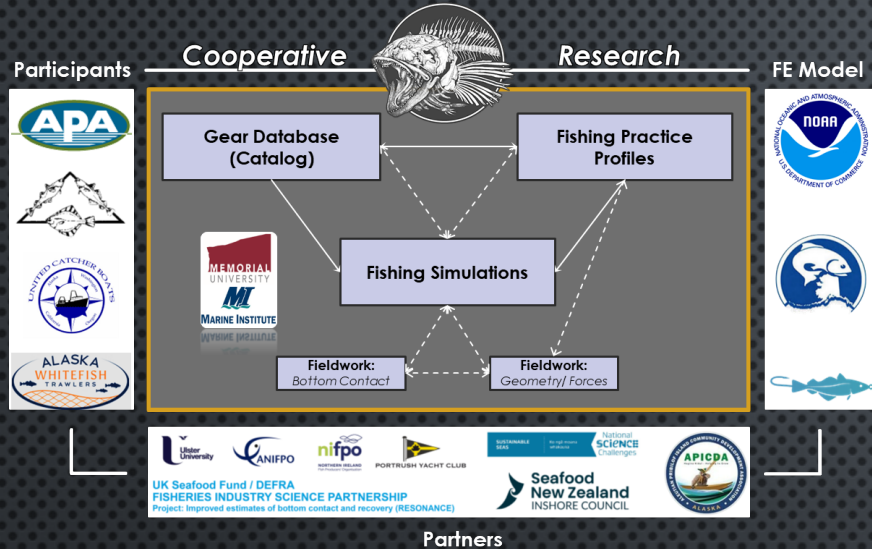- Improving Precision and Accuracy of the NPFMC's Fishing Effects Decision Support Tool

Fishing Effects Model

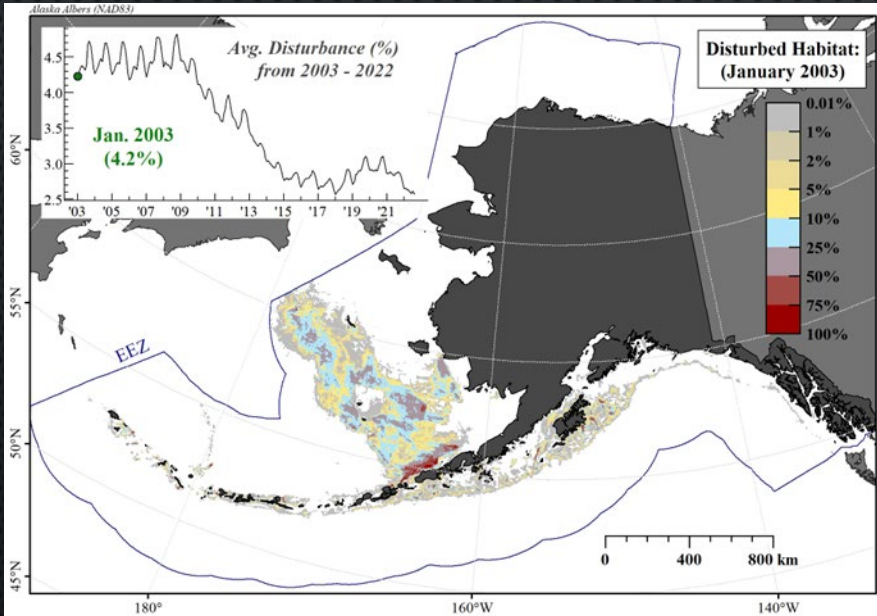*Avg. Disturbance (%) from 2003 - 2022*

Jan. 2003 (4.2%)

Disturbed Habitat: (January 2003)

Trends by (Management) Area
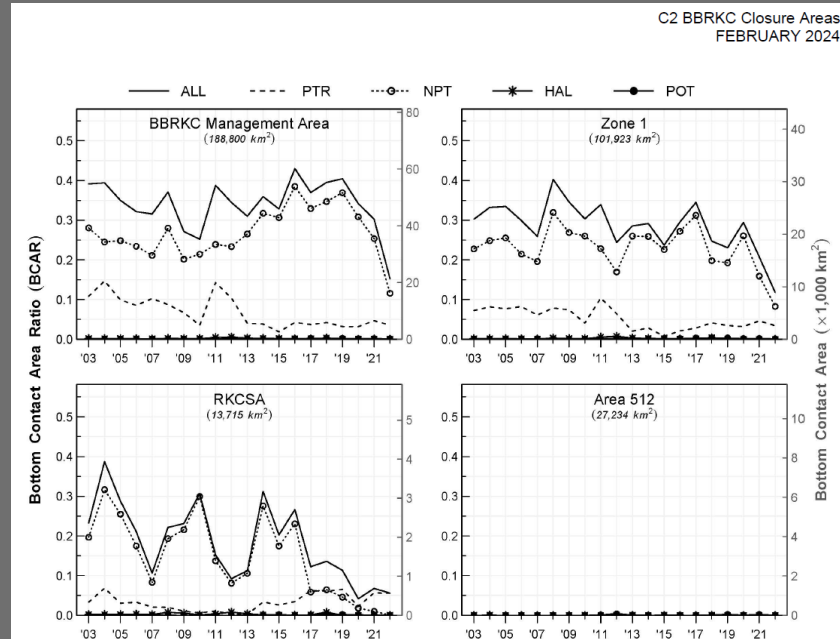

C2 BBRKC Closure Areas
FEBRUARY 2024

Figure 5-19 Estimated yearly bottom contact by gear type within the BBRKC stock boundary, Zone 1, RKCSA/SS, Area 512 from 2003-2022. Note the difference in y-axis scale between "Bottom Contact Area Ratio" on the left y-axis and "Bottom Contact Area" on the right y-axis. (Source: APU FAST Lab)

Thank You

Dr. S. Smeltz
F. Restrepo
Dr. S. Sethi
*J. Olson
M. Eagleton
Dr. S. Lewis
Dr. C. Rose
Dr. J. Pirtle
*A. Nimick
*S. Zagorski
*B. King
*K. Yahnke
NPFMC SSC
AKRO Habitat
NEFMC SSC
NEFMC Habitat PT
… and MANY more!
* Student