FISHING EFFECT MODEL

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Brad Harris, Ph.D.

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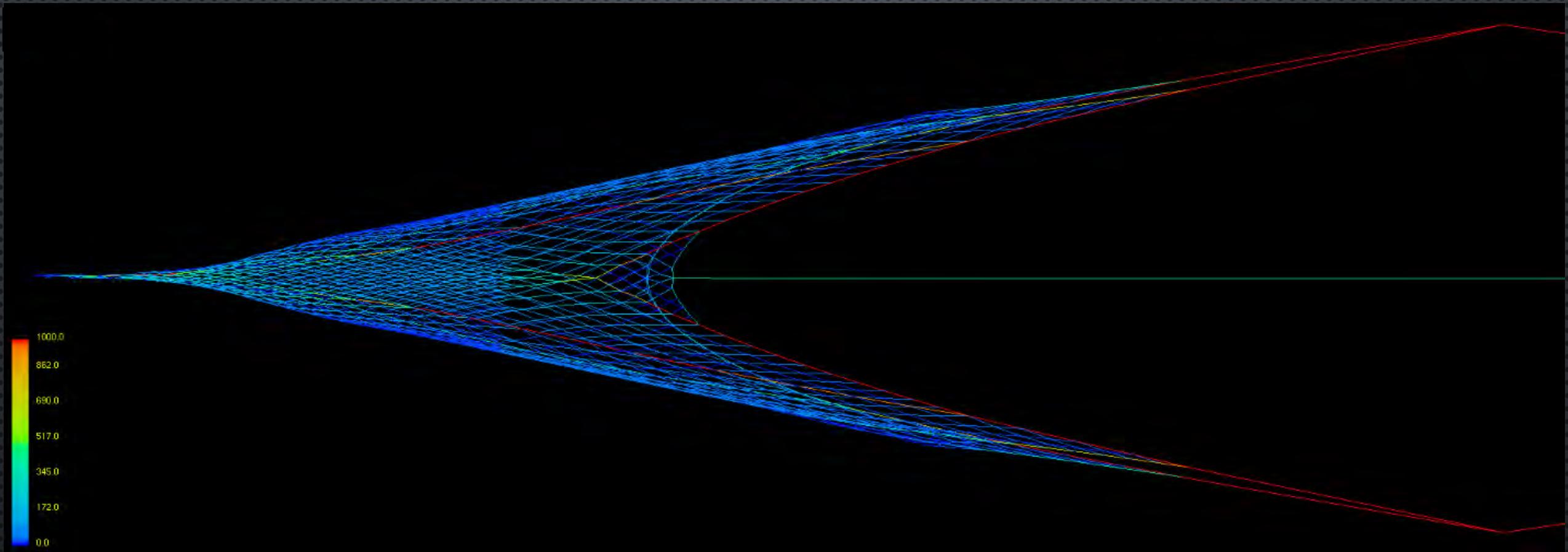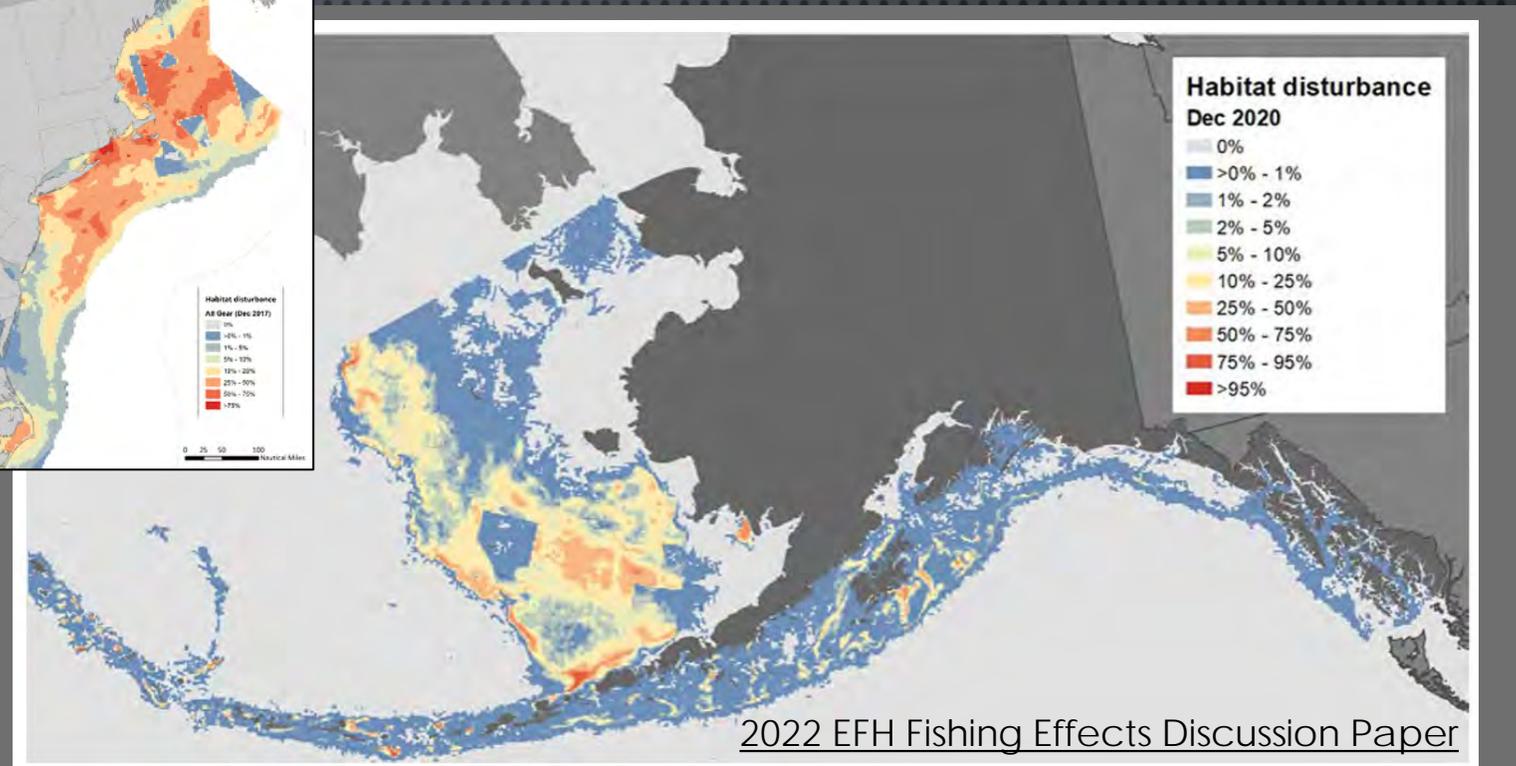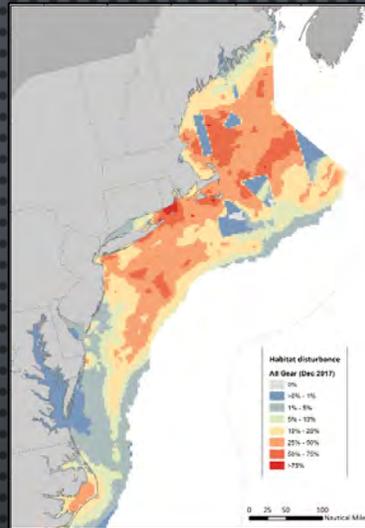
FISHING EFFECTS MODEL

- **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.

2022 EFH Fishing Effects Discussion Paper

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

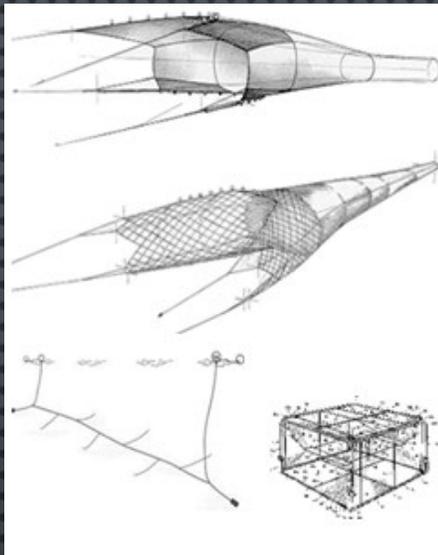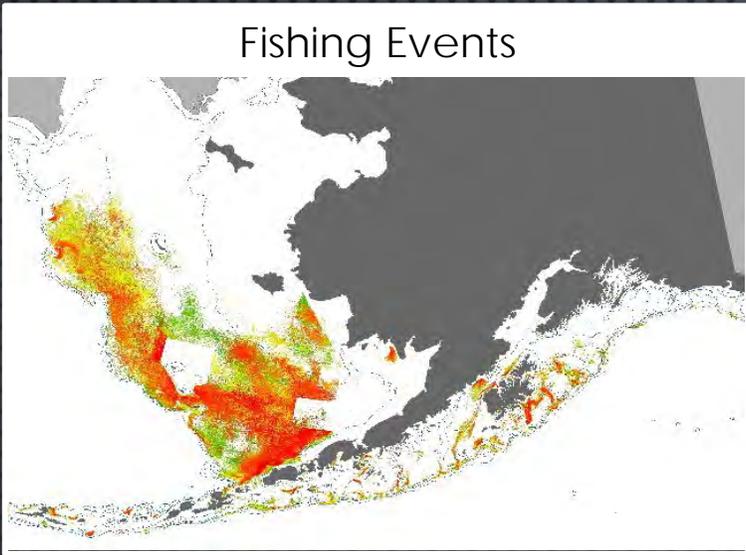**Science Publications:** Grabowski et al., 2014, Smeltz et al., 2019, Smeltz 2023

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….
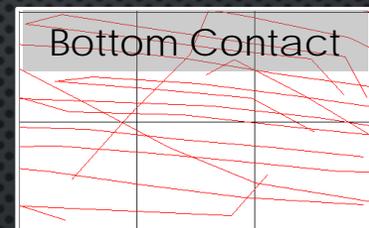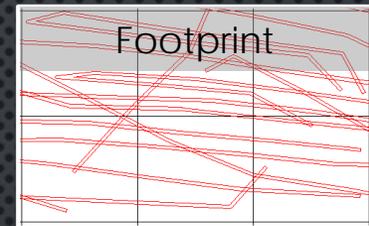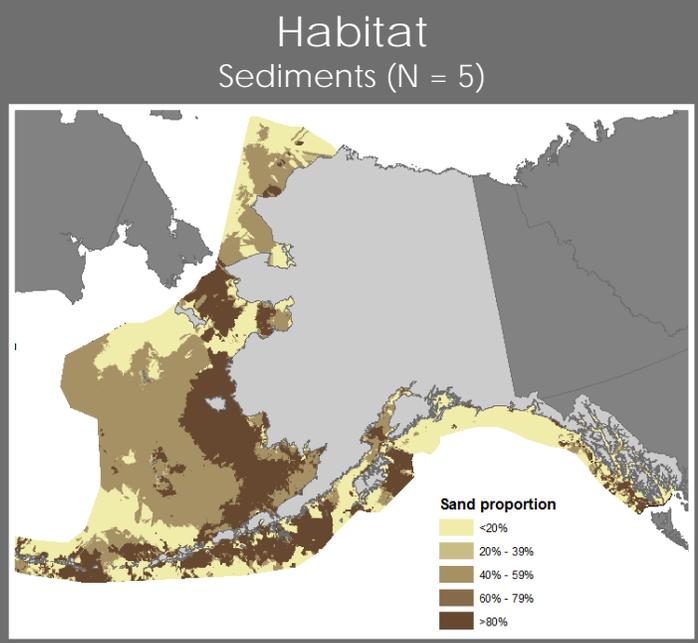
FISHING EFFECTS MODEL – WORKFLOW

Fishing Module

Fishing Events

APPENDIX 2 GEAR PARAMETERS

Footprint

Bottom Contact

Habitat Module

Habitat
Sediments (N = 5)

Sand proportion
- <20%
- 20% - 39%
- 40% - 59%
- 60% - 79%
- >80%

Features
Geo / Bio (N = 27)

Impacts
Literature

Susceptibility
(Prop. Disturbed)

Recovery
(Time to 95%)

Fishing Effects

$$H_{t+1} = H_t(1 - I'_t) + h_t\rho'_t$$

Impacts (I')

Disturbed (h)   Undisturbed (H)

Recovery (ρ')

Swept Area
(Fishing Footprint)

- Area of *potential* gear – seabed interaction

Bottom Contact
(adjusted Swept Area)

- Area of *expected* gear – seabed interaction

Summary Information

- Footprint vs. Contact
- Contact Area Ratio
- Catch/ Contact Area

Yearly Bottom Contact Area & Swept Area (2003 - 2022)
(Source: Catch-In-Areas database)
* Current data available thru Aug. 2022 *
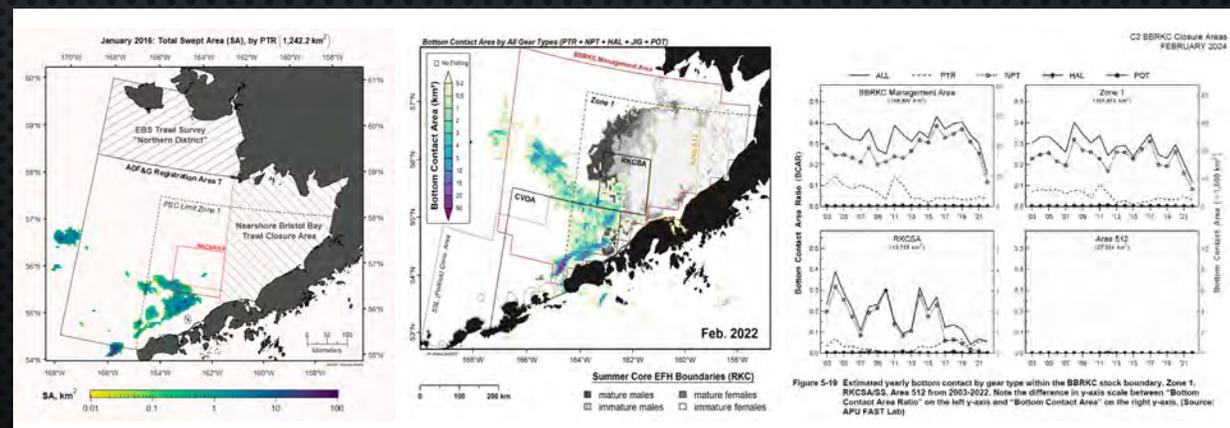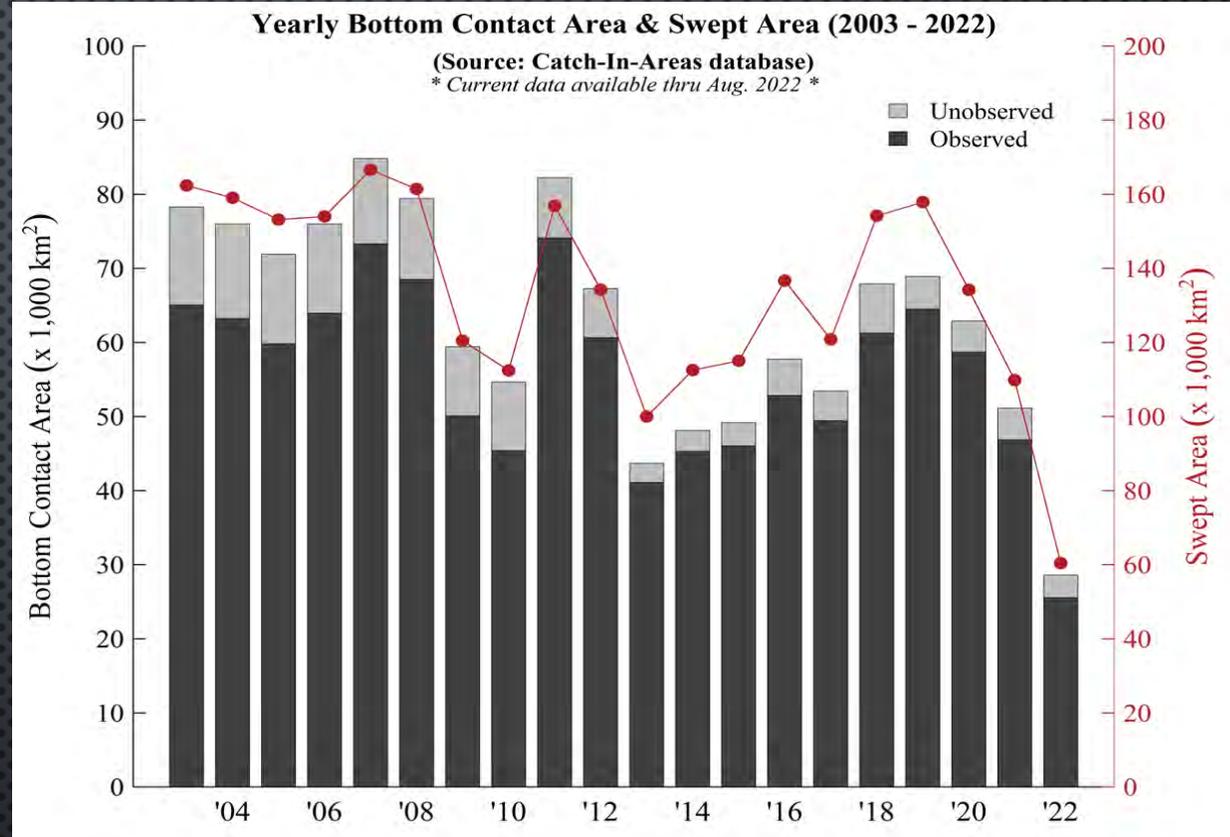
2003-2021:
- 2.6 – 4.8% of benthic habitat (<1000m) in a disturbed state.

- A/B Season pulse of fishing disturbance.

- 2008
  - ↓ Disturbance
    - A80, elevated-sweeps, …

2018 - 2021
- Shift N. in fishing
- ↑↓ Disturbance

Aug. 2022:
- 2.7% of habitat in a disturbed state, 97.3% undisturbed.
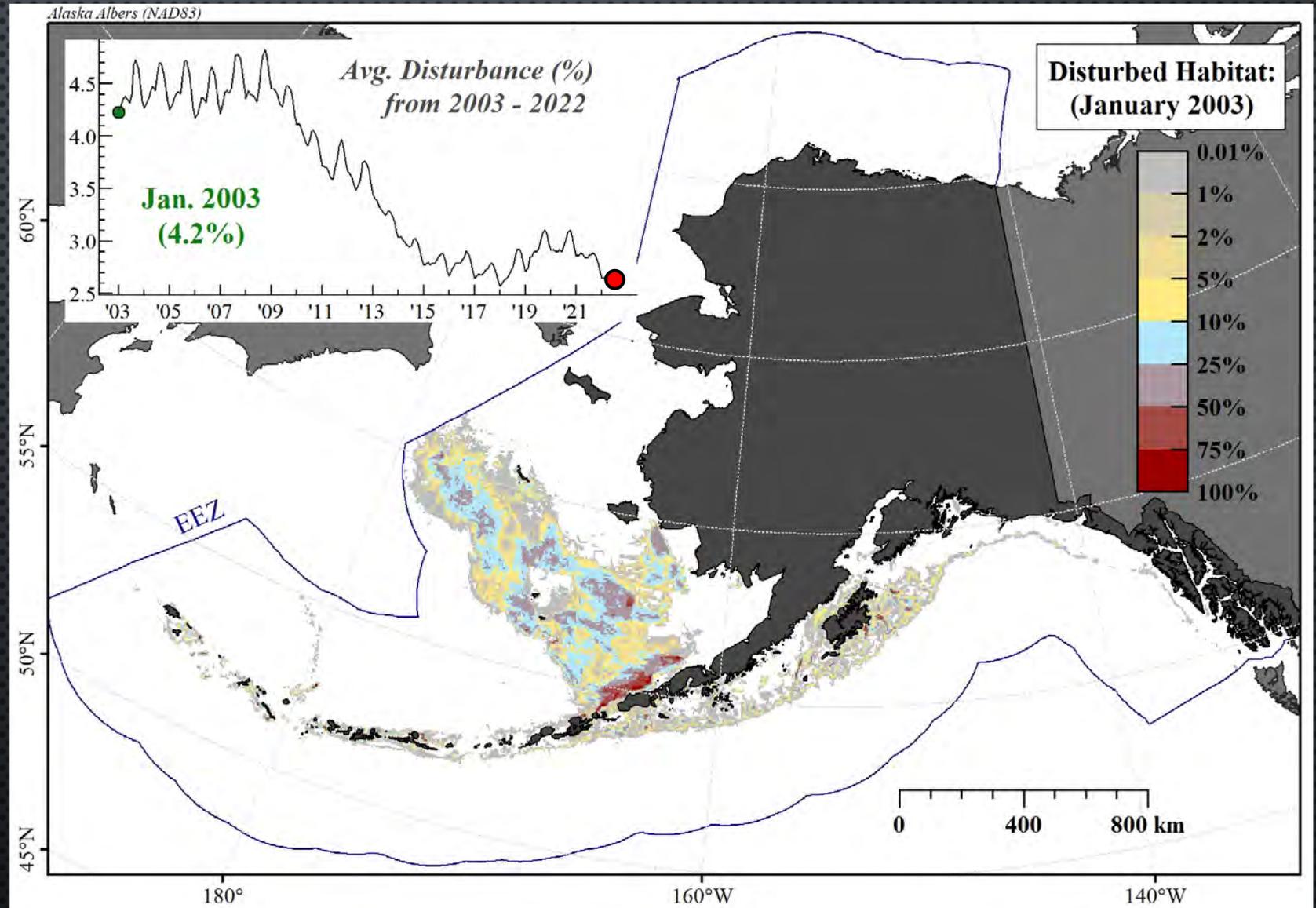
NPFMC Adverse Effects Framework

- *More than minimal AND not temporary*
- *FMP Species - Feeding, breeding and growth to maturity*

Is stock below MSST?

Yes: Elevate for further analysis

Is CEFH disturbance >10%?

Yes: Elevate for further analysis

Significant (p<0.1) correlation with life history parameters?

Yes: Elevate for further analysis

Stock Author Concern?

Yes: Elevate for further analysis

No: Effects Temporary or Minimal

GOA Pacific Ocean Perch

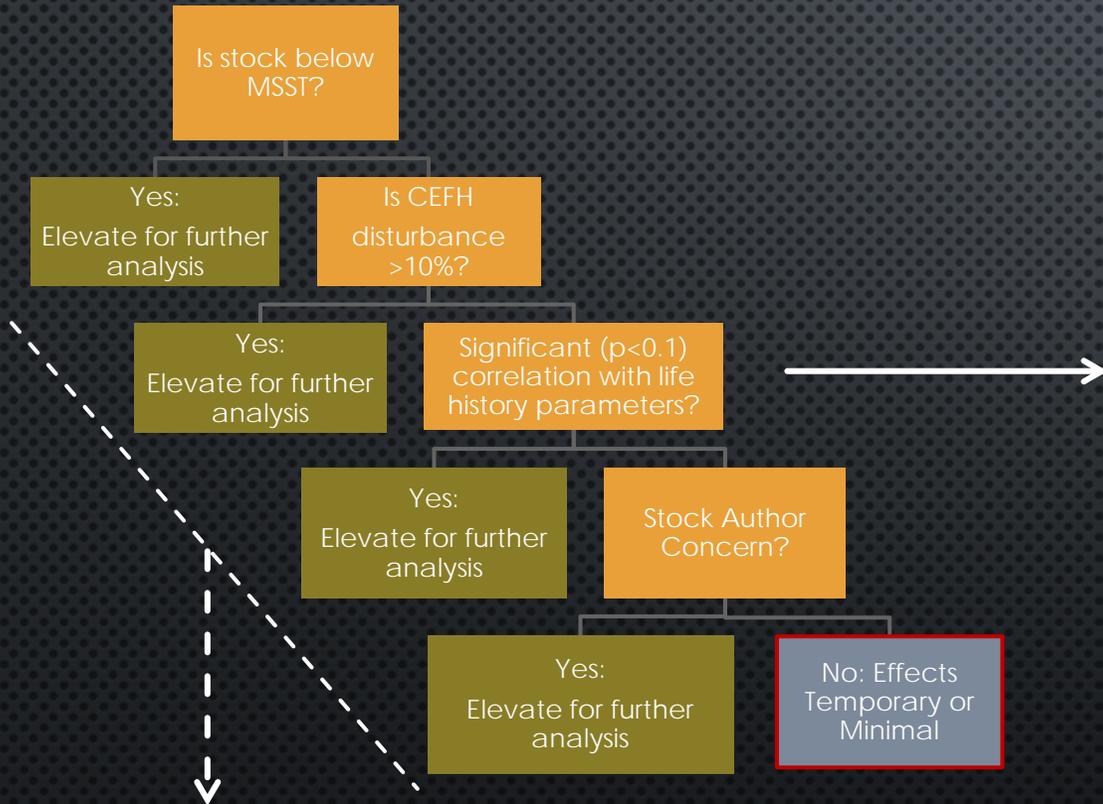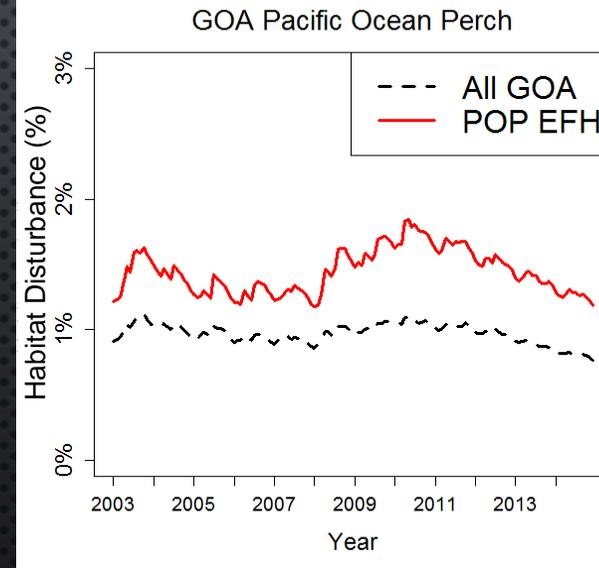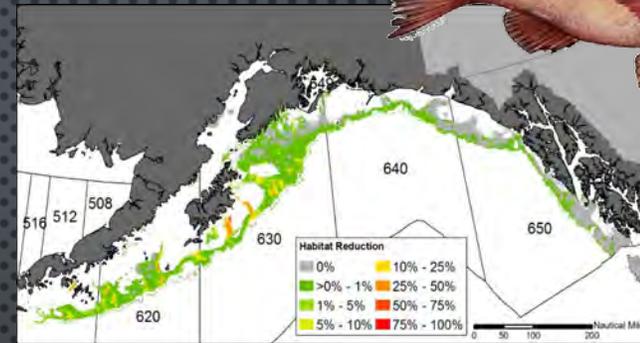Legend: Habitat Reduction — 0%, >0% - 1%, 1% - 5%, 5% - 10%, 10% - 25%, 25% - 50%, 50% - 75%, 75% - 100%

Element		ρ	p-value
Average size-at-age	age-3	-0.49	0.33
	age-4	-0.25	0.63
	age-5	-0.56	0.24
	age-6	-0.58	0.23
	age-7	-0.20	0.71
	age-8	-0.71	0.11
	age-9	-0.25	0.63
	age-10	-0.60	0.21
	age-11	0.02	0.97
	age-12	-0.40	10.43
	age-13	-0.38	0.46
	age-14	0.42	0.41
	age-15	-0.14	0.79
LVB params	L_{∞}	0.56	0.33
	κ	-0.64	0.24
	t_0	-0.64	0.24
Assessment output	Spawning biomass	0.43	0.17
	Total biomass	0.37	0.24
	Recruitment	0.33	0.30

Further Analysis:

- *Informed by adverse effects evidence (e.g., ↑FE : ↓Recruitment)*
- *EFH Team, Stock Authors, Plan Teams, Council*

- GEAR INNOVATION INITIATIVE (GII) -
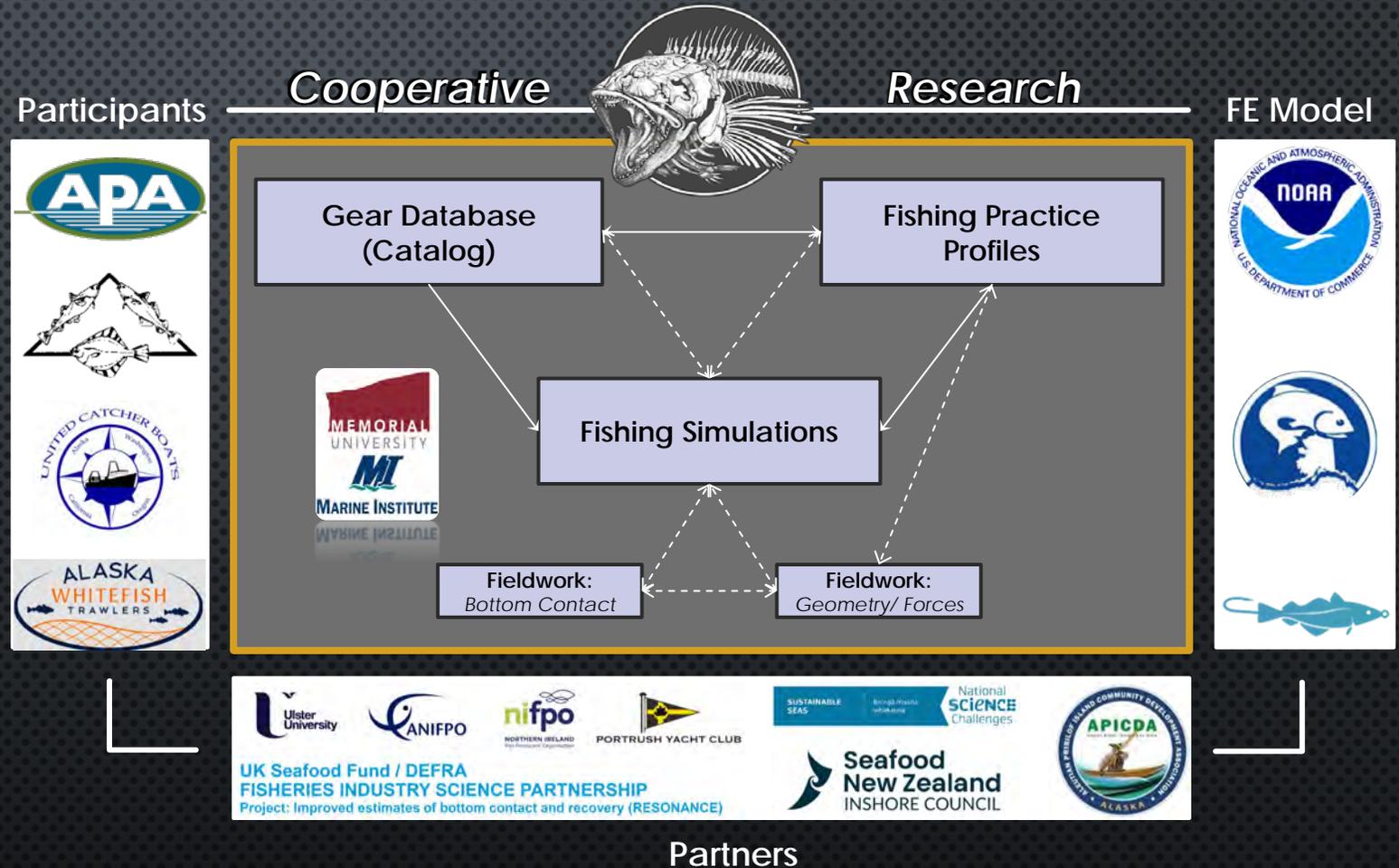
Purpose

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

Participants

Cooperative   *Research*   FE Model

Gear Database (Catalog)

Fishing Practice Profiles

Fishing Simulations

Fieldwork: *Bottom Contact*

Fieldwork: *Geometry/ Forces*

Partners

• CP fleet complete! • CV fleets at >90% • Timeline = Complete for EFH 5-yr Review

Gear Catalog Structure:
- **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

290 Trawls Cataloged!

<u>BS Catcher - Processors:</u>
- 12 vessels (all)
- 84 Individual trawls

<u>BS Catcher Vessels:</u>
- 58/59 vessels
- 116* individual trawls

<u>GOA Catcher Vessels:</u>
- 37/39 vessels
- 64* individual trawls

<u>BS/GOA (cross-over) Catcher Vessels :</u>
- 12 vessels (all)
- 26* individual trawls

- FISHING PRACTICE PROFILES -

• *CP fleet complete!* • *Steady progress with CV fleets* • *Timeline = Complete for EFH 5-yr Review*

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)
- …

85 Fishing Practice Profiles

<u>BS Catcher - Processors</u>:
- Status: Completed
- 12/12 (100%) FPPs completed

<u>BS Catcher Vessels</u>:
- Status: Ongoing
- 29/59 (49%) FPPs completed

<u>GOA Catcher Vessels</u>:
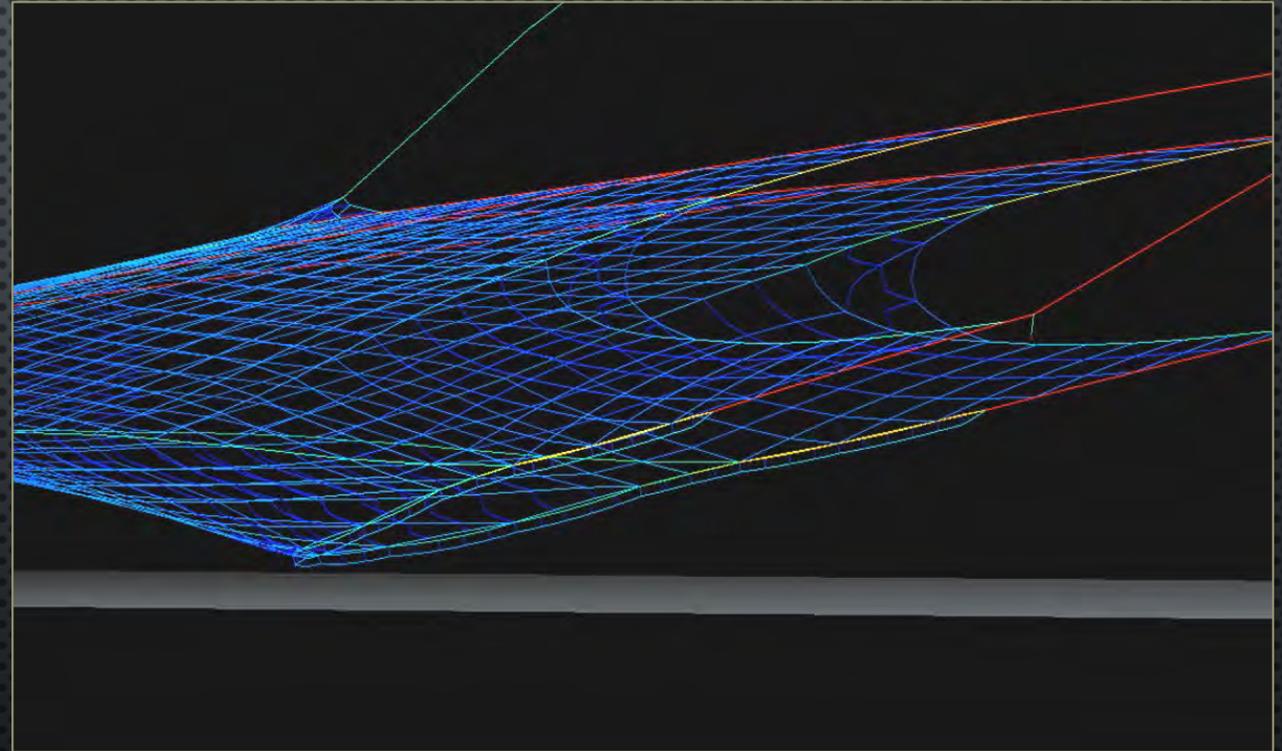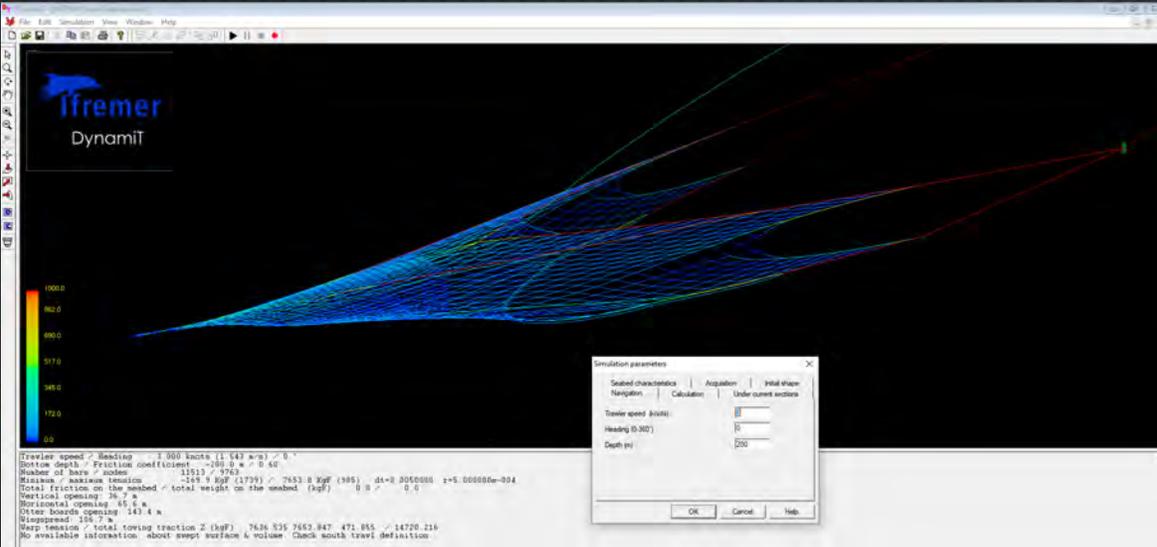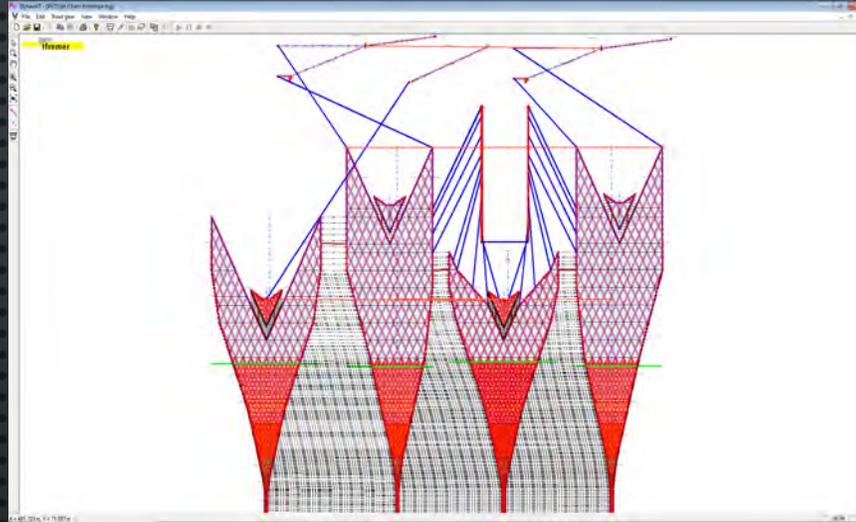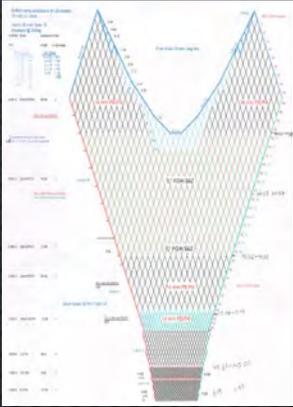- Status: Ongoing
- 33/38 (86%) FPPs completed

<u>BS/GOA Crossover CVs</u>:
- Status: Ongoing
- 11/12 (92%) FPPs completed

Net Plan + Cataloged Specifications + FPP
→ *Geometry, Horizontal / Vertical Forces, Seabed Contact*
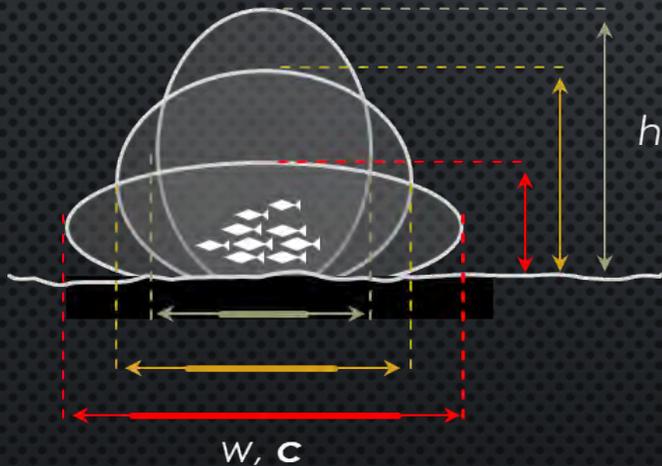
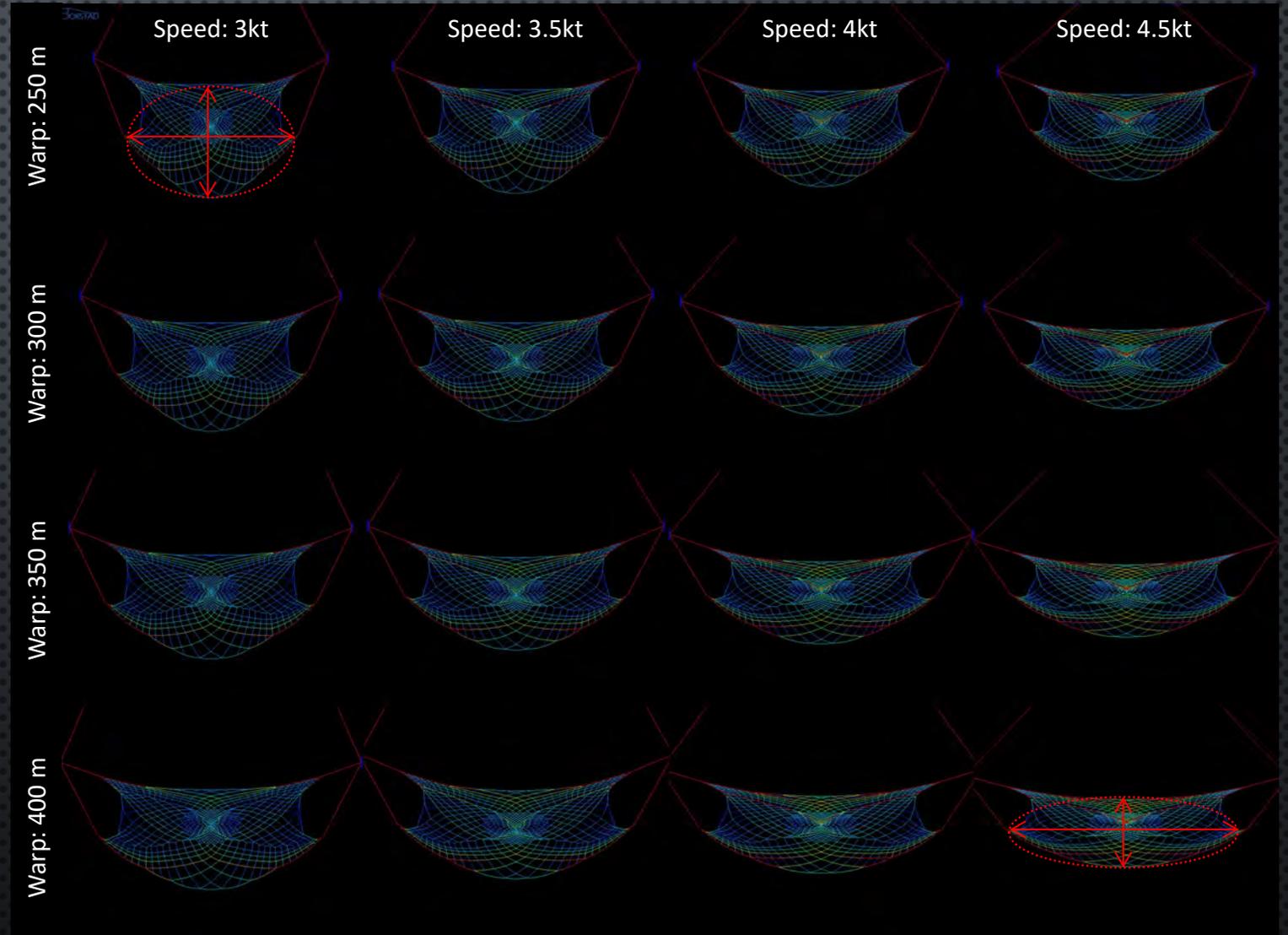• *Geometry → Gear width and potential bottom contact width*

Trawl geometry determines:

- Gear width and potential bottom contact width
- Is influenced by gear design and specs (catalog) and operator decisions (FPP)

h

$w, \mathbf{c}$

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

• Strong CP and CV fleet participation! • 2025 A&B seasons/ 2026 A-season ongoing • Timeline = EFH 5-yr Review

111 Haul Logs

- Haul log sheet collection is ongoing for 2026 A season

- Haul log sheet data collected for:

  - 2025 A season:
    - 38 haul logs
    - 101 entries
    - 8 vessels

  - 2025 B season:
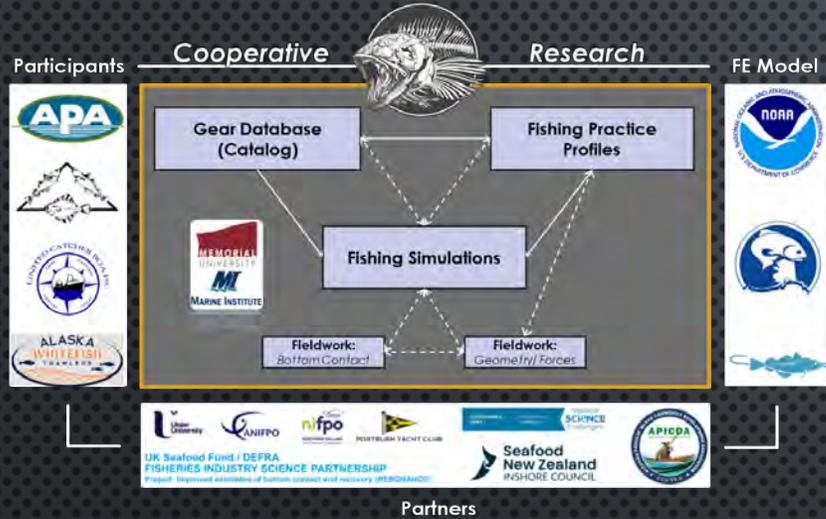   - 73 haul logs
    - 265 entries
    - 21 vessels
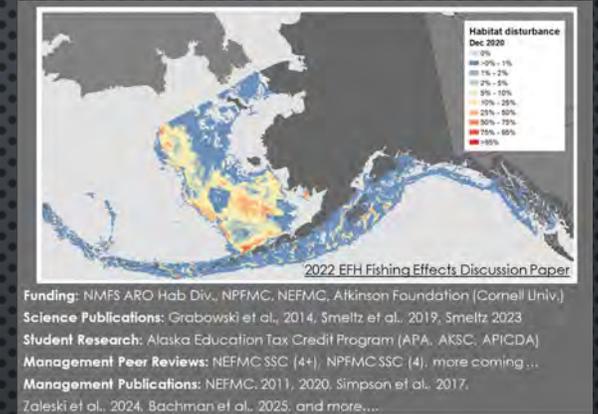
- GEAR INNOVATION INITIATIVE (GII) -

Gear Table → Fishing Effects Model → Essential Fish Habitat (EFH)
Quantitative Assessment of Cumulative Habitat Impacts → Informs if additional measures are needed

GII informs scope and magnitude of gear impacts

- Gear Catalog: *What you Fish*
- Fishing Practice Profiles: *How you Fish it*
- Model Simulations: *How it looks in Theory*
- Haul Logs: *How it looks in Practice*

NPFMC Efforts/ Actions
- EFH 5-Yr Review
- Unobserved Crab Mortality
- GOA Tanner Crab
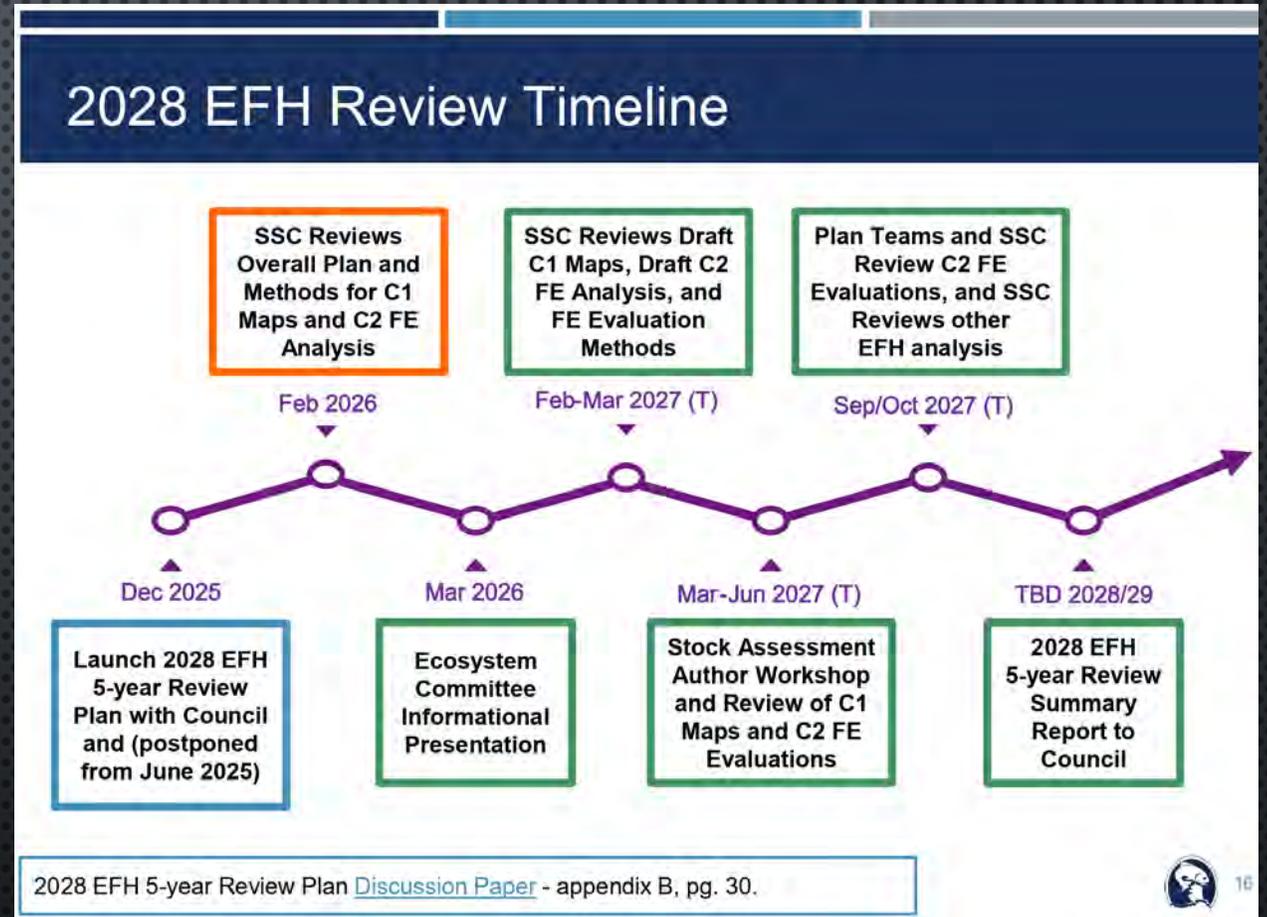- Spatial/ Temporal Fishing effort redistribution
- …

Parallel Ongoing Research
- Trident Seafoods modified footrope design
- American Seafoods testing remotely operated trawl doors
- Voluntary Crab Avoidance Areas
- Improved Data on Fishery Interactions with BS Crab pop's

https://www.npfmc.org/pelagic-trawl-gear-research-summaries/

- **GII informs scope and magnitude of gear impacts**
  - Sourced from gear inventory, fishing practice profiles, model simulations and haul logs.

- **GII → Essential Fish Habitat (EFH)**
  - Gear catalog and fishing simulation-based estimates of nominal width and seabed contact will be used to update the pollock trawl gear parameters

- **GII → Other NPFMC Actions and Parallel Ongoing Research**

- **GII Status: Catalog, FPP, Haul Logs, Sims, Gear Tables**
  - Gear and fishing practice profiles - ongoing
  - 2026 A Season haul logs - ongoing
  - Simulations - ongoing (geometry and forces)
  - GII outputs integrated in the FE analyses on the EFH – 5yr review timeline.

- **FEM: Updated Catch-In-Area effort data, gear parameters, benthic habitat data, habitat susceptibility and recovery rates.**
  - The SSC will review the **updated gear parameters (including nominal widths and bottom contact adjustments)** and any updates to the FE model habitat recovery parameters.

2028 EFH Review Timeline

SSC Reviews Overall Plan and Methods for C1 Maps and C2 FE Analysis — Feb 2026

SSC Reviews Draft C1 Maps, Draft C2 FE Analysis, and FE Evaluation Methods — Feb-Mar 2027 (T)

Plan Teams and SSC Review C2 FE Evaluations, and SSC Reviews other EFH analysis — Sep/Oct 2027 (T)

Dec 2025 — Launch 2028 EFH 5-year Review Plan with Council and (postponed from June 2025)

Mar 2026 — Ecosystem Committee Informational Presentation

Mar-Jun 2027 (T) — Stock Assessment Author Workshop and Review of C1 Maps and C2 FE Evaluations

TBD 2028/29 — 2028 EFH 5-year Review Summary Report to Council

2028 EFH 5-year Review Plan Discussion Paper - appendix B, pg. 30.

Thank You

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*B. King
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NPFMC SSC
AKRO Habitat
NEFMC SSC
NEFMC Habitat PT
… and MANY more!
* Student