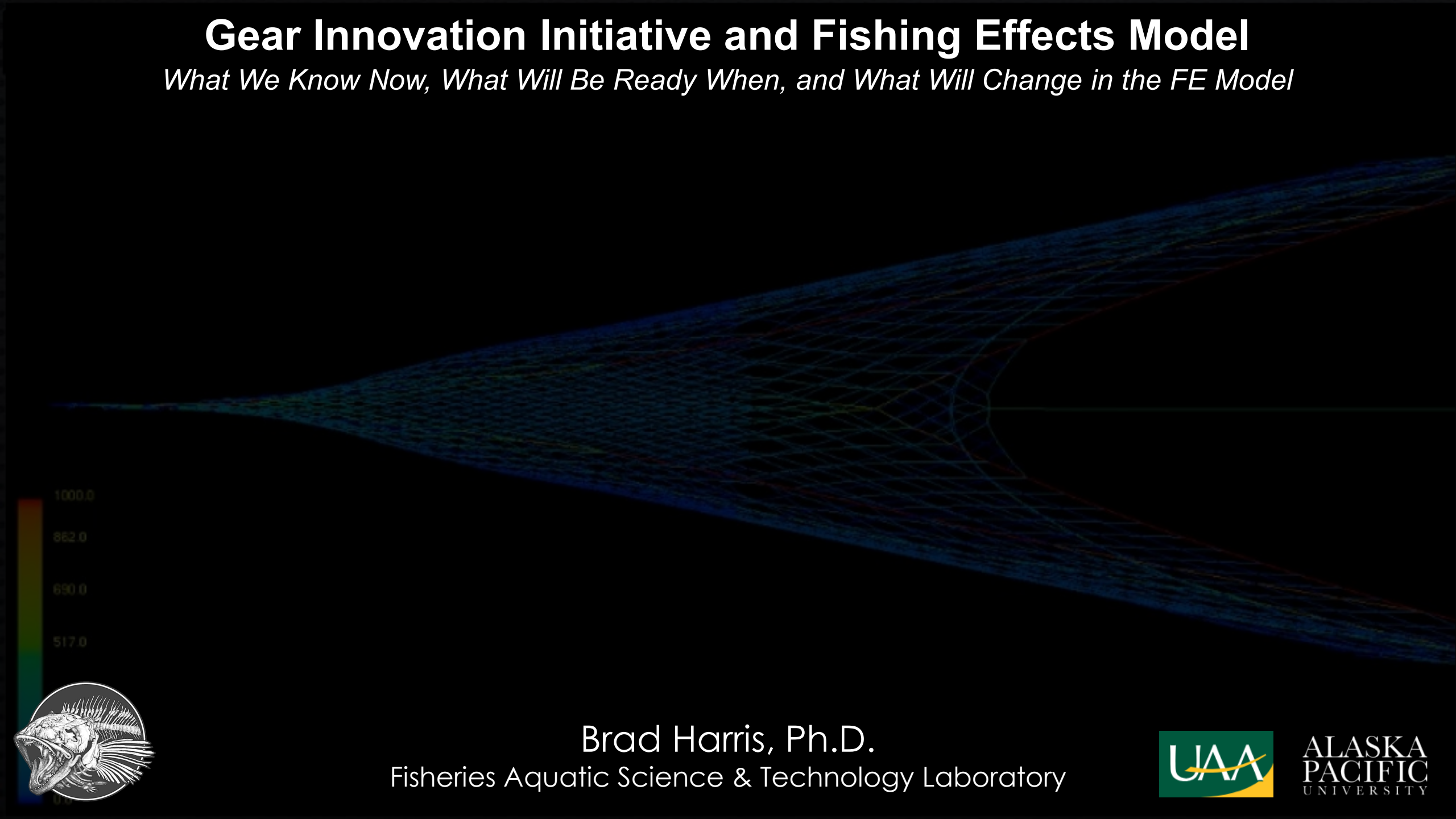
Gear Innovation Initiative and Fishing Effects Model

What We Know Now, What Will Be Ready When, and What Will Change in the FE Model



Brad Harris, Ph.D.
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Three things to cover … in 30 minutes

What we know now, what will be ready when, and what changes in FEM

1 · Research progress

291

Trawls cataloged

- Gear catalog, FPPs, haul logs, simulations, and field validation are now aligned.
- CP foundation is complete and directly useful for bottom-contact estimates.

2 · GII timeline

2027

FE analysis / SSC review gate

- Gear parameter tables move toward model-ready estimates on the EFH review timeline.
- Use source-tiered estimates where validation is still catching up.

3 · FEM changes

4

Major FEM input updates

- The model framework remains stable.
- Inputs are being updated: fishing events, gear, habitat, and impact/recovery parameters.

Emphasis is on decision-readiness

Bottom-Tow Fisheries Sustainability Roadmap

Public concern is part of the sustainability process

Fish and Fisheries

WILEY

FISH and FISHERIES

ORIGINAL ARTICLE OPEN ACCESS

Challenges and Opportunities for Strengthening Bottom-Tow Fisheries Sustainability

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Keywords: animal sourced foods | cooperative science | groundfish | living marine resources | ocean management

ABSTRACT

Bottom-tow gear fisheries (trawls and dredges) produce ~24 million mt of harvest annually, representing a globally important animal-sourced food system. While many are currently sustainably managed, growing concern over the potential for ecosystem impacts from bottom-tow gears has increased pressure to improve these fisheries. We assembled an international working group of > 30 contributors, including fishing industry participants, managers, non-governmental ocean conservation organization representatives, and scientists to synthesize obstacles to bottom-tow fisheries sustainability and to develop expert-based recommendations to operationalize sustainability advancements moving forward. We identified 30 key gaps impeding bottom-towed fisheries sustainability spanning 6 core challenge areas including: seafloor disturbance, bycatch and discards, management design and implementation, fishing operations, cross-sector conflicts, and public perception and communication. We generated 28 priority recommendations to address bottom-tow fisheries sustainability obstacles with themes including: addressing data gaps, advancing mechanistic understanding and modelling tools, strengthening management processes, and improving knowledge sharing and communication. Cross-disciplinary and diverse system experience among fisheries and marine ecosystem stakeholders will be critical for operationalizing bottom-tow fisheries sustainability advancements. As the global human population approaches 10 bn in the next 30 years, ensuring sustainable wild capture fisheries is an imperative for feeding the world. Outputs

Sethi et al. 2026

Challenges and Opportunities for Strengthening Bottom-Tow Fisheries Sustainability

2026	32	30 gaps	4
Publication	Participants	28 recs	Solution Themes

How the synthesis was built

Convene	Deliberate	Synthesize
2024 World Fisheries Congress • Seattle	Day 1: Gaps Day 2: Recommendations	Gap-to-recommendation map review + editing

Who was at the table

Science • Management + Policy
Fishing Sector • Conservation Organizations

Geographic representation

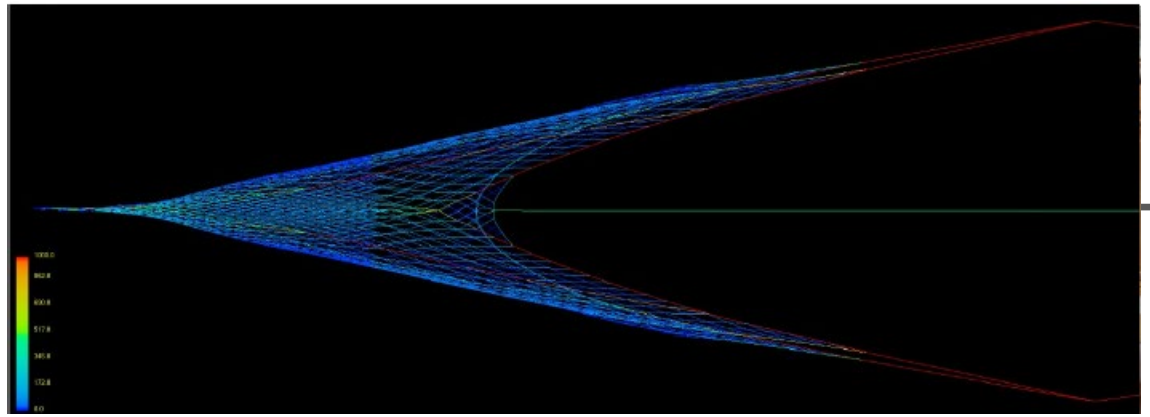
United States • Australia • China • Finland
Iceland • New Zealand • Northern Ireland
Peru • Scotland

Public perception + communication was identified as a sustainability challenge area - recognize concern, then respond with transparent evidence and tradeoff reporting.

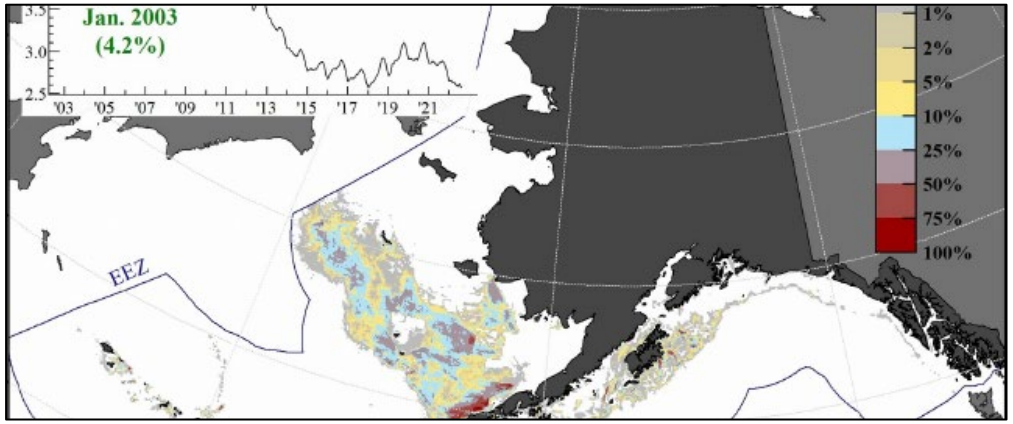
A Different Approach

Public concern + Council decision need → evidence requirements → GII/FEM analysis → reviewable outputs

GII Evidence



FEM Decision Support



Public concern

"What gear is on bottom - where, how much, and how do we know?"

Council need

Transparent inputs and review timing before EFH decisions.

GII – FEM

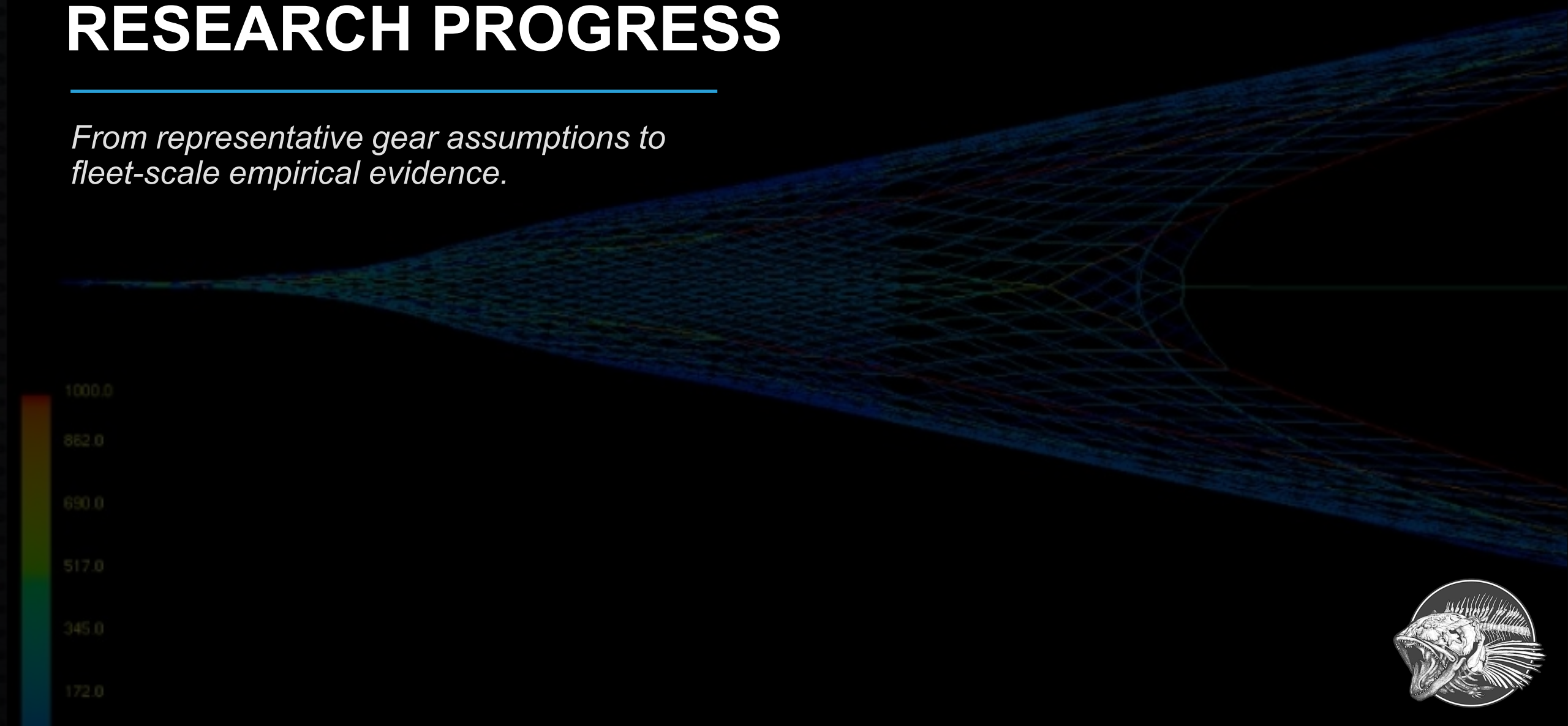
Document gear → estimate contact → show model effects and uncertainty.

Transparent, traceable evidence for decisions

01

RESEARCH PROGRESS

From representative gear assumptions to fleet-scale empirical evidence.

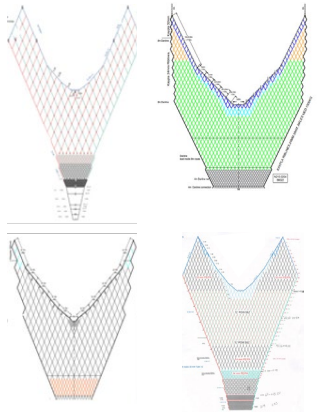


The evidence pipeline is now field-scale

Gear catalog + FPPs + haul logs + simulations + tank validation

291

Trawls cataloged



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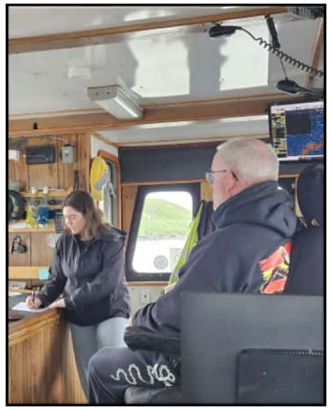
Fishing Practice Profiles



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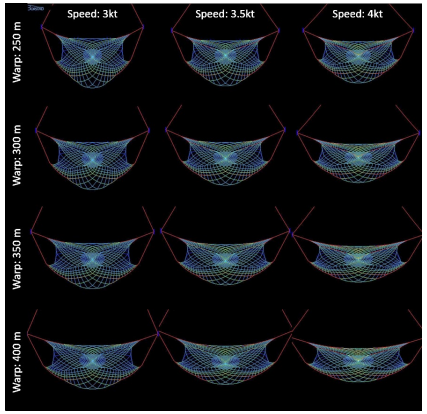
Fishing simulations



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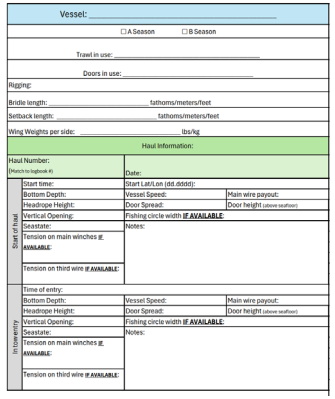
Haul logs collected



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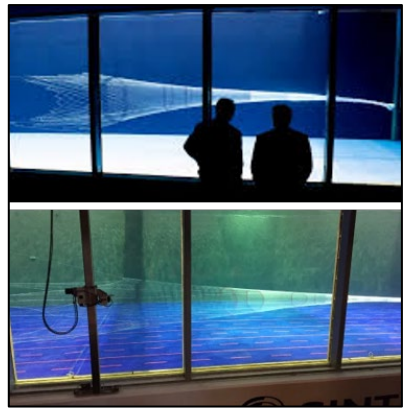
CP scale models for tank validation



Gear catalog
What is fished

→

FPPs
How it is fished

→

Simulations
How gear behaves

→

Haul logs
How it looked in practice

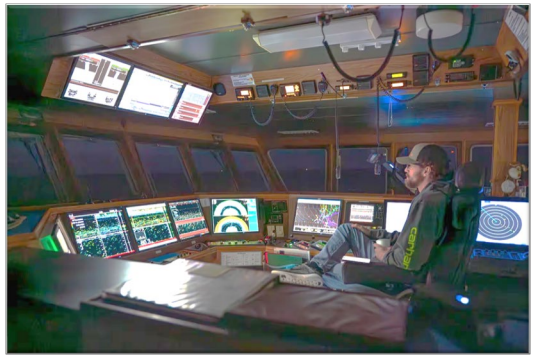
→

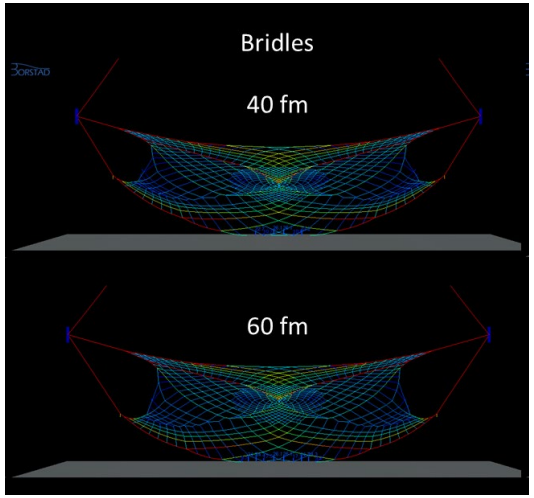
Tank / sensors
How we validate contact

This year the project moved from "*what generic pelagic trawls might do*" to "*what documented gears do under documented fishing scenarios*."

Gear catalog + FPPs: no more generic “pelagic trawl”

Actual gear design and actual fishing practice now drive nominal width and contact estimates





What the catalog captures

- Design and individual net plan
- Materials, including footrope chain dimensions
- Configuration: doors, bridles, setback, wing weights
- Modifications, including salmon excluders

What FPPs add

- Speed, warp length, scope
- Bridle length, setback, door roll
- Target headline depth, vertical opening, wing spread

12/12
CP vessels with complete FPPs

85
CP individual trawls

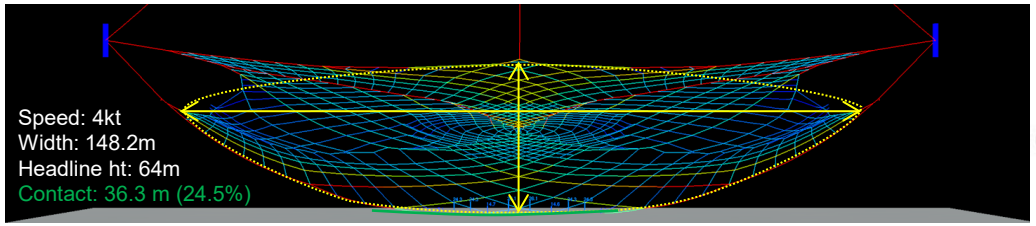
14
CP trawl models

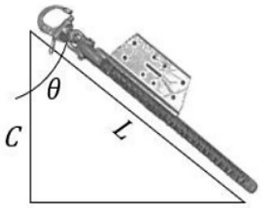
Why it matters

Supports move from broad assumptions toward gear- and scenario-informed parameter values.

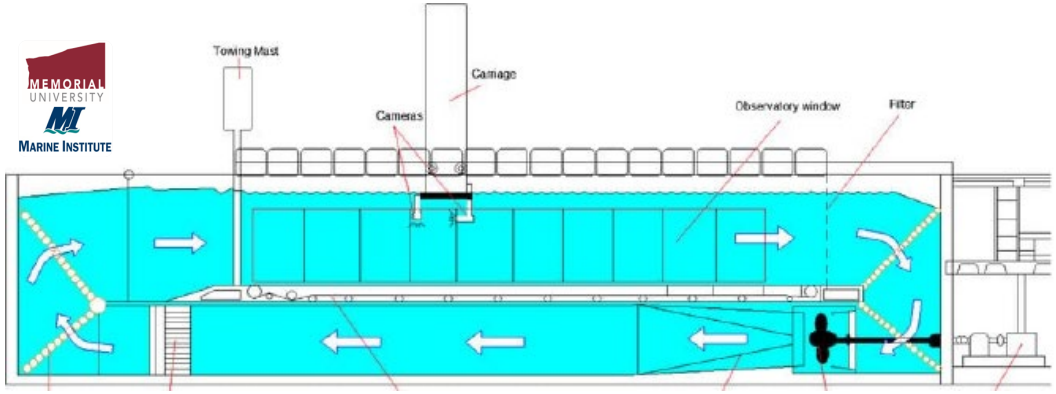
CP Field Study: closing the loop between model and reality

The CP fleet is the strongest near-term foundation for contact estimates





- Purpose built fishing gear research facility
- 1.7-million-liter (450k gallon) recirculating tank
- 8m × 4m test section
- 22m long observation chamber
- Flow speeds up to 1 m/s
- Moving seabed simulation system
- Underwater force measurement capability
- Controlled trawl-geometry experimentation
- Real-time underwater gear observation



A flume is an engineered channel of flowing water used to study how water interacts with objects.

CP foundation

12/12 vessels · 85 trawls · FPPs complete. This gives the cleanest path from cataloged gear to gear-table parameters.

Validation focus

Three common CP trawl models A/B/C represent ~55% of CP trawls and are targeted for tank validation.

Haul-log bridge

Vessel haul logs and net-sensor data provide the realized geometry used to check simulations.

Sensor reality check

Tank tests probe practical footrope clearance/contact sensors: attachment, fouling, vibration, and noise.

What the Council gets from this

- A CP gear parameter FEM package built from cataloged gear and observed fishing practice.
- A validation path for simulation-derived width and contact estimates.
- Clear separation between model-ready estimates and research-continuing sensor work.

Detailed GII status numbers

NORTH PACIFIC FISHERY MANAGEMENT COUNCIL

MENU

PELAGIC TRAWL GEAR RESEARCH SUMMARIES

Gear catalog

- 291 trawls cataloged
- BS CP: 12 vessels, 85 trawls
- BS CV: 58/59 vessels, 116 trawls
- GOA CV: 37/39 vessels, 64 trawls
- BS/GOA crossover: 12 vessels, 26 trawls

Fishing Practice Profiles

- 85 FPPs completed/developed
- BS CP: 12/12 complete
- BS CV: 43/59 complete
- GOA CV: 38/38 complete
- BS/GOA crossover: 12/13 complete

Haul-log sheets

- 2025 A: 38 haul logs, 101 entries, 8 vessels
- 2025 B: 73 haul logs, 265 entries, 21 vessels
- 2026 A: 141 haul logs, 400 entries, 27 vessels
- Door height added on updated sheets for 2026 A

GII Insights

From a gear label to the expected contact area under real fishing scenarios

"Pelagic trawl" is not one contact condition

Bottom contact varies with design, rigging, fishing practice, and operating conditions.

How gear is fished matters as much as what gear is fished

Operator decisions shape trawl geometry, vertical position, and expected seabed contact.

Simulations are now useful management tools

Simulation performance is strong enough to support updated FEM gear parameters.

The fleet is more diverse than assumed - and now quantifiable

Cataloging shows real gear diversity, but also that it can be systematically characterized.

Bottom contact is driven by geometry, not width alone

Vertical opening, footrope shape, and trawl position appear central to contact estimates.

Bottom line

Fishing effects emerge from gear × rigging × fishing practice × operating context.

Key Insight: Fishing effects are not fixed properties of a gear type - they emerge from the interaction of gear design, rigging, fishing practice, and seafloor proximity.

FAQ → FEM parameter

A project audit path

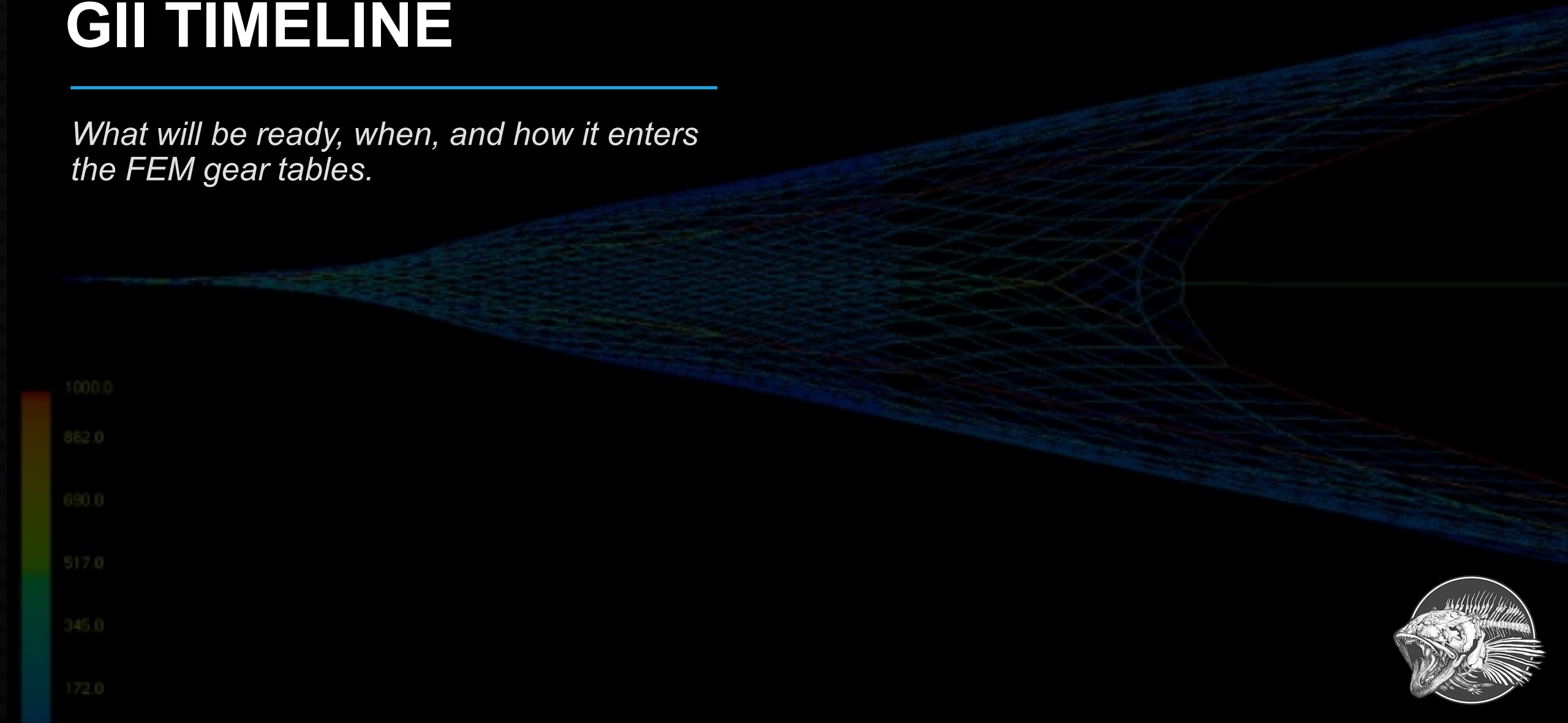
Concern	Scientific question	Evidence stream	FEM output
“Are pelagic trawls fishing on the bottom?”	Which components touch under real gear, rigging, depth, and speed scenarios?	FPPs + haul logs + simulations + tank validation	**Bottom-contact adjustment**
“Are impacts hidden by broad averages?”	How much do gear designs and fishing practices vary across the fleet?	Gear catalog + FPPs + scenario runs	**Gear/scenario-specific nominal width and contact**
“Is FEM a black box?”	Can each estimate be traced to a source and QA step?	Parameter table metadata + bridging analyses	**Audit trail and uncertainty notes**
“Will this be ready for EFH?”	Which parameters are model-ready vs validation-pending?	Readiness board + SSC review gates	**Review-ready FE analysis package**

Public-facing “audit path”: concern → scientific question → evidence stream → parameters.

02

GII TIMELINE

What will be ready, when, and how it enters the FEM gear tables.



GII delivery timeline: model-ready by review gate

The gear parameter package is aligned with EFH review and SSC gates

Spring–Summer 2026

Finalize QA on 2026 A-season haul logs; flume/tank geometry and contact-sensor study.

Late 2026 – early 2027

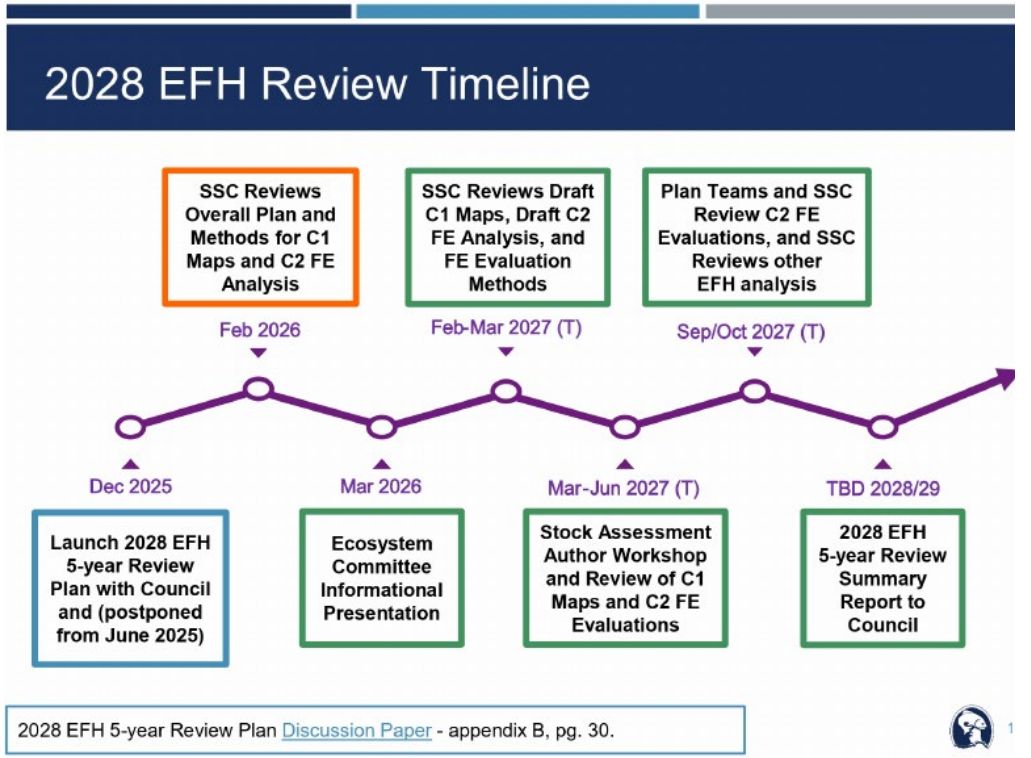
Simulation refinement, overlay/bridging analyses, and draft gear parameter tables.

Feb–Mar 2027 SSC gate

Draft FE analysis and FE evaluation methods, including updated gear parameters and recovery inputs.

Sep/Oct 2027 review gate

Plan Team and SSC review of Component 2 FE evaluations and SSC EFH analysis.



Gear tables can be source-tiered — use simulation/validation where complete and catalog-based estimates where refinement is still underway.

Parameter Readiness

What is complete, what is being validated, and what enters FEM

Parameter / input	Readiness	Source tier	FEM use
Nominal width	**High / draft-ready**	Catalog + net plans + simulation geometry	Gear footprint
Bottom-contact (adjustment)	**In validation**	FPPs + simulations + haul logs + tank	Adjusted contact area
Fishing-practice scenarios	**High for CP; ongoing for CVs**	FPPs + haul-log distributions	Scenario-specific contact
Uncertainty notes	**Under construction**	Simulation-field-tank comparison + source metadata	Interpretation + SSC review
Other FEM inputs	**Updated / QA**	CIA, sediment data, literature updates	Full FE analysis

GII source – tiered approach

GII Tier 1
Validated simulation where field/tank support is available

→

GII Tier 2
Simulation-informed estimate with documented scenario bounds

→

GII Tier 3
Catalog-based fallback with uncertainty note

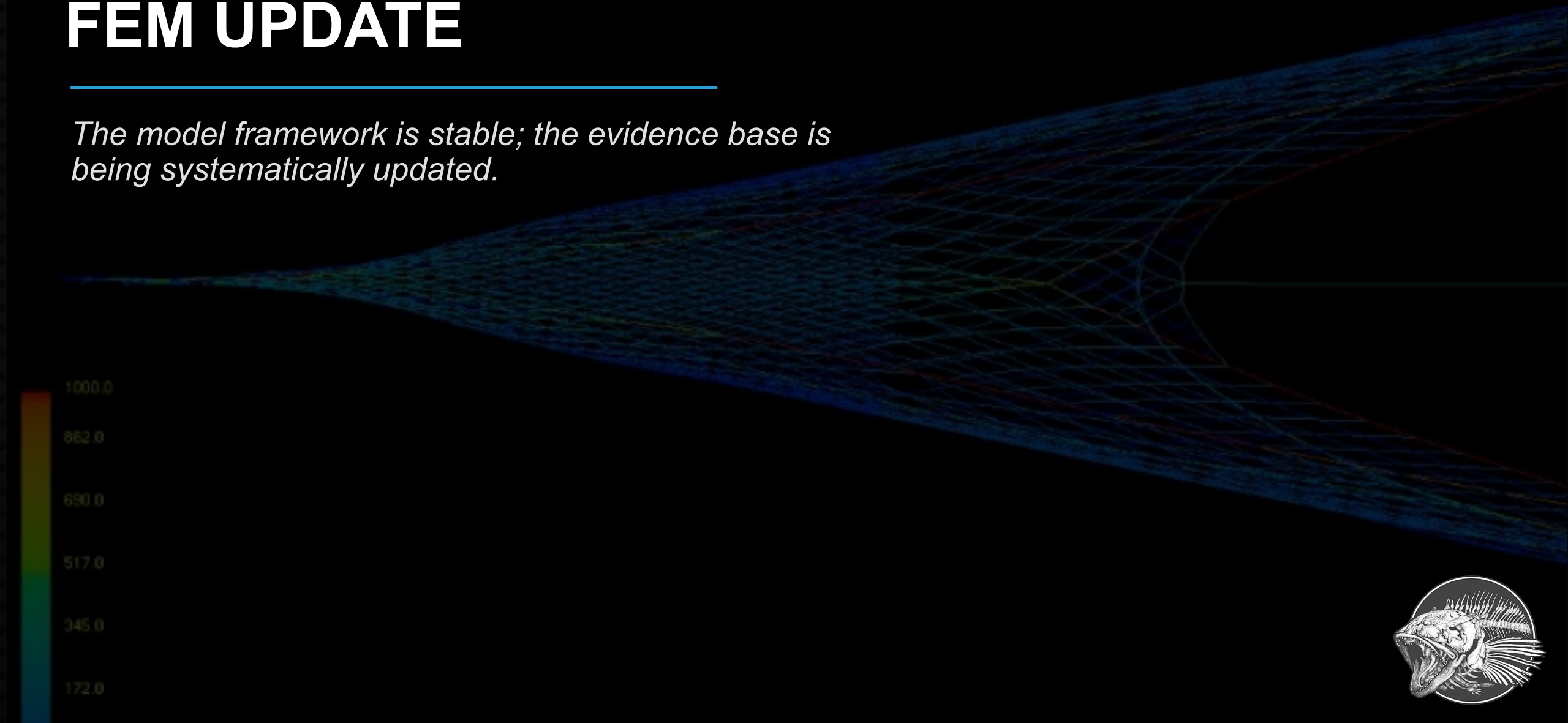
→

Status Quo
Expert-based Gear parameters

03

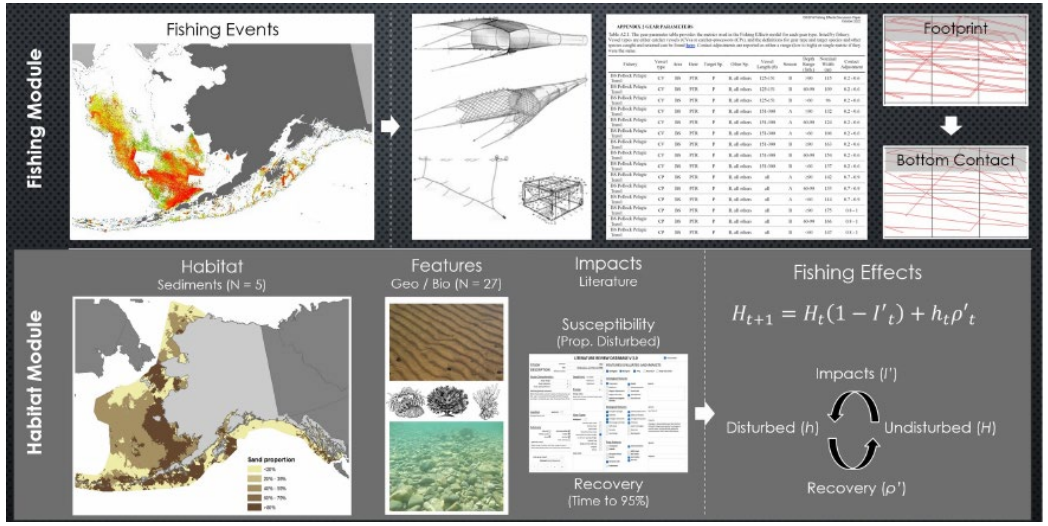
FEM UPDATE

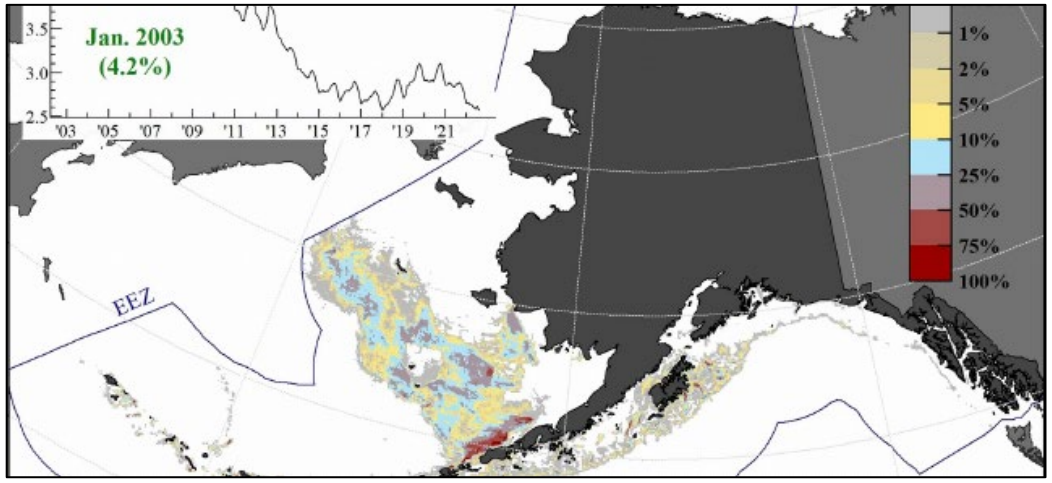
The model framework is stable; the evidence base is being systematically updated.



What is changing in the Fishing Effects Model

Continuity in model logic; stronger inputs and QA





Updated FEM inputs

- **Fishing events** — *Catch-In-Areas database rebuild/QA, including current reconstruction for FE analyses.*
- **Gear parameters** — *Nominal widths and bottom-contact adjustments updated with GII outputs.*
- **Habitat substrate** — *Sediment/habitat data refreshed for the Habitat Module.*
- **Impact & recovery** — *Literature-derived susceptibility and recovery tables updated with new papers.*

What stays stable

The core FEM workflow remains a spatial, monthly decision-support model connecting fishing effort, gear contact, habitat disturbance, and recovery.

One tow through the model

An audit trail for how FEM turns fishing activity into habitat disturbance and recovery

1 Fishing event
CIA: where, when, target, effort

2 Gear width
catalog + gear table

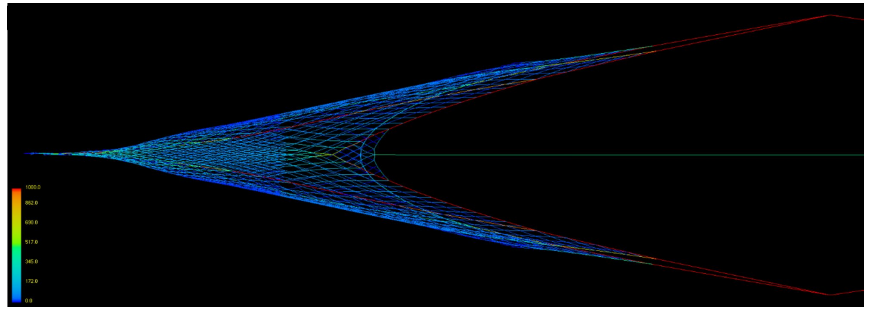
3 Contact
bottom-contact adjustment

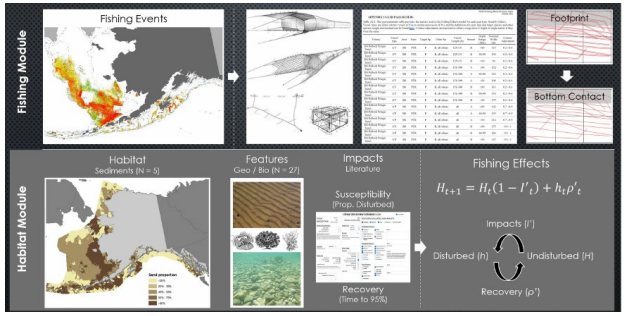
4 Habitat cell
substrate + habitat features

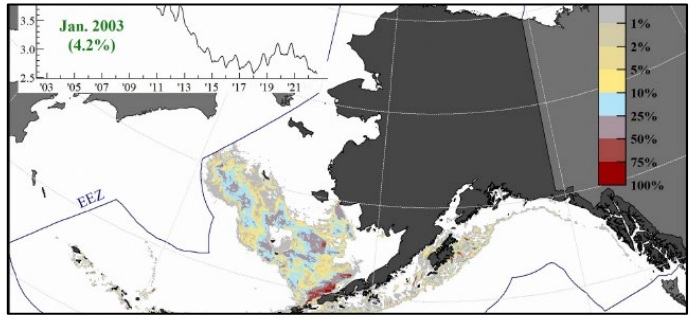
5 Impact
susceptibility / disturbance

6 Recovery
time-varying recovery

7 Output
Cumulative disturbance maps, trends, EFH analysis







Every output can be traced back to an effort source, a gear/contact source, a habitat source, and an impact/recovery source.

How we will show what the updates changed

Bridging Analyses

Base FEM
prior workflow

→

+ CIA
updated fishing events

→

+ Gear
GII width/contact

→

+ Habitat
updated substrate

→

+ Impact/recovery
new literature tables

Maps

Where footprint/contact changes occur.

Time series

How disturbance and recovery change through time.

Sensitivity

Which inputs drive differences in results.

Uncertainty

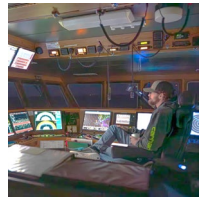
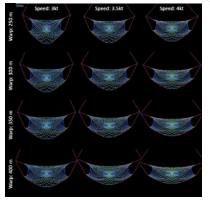
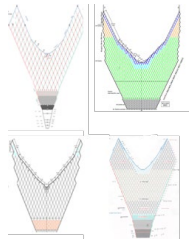
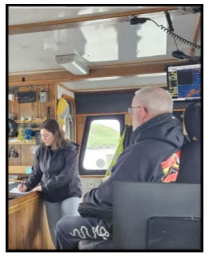
What is measured, modeled, assumed, and still being validated.

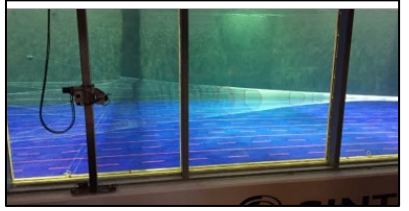
The Council will not only see updated results; it will see how input updates influenced results.

Takeaways

Decision-readiness • Transparency • Traceability

Concern without decision support → Precaution without precision
Decision support gives precaution discipline, aim, and accountability



1. **Sustainability → public concern deserves transparent evidence and tradeoff reporting.**
2. **GII: an empirical gear/fishing-practice foundation for pollock trawl contact estimates.**
3. **Gear parameter tables are on the EFH review track, with source-tiered information structure and SSC review.**
4. **FEM changes are input updates that preserve continuity while improving precision.**

Next deliverable: review-ready gear parameter package + FEM bridging analyses for the EFH review cycle.

Acknowledgements

Thanks to the vessels, companies, gear manufacturers, agency staff, SSC reviewers, students, and collaborators who made the gear catalog, FPPs, haul logs, simulations, field work and FEM analyses possible.

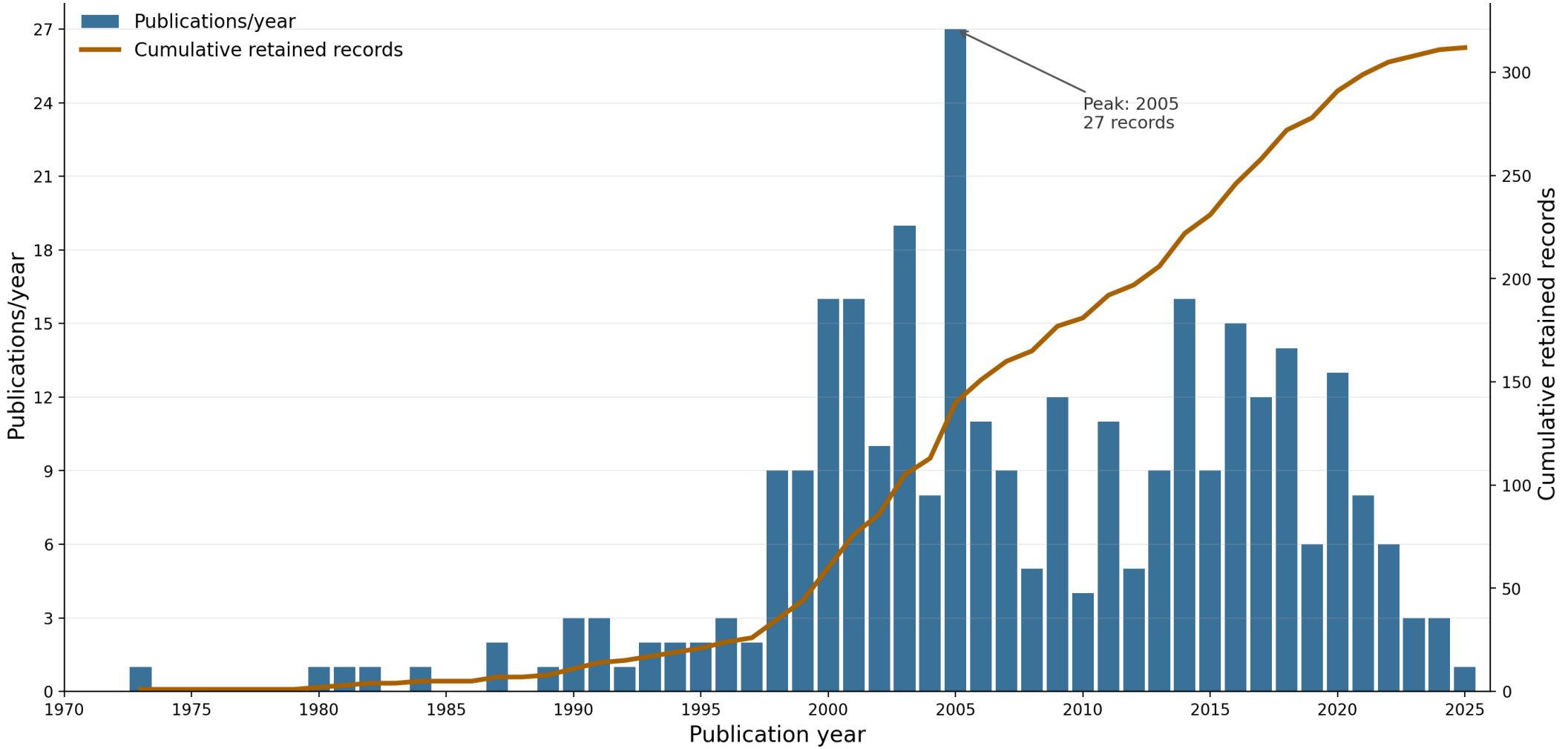
- FAST Lab staff and student researchers
- NMFS Alaska Region Habitat Division and Catch Accounting partners
- NPFMC SSC, Plan Teams, and Ecosystem Committee
- Memorial University / Marine Institute
- Trawl Gear designers/ manufacturers
- Pollock industry collaborators and participating vessels

Thank you!

Questions?

Impact – Recovery: Fishing Effects Literature

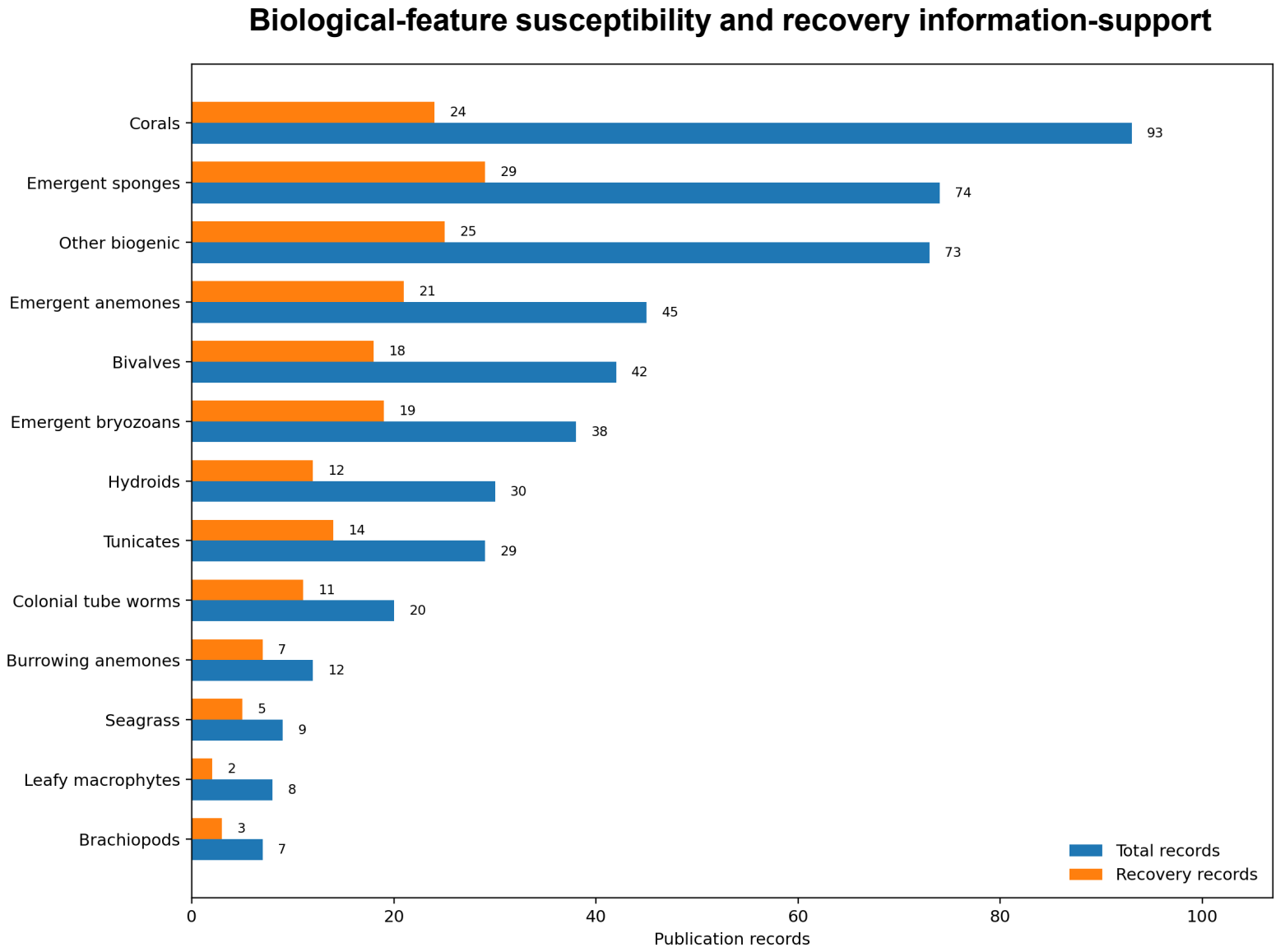
Example: State of the Science → Traceable FEM input



NPFMC-filtered retained records: n=312 • years 1973–2025

Impact – Recovery: Fishing Effects Literature

Example: State of the Science → Traceable FEM input



Impact – Recovery: Fishing Effects Literature

Example: traceable model input