# C3b Pelagic trawl gear innovation discussion paper

Anita Kroska Advisory Panel June 3, 2025





# Action by Council

- Review the discussion paper
- Action as necessary

#### Council motion C2 BBRKC closure areas February10, 2024

- 2. The Council tasks staff with a discussion paper to inform options for incentivizing pelagic trawl gear innovation with the following objectives:
  - · minimizing bycatch to the extent practicable
  - minimizing the impacts of pelagic trawl gear on sensitive benthic habitat and unobserved mortality of stocks that rely on such habitat
  - improving or maintaining fishing efficiency
  - flexibility for trawl gear innovation within the constraints of other objectives (e.g., adapting to new technologies)

#### The discussion paper should detail:

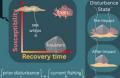
- the current limitations to gear innovation and modification (e.g., technological or enforcement constraints)
- the process for such gear revisions (e.g., EFP)
- examples of how past changes to gear definitions have been moved through the Council process (e.g., elevated sweeps on nonpelagic trawl gear)
- management tools that could be used to inform metrics to achieve these objectives (e.g., EFH and Fishing Effects model)
- downstream impacts to the management objectives of the various regulatory provisions that use the current definition of pelagic trawl gear and have been built upon the previous actions (if applicable)
- potential displacement and spillover impacts from any potential changes (e.g., PSC or target species catch)

The Council will review options for changes to the performance standard following this work.

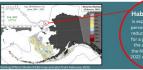


#### Fishing Effects Model (FEM)









### How are habitat features, such as corals and sponges,





#### Fishing Effects Model Applications







#### How are swept area and bottom contact area deterr

al) width of the gear as it is being fished



	Tiday	Vessel Type	Acres	Oer	Target Species	Other Sp.	Vessel Lough Sesson (f)	Respo (Sell.)	Widh (N)	Contract Affections
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00	OOA Selebb Longlar		GOA		Selecte	Greened tuber				0-1

#### Frequently Asked Ouestions

The FEM produces several primary outputs: swept greg, bottom contact greg, and habitat disturbance. Swep area is a measure of the total area of fishing activity; bottom contact area is a measure of the area of sea floor from impact and recovery processes. The units of habitat disturbance range from 0 – 1 and represent the

nominal width that is assumed to make contact with the seafloor during a fishing event. A contact adjustmen value of 0 implies that the gear makes no contact with the seafloor while a contact adjustment value of 1 indicates that the entire swath of the gear makes contact with the seafloor. A middle value between 0 and 1 (e.g., 0.5) can indicate partial contact of gear, partial contact during a fishing event, or a combination of the two. Contact adjustment values are unique to each type of gear and can vary based on fishing depth, vessel size, target

The spatial and temporal scale of the model varies depending on the specific goals of the analysis. Generally, each analysis will have a spatial domain (e.g., the Bering Sea) that is broken into smaller grid cells. The most common output is running the model on 5 km x 5 km grid (i.e., 25 km²) and on monthly time steps for the entirety of the North Pacific (subdivided in the Bering Sea, Aleutian Islands, and Gulf of Alaska). This is the spatiotemporal scale used for the EFH 5-year Review analyses. Higher resolution analyses can be conducted down to 1 km x 1 km (1 km grid cells and weekly time scales, which would be useful for analysis of smaller regions, such as closure areas.

he habitat disturbance output from the FEM is one of the analytical tools that is used during the EFH 5-year Review process to assess whether the impacts of fishing gear are exceeding "more than minimal, and not temporary" adverse effects for the core EFH area of any managed stocks. Stock authors use FEM results o on species core EFH areas, and other life history data to determine whether adverse effects are occurring.

prohibiting a type of fishing in an area?

Yes, the FEM can be used to evaluate potential habitat effects of management actions. To run this type of analysis ould require information on how fishing activity would likely change as a result of the action. For example, to evaluate potential habitat effects of closing an area, analysts would need to predict where the displaced fishing

es, fishing events frequently overlap and the FEM handles them accordingly. Impacts from overlapping fishing onts continue to accumulate until the area (e.g., 5 km x 5 km grid cell) is 100% disturbed. Once all structure-ming habitat features are removed from a location, any subsequent fishing event in that exact location will no add further impacts. Recovery occurs only if sufficient time elapses between fishing eyents. Habitat disturbance (i.e., effects) does accumulate over time; however, it is not strictly increasing. Habitat disturbance is a continual accumulation of impacts (which increase the effects), and recovery (which results from physical and biological processes, and decreases the effects). Thus, an estimate of habitat disturbance for any given point in time reflects



### **Fishing Effects Model Infographic** C3 DRAFT

Collaborative effort: FAST Lab, NOAA AKRO HCD, Council staff

**Format**: four-page glossy, 8.5 x 11" handout. Front two pages can also be stand-alone. Will also anchor a Council (interactive) webpage with additional information, glossary, and related resources.

Target audience: general participant in the Council process; high-level overview of model elements and applications

**Content**: Currently trawl-focused to support ongoing pelagic trawl gear analyses. Looking at ways to incorporate more information on other gear types. Will also help support future EFH 5-Year Review work.

**Timeline to finalize**: end of summer for glossy and first draft of webpage. Staff will work over longer timeline to expand webpage and make interactive.

**Feedback**: Please provide any feedback to Anita Kroska (NPFMC staff) by the end of June.



### What's the difference?

### **Definition EA/RIR**

- Clarify current regs, allow enforcement to clearly & consistently identify legal and noncompliant gear, remove outdated text
- Updates may facilitate process to incentivize innovation (e.g., clarity, allowances for bycatch excluders, metallic instrumentation)

### **Innovation DP**

Motion: The Council will review options for changes to the performance standard <u>following</u> this work.

Trawl performance standards



Current state of knowledge

- Innovations & research
- Regulatory, enforcement, and technological limitations
- Regulatory processes for gear revision
- Management tools





# Working definitions

### **Innovation**

A process or opportunity for flexibility, improvement, or change to existing fishing behaviors, sensor technologies, or gear, with variable implementation timelines

### **Incentive**

Reason or motivation that stimulates, persuades, or encourages action or a desired outcome





# Regulatory limitations: specificity, clarity

Increased specificity = decreased flexibility, innovation

Increased generality = greater risk of ambiguity or enforcement uncertainty

Increased clarity = increased benefits and advancements from innovation

### Feedback:

What do we innovate toward? What does the Council want limited? What are specific objectives and metrics?



Increased clarity in objectives, expectations, and possible incentives could help foster an environment for collaborative development of gear modifications and innovations.



# Regulatory limitations: consistency

State

"a pelagic trawl is a trawl where the net, or the trawl doors or other trawl-spreading device, **do not operate in contact with the seabed**, and which does not have attached to it any protective device, such as chafing gear, rollers, or bobbins, that would make it suitable for fishing in contact with the seabed."

5 AAC 39.105(10)(C)

# edera

"No person trawling in any GOA area limited to pelagic trawling under §679.22 may allow the footrope of that trawl to be in contact with the seabed for more than **10 percent of the period of any tow**."

50 CFR 679.24(b)(3)



Where possible, gear restrictions should also be consistent across State and Federal boundaries to reduce complexity and ease compliance and enforcement.



### Performance standards

Outcomes that must be achieved without prescribing specific means. To be effective, some specificity still required.

### Ex:

Current pelagic trawl performance standard: discourage bycatch and seafloor contact by limiting the number of crab at any given of a certain carapace width – <u>Trawl Performance Standard Workshop</u> (Oct 2023)

(50 CFR 679.7(a)(14))

### Ex:

"No person trawling in any GOA area limited to pelagic trawling under §679.22 may allow the footrope of that trawl to be in contact with the seabed for more than **10 percent of the period of any tow**."

50 CFR 679.24(b)(3)



### Enforcement constraints

- Sensor technology (e.g., bottom contact sensors)
  - not currently allowed via definition but can be complementary tool (e.g., VMS, EM monitoring)
  - Additional future considerations (training, data review, tech issues, point at which data is enforceable)
- Simple, accessible indicator of gear compliance
- Include enforcement early in process



**Enforcement Committee Precepts (2015)** 

pgs. 10-13

### Table 5

Feature	Common Use	Sea	Air	EM
Discs, bobbins, or rollers	Protection from bottom contact; Bycatch reduction; Aggregation of bottom fish (sweeps)	X	X**	X
Chafe protection gear attached to the footrope or fishing line	Protection from bottom contact	X	X**	X
Mesh tied to the fishing line, headrope, and breast lines with less than 20" between knots *Requires measurements	Bycatch reduction; Hydrodynamics	Х		
Stretched mesh sizes *Requires measurements with gauge	Bycatch reduction; Hydrodynamics	X		
Parallel lines spaced closer than 64" from all points on the fishing line, headrope, and breast lines *Requires measurements	Aggregation of bottom fish (includes tickler chains), sink trawl to depth	Х		
Configuration intended to reduce required stretched mesh sizes	Non-compliance with mesh size requirements	X	X***	X***
Flotation other than floats capable of providing up to 200 lb of buoyancy to accommodate the use of a netsounder device;	Maintain net shape/opening at slow speeds	X	Х	Х
Weighted lines on the bottom of the trawl between the wing tip and fishing circle	Aggregation of bottom fish (includes tickler chains); Maintain net shape/opening; Sink trawl to depth	Х	X**	Х
Metallic components aft of fishing circle and forward of 5.5" mesh *Requires measurements	Maintain net shape/opening at slow speeds; Sink trawl to depth	X		
**Observable by singreft primarily when	setting/hauling gas-			

<sup>\*\*</sup>Observable by aircraft primarily when setting/hauling gear.

<sup>\*\*\*</sup>Observable only if such configurations have been previously documented, otherwise would require measurement

## Cost and timeline mismatches

- Sources: industry, grants, regulated fee structures (Trawl EM program, §679.56)
  - Variable timing, availability, priorities may not align with gear research
  - Timeline: can be years (planning, application, pilot data, testing, analysis, reporting)
  - Ex: ActSel, funded via NOAA Bycatch Reduction Engineering Program (BREP) (ongoing; Rose and Barbee, 2022)
- Feedback: costs can be prohibitive to improve daily operations









# Current research & limitations - outline

- Seafloor or bottom contact detection methods
  - Model-based (e.g., FEM)
  - Tilt sensors
  - Physical wear (e.g., footrope chain)
  - Acoustic sensors (e.g., trawl sonar)
  - Cameras
  - Other innovation

- Unobserved mortality
- Bycatch reduction



### Fishing Effects Model (FEM)

A decision-support tool to quantify and visualize commercial fishing activity and resulting seafloor habitat disturbance. The Fishing Effects Model workflow has two parts: the Fishing Module and the Habitat Module.

# Model-based: Fishing Effects Model

- Fishing Module & Habitat Module -> habitat disturbance
- FEM incorporates the following information:
  - Spatial distribution of habitat types
  - Spatial extent of fishing effort from NMFS Catch-in-Areas database
  - Gear parameter table vessel, gear, season, depth, target, and contact adjustment values (trawl and fixed gear)
  - Habitat feature susceptibility and recovery
- Habitat disturbance ex: North Pacific, avg 2.7% (Feb 2022)



estimates the amount of swept area and bottom contact area on the seafloor by integrating track lines of fishing events with corresponding fishing gear parameters.



through the Vessel **Monitoring System** 

gear parameters (widths) x fishing track (lengths)

(seafloor contacted)



The Fishing Module can be used on its own, separate from the

#### The Habitat Module

estimates benthic habitat disturbance from fishing gear by integrating results from the Fishing Module along with the susceptibility (vulnerability to impacts) and recovery time (ability to return to original state) of an area.



prior disturbance | current fishing

= habitat disturbance (% feature reduction)



The Habitat Module incorporates the Fishing Module results and empirical habitat information to estimate seafloor habitat



#### Habitat Disturbance

percentage of habitat feature reduction on a monthly basis for a given area. For example, the average disturbance in the North Pacific in February



Disturbance





## Model-based: FEM limitations

- Model results
  - provide the best available estimate of the impacts of Alaska federal fisheries on Essential Fish Habitat
  - do not provide real-time bottom contact detection
  - Contact adjustment values are estimations and are currently not tow or vessel specific
  - Fishing Module swept area and bottom contact area – can recognize fishing patterns and hotspots, but obscures other factors, not useful for understanding habitat disturbance
- Future improvements additional data on gear, net behavior, field measurements of bottom contact, and improved habitat information



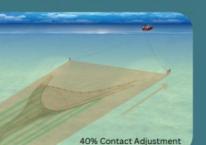
\*See C3a Innovations development presentation

\*C3 DRAFT FEM infographic

#### How are swept area and bottom contact area determined?

Swept area is the maximum area over which gear-seafloor interactions may occur. This can be seen as the rectangular area created by the full (nominal) width of the gear as it is being fished.





Trawl images provided by Seafish

Bottom contact area—a fraction of swept area is the estimated amount of seafloor contacted by fishing gear, and differs by gear type and other fishing factors.



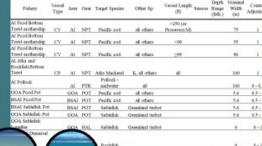
Contact adjustment is the proportional (percentage) value that modifies swept area to estimate bottom contact area. Fishing gear does not always make contact across its full width, or for the duration of the fishing event. These dynamics are dependent on specific gear-vessel configurations, fishing practices, and hydrodynamic forces.

#### For Example:

Contact adj. = 1 full contact Contact adj. = 0.4 partial contact Contact adj. = 0 no contact

#### What gear information does the Fishing Effects Model use?

Contact adjustment proportions are specific to combinations of vessel, gear, and time of year. These values are also dependent on fishing practices (e.g., fishing depth, target species). This information is compiled in the gear parameter table of the Fishing Effects Model. The more we know about gear specifications and fishing practices, the better the estimates of bottom contact area.











FEM gear parameter table, Zaleski et. al. 2024.

# Tilt sensors – bottom contact w/ trawl gear

NOAA Bottom Trawl Survey Currently deployed



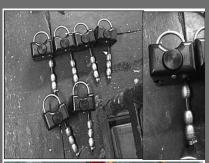
Nonpelagic

Images provided by FAST Lab, 2025

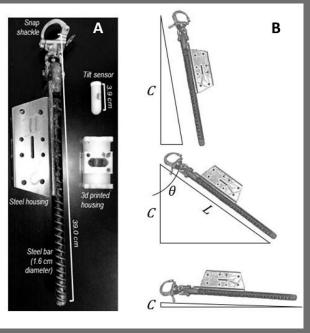
Alt. Groundgear Materials NPRB Proj. 1319 (Rose et al., 2016)

Contact Sensor Performance CV Gear Study (King et al., 2019, Harris et al., *In Prep*) Quantifying and reducing interactions between fishing gear and the seabed in New Zealand (Wilson et al., 2023)

Improving Estimates of Bottom Contact and Recovery (McGonigle et al., 2025)





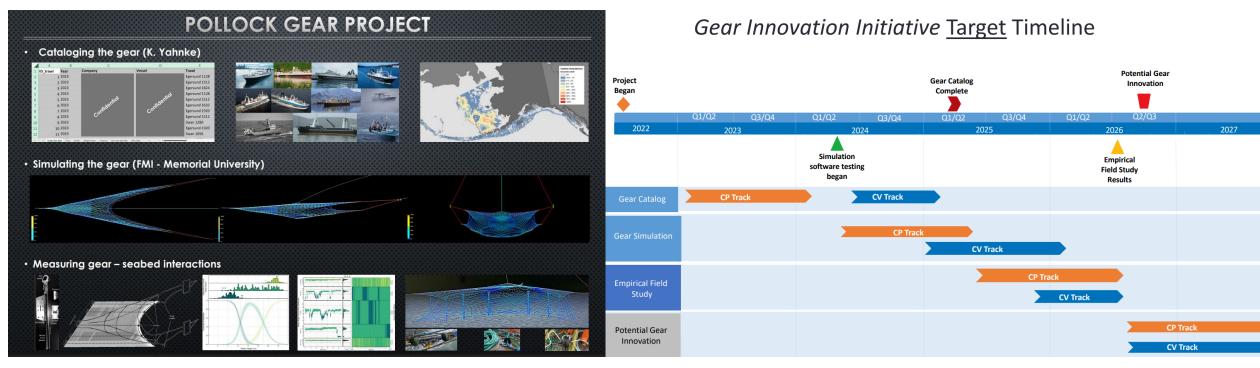






Pelagic Pelagic Nonpelagic Nonpelagic

# Pollock Gear Project & Gear Innovation Initiative



February 2024

October 2024

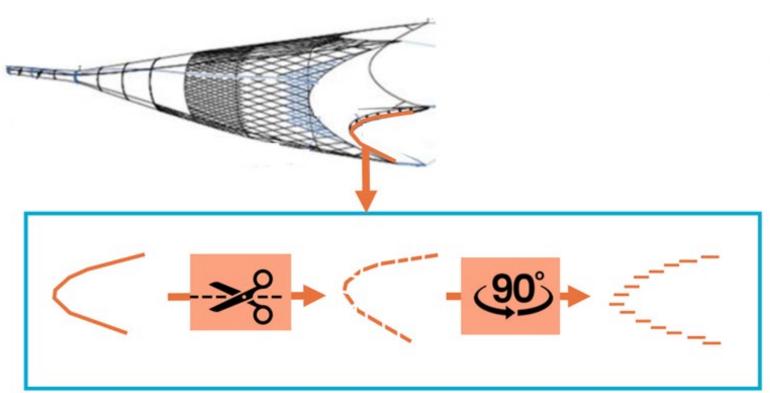


\*See C3a Industry/research update presentation

\*C3 DRAFT FEM infographic



# Physical wear - Pelagic trawl gear footrope EFP



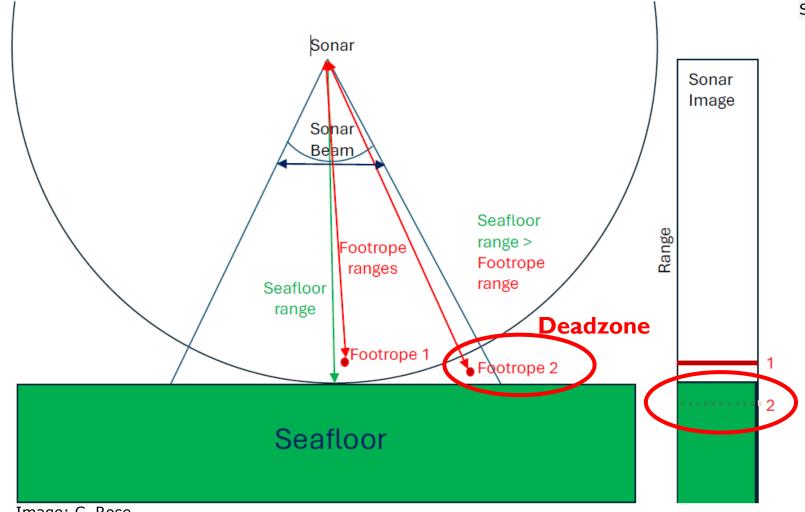




# Acoustic sensors



Simrad FS80 Trawl sonar







### Cameras

- Electronic monitoring for catch accounting
- Live feed cameras (third, forth, or wireless system)
   to observe fish and net behavior
- Verification of tilt angle or footrope position or net behavior
- Turbidity challenges from mud, sand, particulate matter in the water column (NOAA bottom trawl survey modernization gear testing; tilt sensor bottom contact studies; FAST Lab bottom contact projects)

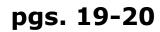




Ex: live feed camera system, Simrad FX80 camera and light









# Seafloor contact innovation - Other examples

- Midwater door adoption widely used across nonpelagic and pelagic fleets
- Live feed camera system +
   manufacturer net plans optimize
   spread and minimize contact by
   watching results in camera feed
  - under- or overspreading, camera clouded with turbid water, correct spread, camera view clear







# Unobserved crab mortality

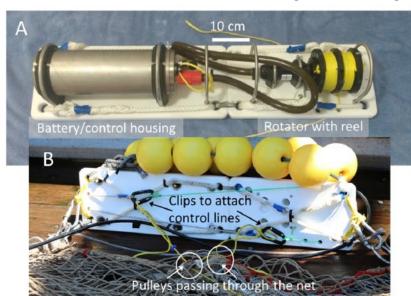
Coor Tuno		Indiv	vidual Event (e.g., pot/	Population Level		
Gear Type (# of configs)	Information Type	Bottom Contact Area	Time on Bottom	"Lethality" of gear	Total # of Events (pot lifts/trawls)	Overlap with Crab
Pots (2)	Magnitude	10 <sup>1</sup> m <sup>2</sup>	Hours to Days	High	10 <sup>5</sup>	High
	Data Available	Yes	Yes	No	Yes	Yes
	Research Needed	Data mining	Data mining	Field exp'ts	Data mining	Data mining
	Priority	Low	Low	Low	Low	Low
	Timeline (years)	0.5-1	0.5-1	3-5	0.5-1	0.5-1
Lost Pots (2)	Magnitude	101 m <sup>2</sup>	Months to Years	Medium	Unknown	High
	Data Available	Yes	Some	Some	Some	Some
	Research Needed	Data mining	Field expt's	Field expt's	Data mining/Field expt's	Data mining
	Priority	Low	Medium	Medium	Medium	Low
	Timeline (years)	1-2	3-5+	1-3	3-5	0.5-1
Hook-and-Lin	Magnitude	10⁴ m²	Hours to Days	Low	10⁴	Medium
e (3)	Data Available	Yes	Yes	No	Yes	Some
	Research Needed	Data mining	Data mining	Field expt's	Data mining	Crab Dist.
	Priority	Low	Low	Low	Low	Low
	Timeline (years)	0.5-1	0.5-1	3-5	0.5-1	0.5-1
Non-Pelagic	Magnitude	10 <sup>6</sup> m <sup>2</sup>	Minutes	High	10⁴	Medium
Trawl (13)	Data Available	Yes	Yes	Some	Yes	Some
	Research Needed	Data mining	Data mining	Field Exp'ts	Data mining	Crab Dist.
	Priority	Medium	Medium	Medium	Low	Medium
	Timeline (years)	0.5-1	0.5-1	3-5	0.5-1	1-5
Pelagic Trawl	Magnitude	10 <sup>5</sup> m <sup>2</sup>	Minutes	High	10⁴	Medium
(30)	Data Available	Yes	Yes	No	Yes	Some
	Research Needed	Data mining	Data mining	Field Exp'ts	Data mining	Crab Dist.
	Priority	Medium	Medium	High	Low	Medium
	Timeline (years)	0.5-1	0.5-1	3-5	0.5-1	1-5



2

# Bycatch reduction

## Active Selection (ActSel)

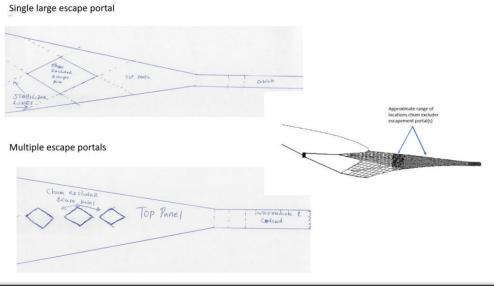


Rose and Barbee 2022

Custom TIMEZERO



Chum excluder EFP 2025-01



NPFRF, Gauvin 2025





\*image copied from TIMEZERO, not an actual depiction



pgs. 23-24

21

	FEB	NMFS and Council considering actions to protect essential fish habitat
2005		Final action on EFH left action on Bering Sea open for consideration of actions—including Gear Modifications
₹	MAY	First meeting with captains and trawl manufacturers - Develop concepts and plan research
	SEPT	Research to develop twin trawl tests of sweep effectiveness for fish capture (F/V Cape Horn)
	MAR	Meeting with captains and trawl manufacturers - discuss results and research plan
Ц	SEPT	Twin trawl experiment on effects of different sweep elevations on fish capture (F/V Cape Horn)
8	MAY	Experiment to measure effects on benthos—video / sonar sled (F/V Pacific Explorer)
2006	NOV	Meeting with captains and trawl manufacturers - discuss results and research plan
	DEC	Presented Initial results to Management Council (NPFMC)
	DEC	Workshop - initial discussions of potential regulations and enforcement
	MAR	Meeting with captains and trawl manufacturers - discuss results and research plan
	APR	Workshop - Further discussions of potential regulations and enforcement
9	JUN	Pilot research on crab mortality - Develop crab mortality methods and pilot test recapture nets (F/V Pacific Explorer)
7	JUN/JUL	Experiment to measure effects on benthos over day, week, month, year—video / sonar sled (F/V Pacific Explorer—R/V Oscar Dyson)
	OCT	Meeting with captains and trawl manufacturers - discuss results and research plan
	JAN	Presentation of results at annual captains meeting
	MAR	Tests of sweep clearance achieved with alternative bobbin spacing and height (F/V Unimak)
0	MAY	Tests of sweep clearance achieved with alternative bobbin spacing and height (F/V Arica)
2008	JUN	Presented results of sweep clearance tests to Council
7	AUG	Crab mortality research—Modifications reduce mortality of Tanner and snow crabs (F/V Pacific Explorer)
	SEPT	Workshop at net shed with captains, gear manufacturers, scientists, enforcement and council regional staff on regs and enforcement
	JAN	Presentation of results at annual captains' meeting
	JAN	Onboard meeting with enforcement, Council and regional staff to clarify regulations and enforcement issues
S)	JUN	Twin trawl tests of fish capture with thinner cables (F/V Cape Horn)
9	FEB	Council presentation on crab mortality research
7	AUG	Crab mortality research - Modifications reduce mortality of king crab (F/V Pacific Explorer)
	OCT	Presentation to Council - research update
	OCT	Council reccomends regulations
	NOV	Two workshops explaining draft regualtions and discussing enforcement
	ALL	Regulations drafted, discussed, reviewed and finalized
	YEAR	Fleet and gear manufacturers pretest specific devices, handling and attachment alternatives — comment on draft regulations
	OCT	Final Rule published (Ammendment 94)
701.1	JAN	Requirement goes into effect

# Gear revision process – Trawl sweeps

# Trawl sweep modification to nonpelagic trawl gear

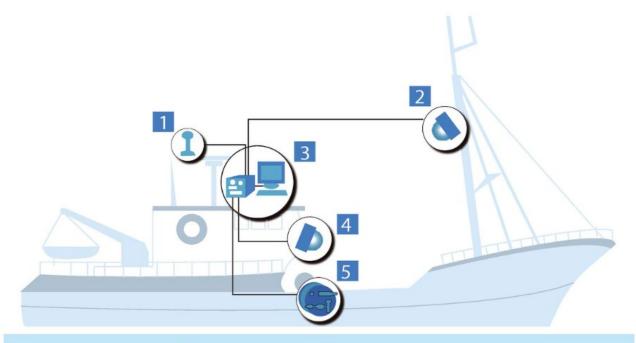
- BSAI FMP Amendment 94 (6 yrs) and subsequent extension - GOA FMP Amendment 89, 3 more years
- Incentive: reopen a portion of Northern Bering Sea Research Area (NBSRA) once trawl gear modification was implemented

### Figure 6

Cooperative participation of the fleet in all project stages:
 concept development and research planning,
 field research, gear development
 and testing
 review and presentation of results to management, and
 preparation for implementation (concepts and review
 for regulations and enforcement)



# Gear revision process – Trawl EM



GPS Receiver Tracks vessel locations

Hydraulic and drum-rotation

Tracks fishing activity

sensors

- Video Camera
  Records
  and monitors
  fishing activity
- Control Center
  The electronic
  monitoring control
  center



- BSAI FMP Amendment 126, GOA FMP Amendment 114
- Applies to: Catcher vessels, pelagic gear, tender vessels delivering pollock
- 2018 pilot testing w/ volunteers
- 2019 EFP w/ 79 CVs
- 2022 draft EA/RIR
- 2024 final rule published in August



# Management tools to inform metrics to achieve Council objectives

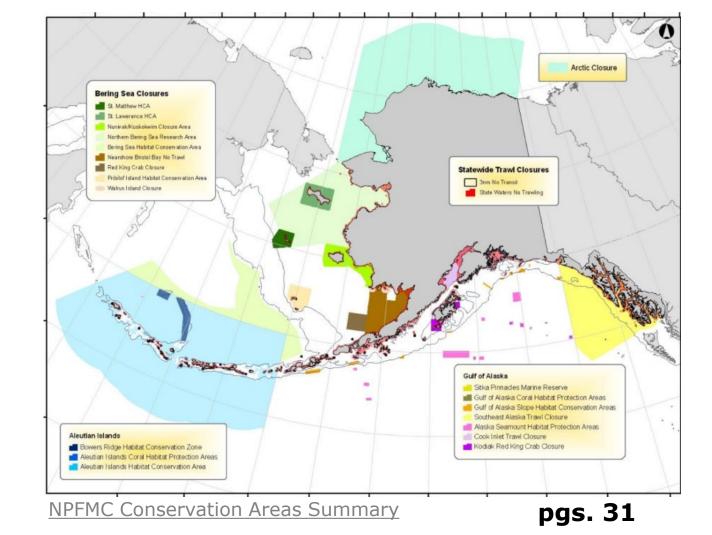
- EFP allow for testing
- EFH 5-year Review determination of adverse effects (Component #2; 50 CFR 600.815(a)(2))
- FEM currently our best tool to determine habitat disturbance from commercial fishing gear

- Ad hoc committees e.g., UFMWG in 2023
- **IPAs** salmon bycatch avoidance
- Performance standards
- Outreach e.g., workshops, webinars



# Future considerations

- Closure areas, gear limitations -Several regs rely upon definition
- Displacement/spillover e.g., changes to CPUE or PSC rates





\*See <u>C3c EA/RIR analysis</u> to modify PTR definition for complete list

# Council action at this meeting

- Expanded discussion paper
- Move to analysis:
  - Establish Purpose and Need, alternatives for analysis
- No further action





# Thank you!



