Pelagic Trawl Gear Innovation Discussion Paper

May 17, 2025[1]

1 Introduction

In February 2024, the North Pacific Fishery Management Council (Council) tasked staff to prepare a discussion paper to inform options for incentivizing pelagic trawl gear innovation with the following objectives[2]:

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

This motion requests the following to be included in a discussion paper:

- The current limitations to gear innovation and modification (e.g., technological or enforcement constraints)
- The process for such gear revisions (e.g., Exempted Fishing Permit)
- 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., Essential Fish Habitat and Fishing Effects Model)

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[2] C2 Council motion February 2024

- 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 motion for this discussion paper followed final action in the February 2024 C2 Bristol Bay red king crab (BBRKC) closure areas action , where the Council decided to take no further action on the analysis of alternatives for Bering Sea/Aleutian Islands (BSAI) groundfish fishery area closures due to potential negative impacts on Chinook salmon, chum salmon, halibut, and other Prohibited Species Catch (PSC) species. In addition to the request for this discussion paper on pelagic trawl gear innovation, the February 2024 motion indicated Council intent to use in-season information and results from several ongoing research projects (e.g., winter pot surveys, crab tagging studies, pelagic and pot gear research) to develop framework agreements for dynamic closures and crab avoidance measures for the BSAI trawl, pot, and hook-and-line sectors to respond to changes in crab abundance and distribution with measurable objectives to evaluate performance. The Council affirmed its high priority for these research projects and requested regular updates on ongoing collaborative research. An initial update was provided by researchers in October 2024, and another is scheduled for June 2025.

This discussion paper on pelagic trawl gear innovation is separate from the concurrent Environmental Assessment/Regulatory Impact Review (EA/RIR) to clarify the definition of pelagic trawl gear that was initiated in February 2024, but the two issues are interrelated. The Council identified the pelagic trawl gear definition as a separate and focused regulatory action that is intended to clarify current regulations and allow enforcement officers to clearly and consistently identify legal and noncompliant pelagic trawl gear. Clarifying the regulatory definition is expected to facilitate the process to incentivize trawl gear innovation to minimize the impacts of pelagic trawl gear on bycatch, sensitive habitat, and unobserved mortality. For example, adoption of one or more alternatives in the pelagic trawl gear definition EA/RIR could allow for bycatch excluder devices and additional metallic components (e.g., monitoring instrumentation with protective metallic housing), providing a path forward to innovate towards minimizing seafloor contact and bycatch.

In the motion tasking this gear innovation paper (Agenda Item C2; Feb 2024), the Council stated an intent to “review options for changes to the performance standard” following development of the discussion paper and the availability of research results. As such, this paper does not focus on the trawl performance standard. Instead, the paper focuses on the motion language to highlight current knowledge and collaborative processes that could inform a process for incentivization, added regulatory flexibility, pathways for enforcement, and which may guide the Council to identify objectives to minimize pelagic gear impacts. This paper highlights current research innovations, limitations to innovation, regulatory processes for gear revision, and management tools.

To help track the history of these actions, provide further context, and to delineate between the two papers, a Council Timeline (Table 1) is provided in Section 1.1 below as a reference. Further detail on histories of some of the motions can be found in the concurrent EA/RIR analysis to clarify the definition of pelagic trawl gear.

1.1 Related actions and history of this action

This discussion paper analyzes available information to inform options to encourage and/or incentivize innovation that is expected to minimize the impacts of pelagic trawl gear bycatch, sensitive seafloor habitat and unobserved mortality, and improve gear efficiency and effectiveness. This proposed action is separate from the ongoing EA/ RIR that analyzes the impacts of proposed changes to the definition of pelagic trawl gear for the purpose of facilitating compliance and enforcement.

A **pelagic trawl gear definition EA/RIR** is scheduled to be presented during this agenda item for Initial Review at the June 2025 Council meeting. Refer to this document for a detailed overview of the history of this action. For the purposes of this discussion paper, a brief timeline has been included below to summarize this information and to assist in the delineation between these two documents. The Council motion for the pelagic trawl gear definition EA/RIR paper (eAgenda item C6, October 2024) adopted the following Purpose and Need statement:

> *The purpose of this action is to update the regulatory definition of pelagic trawls in Alaska to clearly allow commonly used components in codends and bycatch excluder devices, allow instrumentation necessary to monitor and adjust net performance, and remove unnecessary outdated text. The definition of pelagic trawl gear within 50 CFR 679.2 has remained unchanged since 1993. Clarifying the definition of pelagic trawl gear will also facilitate the process to incentivize trawl gear innovation or other measures to minimize the impacts of pelagic trawl gear on bycatch, sensitive habitat, and unobserved mortality.*

Related pelagic gear research has also been presented to the Council and include ongoing efforts to understand seafloor contact, impacts of gear modification on unobserved mortality, and effectiveness of bycatch reduction devices. The research projects listed below are those that are currently in the Council process at some stage of development or reporting, and are some of the projects detailed in Section 3 of this report:

- Dr. Brad Harris and Dr. Craig Rose (B1 Presentation; Feb 2024): fishing gear research (including trawl gear modifications, estimation of unobserved crab mortality), the Fishing Effects Model (FEM), and the Pollock Gear Project
- Gear Innovation Initiative (testimony, Oct 2024): work plan that is an expansion of the APU Pollock Gear Project, which includes: pelagic gear cataloging, simulation, and field tests, presented by the Pelagic Trawl Gear Industry Working Group
- Dr. Noëlle Yochum and Mr. Shannon Carroll (B2 Trident EFP; Oct 2024): EFP, modified footrope designs on pelagic gear
- Dr. Craig Rose and Mr. David Barbee (testimony, Oct 2024): comments on pelagic trawl gear definition paper and development of active selection (ActSel) bycatch reduction device
- Mr. John Gauvin on behalf of North Pacific Fisheries Research Foundation (B2 Salmon Excluder EFP; Apr 2025): chum salmon bycatch excluder research with pelagic trawl gear

Table 1 Council timeline for pelagic gear definition and innovation papers, and some related agenda items. Bolded text indicates the tasking motion for this discussion paper. Additional information on the history of the motions can be found in the EA/RIR analysis to clarify the definition of pelagic trawl gear, presented at the June 2025 meeting.

Council mtg	Agenda item	Link	Description
Dec 2022	RKC Savings Area Emerg. Rule	C1 Council Motion 2	Council adopts BBRKC Purpose and Need, alternatives. Requests expanded discussion on PTR trawl gear performance standard and definition to help evaluate whether they are meeting Council objectives.
Feb 2023	EFH 5-year review	C4 Report	FE info in FMPS: None of the Fishing Effects evaluations concluded that habitat reduction within the Core EFH Area for a given species was affecting the species in ways that were more than minimal or not temporary.
June 2023	BBRKC closure areas analysis	C4 BBRKC Analysis	Section 4 provided brief analysis on PTR definition and performance standard.
	BBRKC closure areas	C4 Council Motion	Council requests NMFS and OLE work with Council staff and industry to identify revisions to the regulatory definition of pelagic trawl gear.
	BBRKC closure areas	C4 Council Motion 2	Council requests the PTR gear definition be addressed separately. Request NMFS and the Enforcement Committee, in consultation with industry, identify ways to revise the pelagic gear performance standard to be enforceable. Continue to incorporate this discussion into BBRKC analysis.
Oct 2023	Trawl Gear Performance Standard Workshop	Trawl Wkshp eAgenda	Public workshop led by NOAA OLE to solicit feedback on PTR performance standards, held during Oct 2023 Council meeting.
	Trawl Performance Std	E Report Wkshp Summ	Trawl Workshop summary includes feedback on performance standards.
Feb 2024	Fishing Gear Research	B1 Presentation	Dr. Brad Harris (APU) and Dr. Craig Rose (FishNext) joint presentation on Fishing Effects Model and fishing gear research.
	BBRKC closure analysis	C2 Analysis	BBRKC EA/RIR analysis of groundfish closures. Section 8 includes discussion on PTR performance standards.
	BBRKC closure areas	C2 Council Motion	**The Council tasks staff with a discussion paper to inform options for incentivizing pelagic trawl gear innovation.**
	PTR definition discussion paper	D1 Discussion Paper	Discussion paper focused only on pelagic gear definition and policy recommendations, not tied to BBRKC actions.
	Pelagic trawl gear definition changes	D1 AP motion	AP motion requesting expanded discussion paper to pelagic gear def. this language used in Council motion to task separate pelagic innovation discussion paper.
	Pelagic trawl gear definition changes	D1 Council Motion	Council adopts Purpose and Need, Alternatives for PTR definition preliminary review.
Apr 2024	Doug Vincent-Lang (ADFG) ADN Op-ed	ADN Op-ed	"Safeguarding Alaska offshore habitat and providing a path forward for trawling" – Doug Vincent-Lang met w/ industry in April. Published just prior to Oct Council mtg; posted on eAgenda.
Jun 2024	Unobserved Fishing Mortality Working Group	D1 Final Report	WG paused; "substantial data deficiencies currently preclude meaningful estimation of UFM". PTR impact lethality listed as 'high' priority, no avail data, field work needed, timeline 3-5 years.
	Research Priorities	D4 SSC Report	#2: "Quantify the magnitude of fishing gear (e.g., pelagic trawl vessels, derelict crab pots, and modified crab pots to reduce bycatch) impacts on crab and their associated benthic habitat and develop fishing gear innovations where needed"
Oct 2024	Pelagic trawl gear definition changes	C6 PTR Definition RIR	PTR definition Initial Review Regulatory Impact Review
	Pelagic trawl gear definition changes	C6 Council Motion	Council revised alternatives, move to initial review (EA/RIR)
	Gear Innovation Initiative (GII)	E1 Testimony	GII testimony presentation from all pollock fleets on gear innovation work plan
June 2025	Pelagic trawl gear	C3 Action memo	Innovation discussion paper and PTR definition EA/RIR to be presented under same action item

1.2 Fisheries description

Pelagic trawl gear has historically been used to catch pollock (*Gadus chalcogrammus*) and Pacific Ocean perch (POP; *Sebastes alutus*) in the BSAI and Gulf of Alaska (GOA) regions. Only the Bering Sea pollock fishery is required to use pelagic gear (§ 679.24); there is no similar requirement for vessels targeting other groundfish in either region or pollock in the GOA. These fisheries are described in further detail in the concurrent pelagic trawl gear definition EA/RIR, but a summary is provided in this section for quick reference. A current published catalog of pelagic trawl gear specifications and vessels fishing Alaskan waters does not exist. Some data could be provided from the ongoing collaborative research between industry and Alaska Pacific University (Gear Innovation Initiative; see Section 3.2.2) regarding current gear configurations and specifications, but in lieu of published results, the North Pacific Fishery Management Council's Fishing Fleet Profiles is the most up-to-date publicly-available information on fleet-wide gear and vessel use by region, published in 2012. Summary data shown below (Table 2 through Table 4) provide a basic summary of vessels by type and region since that report was published. Data are reported by year and separated by general management boundaries (Figure 1) and vessel type (catcher vessel (CV) vs catcher processor (CP)).

The Bering Sea pollock fishery is required by regulation to use pelagic trawl gear. Fishery regulations mandate the use of pelagic trawl gear for directed fishing for pollock in the BSAI (50 CFR 679.24(b)(4)). The NMFS Observer Program provides near real-time catch data during the season, and vessels operate within well-defined catch limits. The Bering Sea pollock fishery is the largest U.S. fishery by volume. Bering Sea pollock is typically not sold fresh but instead processed into a variety of product forms, the most significant of which are fillets, surimi, and roe. In 2021 and 2022, the total gross first wholesale value of the Bering Sea pollock fishery harvest was $1.5 billion. Between 2012 and 2024, the number of CPs has slightly decreased from a maximum of 16 vessels in 2014, to a minimum of 13 CPs in 2024. During the same timeframe, the number of CVs decreased from a maximum of 89 vessels in 2012 to a minimum of 74 vessels in 2024 (Table 2). Of the 74 vessels that currently participate in the Bering Sea (BS) subarea, 12 of them participate in the Central Gulf (CG), and 1 participates in the Western Gulf (WG) (Table 3). BSAI pelagic trawls range in nominal gear width from 50-175m (Appendix 2, Zaleski et al., 2024).

Between 2012-2024, the Aleutian Islands only had vessel participation in a directed pollock fishery in 2015, and 2018-2021 (Table 2). Thus, the tons landed for this subarea (Table 4) are mostly hidden due to confidentiality restrictions.

In the GOA, pelagic trawl gear is mainly used to target pollock and POP. Operators are not restricted on gear type for these targets, and therefore can decide to switch between pelagic and nonpelagic fishing. For pollock, the fishery is, by regulation, almost entirely shore-based, with 96% of the catch taken with pelagic trawl gear and delivered to plants for processing. The GOA POP fishery is prosecuted by both CPs and smaller shore-based CVs with both nonpelagic and pelagic trawl gear. In 2007, the Central GOA Rockfish Program was implemented to enhance resource conservation and improve economic efficiency for harvesters and processors who participate in the Central GOA rockfish fishery. This rationalization program established cooperatives among trawl vessels and processors which receive exclusive harvest privileges for rockfish management groups. The primary rockfish management groups are northern rockfish, POP, and dusky rockfish. The season runs from the beginning of April through mid-November (Hulson et al, 2021). According to Zaleski et al. (2024), GOA pelagic trawls range in nominal gear width from 50-100m.

In the WG subarea from 2012-2024, the number of CVs varied over time, with a maximum of 29 vessels in 2012, 2016, and 2017, and a minimum of 20 vessels in 2022. Only one CP participated in the WG in 2015. In the CG subarea from 2012-2024, the number of CVs decreased from a maximum of 60 vessels in

2012 to 38 in 2024. During the same timeframe, 1-2 CPs participated except for 2015 and 2017-2019. In 2024, of the 38 CG CVs, 12 participated in the BS, and 10 in the WG. In Western Yakutat (WY) from 2012-2024, the number of CVs varied from a maximum of 27 in 2023, to a minimum of 0 in 2016 and 2017. One to two CPs have participated in the WY, but none since 2019 (Table 2).

In the GOA region from 2019-2024, between 52 and 62 vessels targeted pollock, with a total catch ranging from ~99,000 mt to 135,700 mt. From 2019 to 2024, the number of vessels ranges from 16-25, with total catch ranging from 7,176 mt to 14,778 mt (see concurrent PTR definition EA/RIR analysis). The percentage of Gulf-wide POP taken with pelagic trawl gear increased from an average of 7% (1990-2005) to an average of 33% in 2023. Catcher vessels take ~60% of the catch in the CG and 35% in WY, where catcher processors take nearly all of the catch in WG area (Hulson et al, 2021).

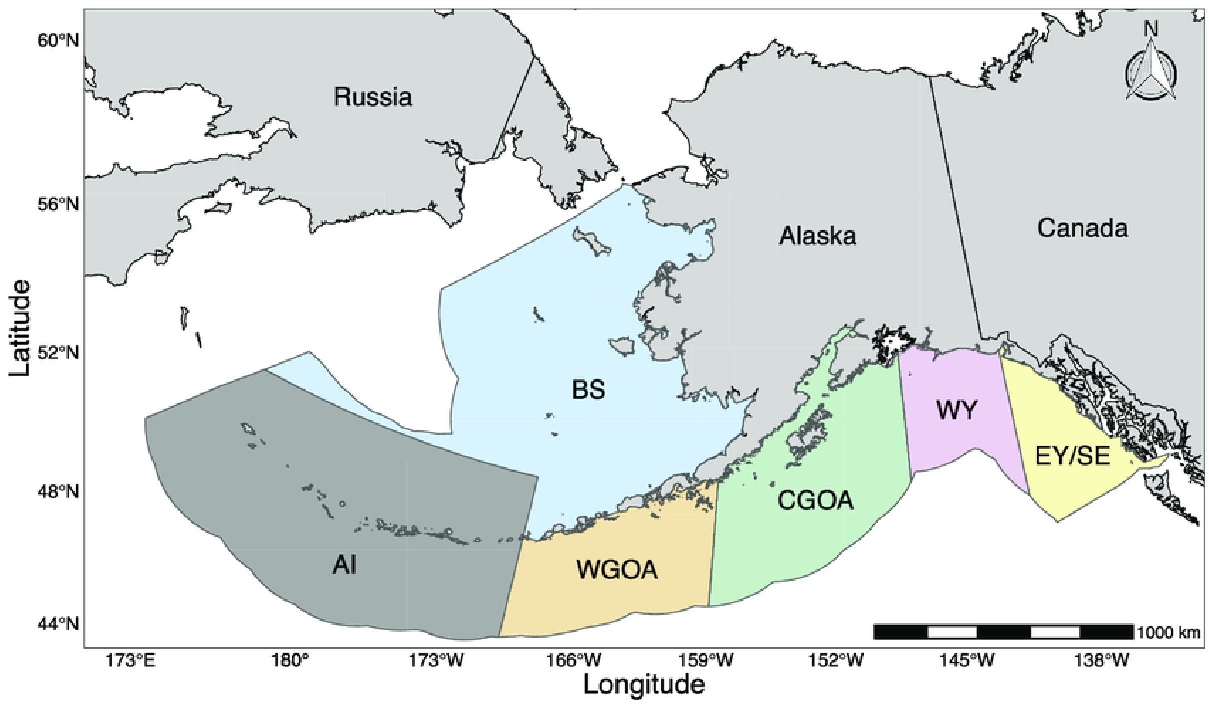

Figure 1 Fishery management boundaries in the U.S. EEZ that align with categories described in the pelagic trawl gear fisheries sectors. Subareas: BS = Bering Sea, AI = Aleutian Islands, WGOA = Western Gulf of Alaska, CGOA = Central Gulf of Alaska, WY = Western Yakutat. These acronyms are used for Tables 2 and 3. (from Cheng et al. 2023)

Table 2 Number of vessels (catcher processors, CP, or catcher vessels, CV) by subarea as identified in Figure 1, from 2012 – 2024. (NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA)

Subarea/Vessel	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
AICP				1					1	1			
AICV							1	1	3				
BSCP	14	15	16	14	14	14	14	14	14	13	13	13	13
BSCV	89	85	86	85	88	86	83	82	85	83	81	75	74
CGCP	2	1	2		1				1	1	1	1	1
CGCV	60	49	49	55	54	47	55	55	55	46	42	40	38
WGCP											1		
WGCV	29	24	25	20	29	29	28	27	28	24	23	24	25
WYCP	1		2	1	1	1	1	1					
WYCV	13	18	12	3			20	16	20	20	24	27	9
Grand Total	**149**	**145**	**153**	**143**	**150**	**147**	**147**	**140**	**144**	**137**	**132**	**128**	**128**

Table 3 Number of vessels per region and type (catcher processors, CP, or catcher vessels, CV) in 2024 that demonstrate cross-over in other fisheries and/or fleet. Cells with a bold outline indicate the total number in the fishery itself; other cells in the row indicate number of vessels from that category that also fish in other fisheries and/or fleets. For example, 74 catcher vessels fish in the Bering Sea, and of those, 12 also fish in the Central Gulf of Alaska. AI (CP and CV) and WGCP are not included as they had no activity in 2024. (NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA)

	BSCV	BSCP	CGCV	CGCP	WGCV
BSCV	74	0	12	0	1
BSCP	0	13	0	0	0
CGCV	12	0	38	0	10
CGCP	0	0	0	1	0
WGCV	1	0	10	0	25

Table 4 Total groundfish landed by sector and area in thousands of metric tons, not separated by fishery. Cells marked with an asterisk (*) are not shared due to confidentiality limitations. (NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA)

Subarea/Vessel	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
AI CP				*					*	*			
AI CV							*	*	1				
BS CP	561	583	584	600	612	619	623	642	607	629	496	586	587
BS CV	642	665	673	695	707	714	724	742	735	724	572	681	682
CG CP	*	*	*		*				*	*	*	*	*
CG CV	69	75	119	132	112	134	122	92	87	87	111	111	100
WG CP											*		
WG CV	28	7	14	29	61	*	31	22	19	18	24	26	32
WY CP	*		*	*	*	*	*	*					
WY CV	3	*	1	*			4	7	5	5	7	*	*
Grand Total	**1,303**	**1,330**	**1,391**	**1,456**	**1,492**	**1,467**	**1,504**	**1,505**	**1,454**	**1,463**	**1,210**	**1,404**	**1,401**

1.3 Relevant definitions

For this analysis, and with consideration to the intent of the motion, the term '**innovation**' is considered to be a process or opportunity for flexibility, improvement, or change to existing fishing behaviors, sensor technologies, or gear, with variable implementation timelines (e.g., using fishing knowledge to make changes quickly as compared to a permitted gear testing and implementation process with a several year life cycle). Additionally, innovation should align with stated objectives in the Council motion, to improve or maintain fishing efficiency and effectiveness, while minimizing bycatch to the extent practicable and minimizing impacts on sensitive seafloor habitat and unobserved mortality of stocks that rely on such habitat.

For this analysis, we considered an **incentive** to be a reason or motivation (through regulation, agreements, actions, etc.) that stimulates, persuades, or encourages action or a desired outcome. For example, BSAI FMP Amendments 91 (75 FR 53026) and 110 (81 FR 5681) are innovative approaches to managing Chinook and chum salmon bycatch through vessel-level incentives. The plans create incentives to avoid salmon bycatch by allowing vessels with good Chinook/chum salmon bycatch performance increased access to fishing grounds, while vessels with poor performance are restricted in fishing opportunities, affecting operating costs and profits.

Adjustment to the regulatory **pelagic gear definition** work is under way in a concurrent analysis. The action alternative would update federal regulatory language to reflect the way gear is currently employed and to allow vessels to use bycatch reduction devices. The current federal definition can be found in paragraph 14 of the definition of "authorized fishing gear" at §679.2, and the codend is defined at 50 CFR 600.10. For reference, the current definition of pelagic gear is listed here:

(14) Pelagic trawl gear is defined as a trawl that:

- (i) Has no discs, bobbins, or rollers;
- (ii) Has no chafe protection gear attached to the footrope or fishing line;
- (iii) Except for the small mesh allowed under paragraph (14)(ix) of this definition:
  - A. Has no mesh tied to the fishing line, headrope, and breast lines with less than 20 inches (50.8 cm) between knots and has no stretched mesh size of less than 60 inches (152.4 cm) aft from all points on the fishing line, headrope, and breast lines and extending passed the fishing circle for a distance equal to or greater than one half the vessel's LOA; or
  - B. Has no parallel lines spaced closer than 64 inches (162.6 cm) from all points on the fishing line, headrope, and breast lines and extending aft to a section of mesh, with no stretched mesh size of less than 60 inches (152.4 cm) extending aft for a distance equal to or greater than one-half the vessel's LOA;
- (iv) Has no stretched mesh size less than 15 inches (38.1 cm) aft of the mesh described in paragraph (14)(iii) of this definition for a distance equal to or greater than one-half the vessel's LOA;
- (v) Contains no configuration intended to reduce the stretched mesh sizes described in paragraphs (14)(iii) and (iv) of this definition;
- (vi) Has no flotation other than floats capable of providing up to 200 lb (90.7 kg) of buoyancy to accommodate the use of a net-sounder device;
- (vii) Has no more than one fishing line and one footrope for a total of no more than two weighted lines on the bottom of the trawl between the wing tip and the fishing circle;
- (viii) Has no metallic component except for connectors (e.g., hammerlocks or swivels) or a net-sounder device aft of the fishing circle and forward of any mesh greater than 5.5 inches (14.0 cm) stretched measure;
- (ix) May have small mesh within 32 ft (9.8 m) of the center of the headrope as needed for attaching instrumentation (e.g., net-sounder device); and
- (x) May have weights on the wing tips.

Pelagic trawl gear is also defined for *state waters* in the Alaska Administrative Code (5 AAC 39.105(10)(C)) where "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."

Trawl gear performance standards were established at the same time when pelagic gear was defined in regulation in 1993. The preamble to the proposed rule identified an objective to "reduce halibut and trawl bycatches by discouraging or preventing trawl operations on the seabed when halibut and crab PSC allowances have been reached (April 1, 1993; 58 FR 17196). Performance standards differ by region (50 CFR 679.7(a)(14)):

(i) BSAI. Except for catcher vessels in the trawl EM category, use a vessel to participate in a directed fishery for pollock using trawl gear and have on board the vessel, at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension.

(ii) GOA. Except for catcher vessels in the trawl EM category, use a vessel to participate in a directed fishery for pollock using trawl gear when directed fishing for pollock with nonpelagic trawl gear is closed and have on board the vessel, at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension.

Additionally, regulations for gear limitations at 50 CFR 679.24(b)(3) operate like a performance standard in the GOA region. This regulation restricts trawl footropes such that "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."

2 Management, enforcement, and logistical limitations to gear innovation

2.1 Regulatory approaches, flexibility, & Council objectives

NMFS has multiple ways of implementing Council management objectives. The Council could recommend that NMFS adopt very specific regulatory criteria at the possible expense of allowing future innovation and flexibility. For example, the recordkeeping and reporting regulations for eLandings in § 679.5(e) specifically list what has to be reported, how, and by whom. Another example are the specific restrictions on the locations various components are allowed under the current pelagic trawl gear definition (§ 679.2). NMFS could also identify broader management or policy goals it wants vessels to achieve and process to evaluate the degree to which gear configurations are meeting those goals, but the more general the regulations the greater the risk of ambiguity or enforcement uncertainty. For example, under the regulations governing the use of flow scales, NMFS can evaluate and approve any scales that meet a set of defined regulatory criteria (§ 679.28). This approval method works well for scales and VMS, because these are part of a well-established technology with larger international trade organizations determining what types of scales to approve for use in trade. The downside of such an approval process is it creates an additional administrative process for participants and the agency, and regulatory criteria for evaluating the effectiveness of technology can become outdated as technology changes.

Another example of a more flexible regulatory approach are the performance standards for the Catch Monitoring and Control Plan (CMCP) (§ 679.28(g)(7)). Under these regulations, a shoreside processor must meet a set of specific standards to ensure proper accounting for catch occurs and the shoreside processor submits a plan to NMFS for approval that describes how they will meet those standards. The CMCP regulations describe how a shoreside processor must meet a set of specific standards to ensure proper accounting for catch occurs and the shoreside processor submits a plan to NMFS for approval that describes how they will meet those standards. When developing these regulations, NMFS recognized that although these plants all might process the same species, they all had very different methods for accomplishing that goal. Rather than requiring an identical plan that might not work equally well for all the processors, the agency focused on what goals needed to be accomplished and allowed the processors, with significant input from NMFS staff, to describe how they would meet those goals.

Performance standards can provide benefits by allowing for innovation and plant-specific or vessel-specific process variation while still achieving the management goal. However, performance standards require considerable thought ahead of time to ensure that the standards are clearly defined and would achieve defined management goals. In other words, they are only effective if they are well written. Another challenge with performance standards is they require implementation work for both the agency and the regulated entities. Communication and cooperation between the NMFS staff approving the system and the industry, especially in the first years of a program, can be time consuming.

The Enforcement Committee Precepts (2015) reinforce the idea of regulatory clarity and reduced complexity to create effective and enforceable regulations:

- *Regulations should be as simple and straightforward as possible – reduced complexity equates to easier compliance and enforcement, and to the extent practicable, consistency should be considered.*
- *Where feasible, seek to reduce the number of regulations – multiple or overlapping regulations can lead to frustration, ambiguity, inadvertent noncompliance, and unintentional errors.*
- *Clear record of Council intent – especially important for socio-economic regulations when impacts to the resource is minimal.*

Generally, the more specific the regulatory gear definition is, the less innovation is possible. In the concurrent EA/RIR analysis to clarify the definition of pelagic trawl gear, several aspects of the pelagic trawl gear definition were identified as possibly limiting to innovation due to the level of prescriptiveness. Generally, benefits and advancements from innovation can increase as the clarity of the problem increases, as well as clarity of policy and management objectives. During discussions with industry representatives, the definitions of 'incentivize' and 'innovation' were noted as lacking clarity, as there are not yet specific metrics that pelagic trawl gear users should innovate toward. **Increased clarity in objectives, expectations, and possible incentives could help foster an environment for collaborative development of gear modifications and innovations.**

Where possible, gear restrictions should also be consistent across State and Federal fisheries boundaries to reduce complexity and ease compliance and enforcement (Enforcement Committee Precepts, 2015). The State of Alaska pelagic trawl gear definition (Section 1.3; 5 AAC 39.105(10)(C)) states that the gear "do[es] not operate in contact with the seabed", whereas the current Federal pelagic trawl gear definition and performance standard does not include any mention of bottom contact limitations. Additionally, in reference to gear restrictions in the GOA, 50 CFR 679.24(b)(3) states, "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."

2.2 Enforcement constraints

The most current NPFMC Enforcement Committee Precepts (2015) advocate for gear restrictions that can be enforced in real-time to stop unlawful conduct as it occurs through at-sea boardings, dockside inspections, observer reports, aerial patrols, and electronic monitoring technologies. The Precepts provide several recommendations to enhance enforceability of gear restrictions. Common to all recommendations are considerations of available enforcement resources "as they are spread thin nationally", the need for regulatory clarity and simplicity, and the need to consult enforcement on the implementation of any new regulation or technology to determine feasibility (i.e., equipment reliability, performance standards, evidentiary requirements) and to limit disruptions. As it pertains to gear monitoring technology, the current pelagic trawl gear definition only allows for a single net-sounder and inherently does not allow for any other technology due to the limitations of metallic components. As for commonly used bycatch excluder devices, these are also not allowed under the current definition due to restrictions on floatation use. If the Council recommends revisions to the current pelagic trawl gear regulatory definition, this may change. As the concurrent EA/RIR analysis to clarify the definition of pelagic trawl gear expands on many of the recommendations and challenges for enforcement with the pelagic trawl gear definition, we focus here on constraints that pertain to implementation of innovative gear technology if the definition of pelagic trawl gear is updated to allow for it.

Monitoring technology can be a complementary tool for enforcement. The NOAA Office of Law Enforcement (OLE) and the United States Coast Guard (USCG) already use Vessel Monitoring Systems (VMS) to monitor fisheries and to focus patrols on high priority areas, though it does not replace traditional surveillance platforms. Further, technology could provide enforcement officers with tools to monitor vessel or gear performance both at sea (potentially even remotely), and retroactively, thereby improving efficiency. Electronic monitoring cameras and flow scales have also been beneficial to enforcement. For example, the 'Trawl EM' program for eligible CVs in the BSAI and GOA regions fishing for pollock with pelagic gear allows approved vessels to have EM systems installed in lieu of an onboard observer. This allows for remote monitoring for compliance and catch handling.

However, some requirements can be challenging to enforce unless direct measurements are made during at-sea or dockside boardings or through other platforms if they have been previously documented (Table 5). It can then be inferred that additional gear monitoring, technology, and modification requirements, especially those involving some kind of sensor technology, would add additional time for enforcement to train staff, to directly observe deployment, to conduct compliance data reviews, and to resolve technical difficulties as "more time will be needed to review and verify EM data (e.g., pulling and viewing video of flow scales while conducting a boarding" (Enforcement Committee Precepts, 2015)).

Sensor technology can detect aspects of the net's behavior and are attached at various points across the gear (e.g., on the net, doors, or footrope). Some systems provide information on a real-time basis with information transmitted through a third wire system or wirelessly, and accessible on computer systems in the wheelhouse (e.g., live feed camera systems to view fish entering the net or codend or trawl sonars to detect the depth from the water surface to the fishing gear), whereas other sensor technology stores data that is then downloaded for review and later analysis (e.g., some bottom contact sensors attached to the footrope). The Enforcement Committee Precepts encourage the use of electronic sensors (e.g., video monitoring, electronic reporting) where specific gear must be deployed (e.g., codend excluders) to verify gear deployment; however, this process and at what point the data is enforceable, would need to be considered by the Council and enforcement. See Section 4 for further consideration of the gear revision and sensor data collection process.

A simple, visible, and accessible indicator of gear compliance may be an expedient route for monitoring (e.g., the quickly discernable lack of bobbins and rollers attached to the footrope equating to pelagic gear or how many crab are present on deck at any one time). The Trident EFP (reviewed by the Council in October 2024 and issued a permit in December 2024) tests the use of modified chain footropes with altered orientation, which could be a simple metric to check for compliance (see Section 3.2.3). But other gear modifications (e.g., bycatch excluders) may be more challenging to inspect depending on location on the net and approved configuration (i.e., size, location, metallic component use, amount and location of flotation).

A performance standard, a rule by which the performance of the fishing gear can be assessed, could also be a more expedient route for enforcement. As indicated in Section 8 of the February 2024 BBRKC initial review analysis, there must first be an enforceable definition of the gear type that allows for clear and consistent identification of legal and non-compliant gear. This also holds true for enforceability of performance standards. The pelagic trawl performance standard "at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches at the widest dimension"), has been used with a goal to reduce bycatch of crab and halibut, and minimize impacts to the seafloor. However, this performance standard does not apply to vessels that participate in the trawl EM program due to the regulatory exemption from the performance standard. Discussions during the OLE Trawl Performance Standard Workshop (Oct 2023) highlighted enforcement challenges of observer sampling priorities, safety concerns, and time constraints. If observers are considered as a possible means for enforcement in any future gear monitoring regulations or plans, these concerns should also be weighed.

There can be additional challenges associated with other types of performance standards. For example, a regulation in the GOA region states that "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)). An analyst noted that, as written, this rule is currently unenforceable due to ambiguity, and without any regulatory requirements for bottom contact sensors and associated data, and lack of current technology for enforcement, there is no way to determine whether vessels are meeting this standard. Analysts noted in the February 2024 BBRKC EA/RIR, Section 8, analysts noted that:

> *The difficulties with this are numerous. For example, is this threshold for 10% of each tow by bottom time exhibiting ANY seafloor contact, or 10% of the swept area (footrope contact)? Both would continue to present difficulties, as vessels are required to report when the net enters the water, instead of reaching fishing depth. Even given a future ability to measure this, more clarity would be required. Without improved capabilities to detect and quantify seabed contact through the development and application of existing or emerging technologies, it is currently impracticable to establish that threshold gear restrictions (such as that referenced) have been exceeded.*

Future gear revision would benefit from the inclusion of enforcement personnel early in the development process. This would help to address enforcement concerns and considerations listed above. During the process of research and implementation of the final rule for trawl sweep modifications in the BS (see Section 4.1), enforcement personnel were consulted early in the process and invited on the vessel to test for proposed gear compliance measures (e.g., measuring a bobbin; J. Gauvin, pers. comm.).

Table 5 Pelagic trawl gear restrictions and means of detections available to OLE based on the current definition. From PTR definition discussion paper, Agenda item D1, Feb 2024.

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	X		
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	X		
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 net-sounder device;	Maintain net shape/opening at slow speeds	X	X	X
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	X	X**	X
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 aircraft primarily when setting/hauling gear. ***Observable only if such configurations have been previously documented, otherwise would require measurement				

2.3 Cost and timeline mismatches

Funding can be a barrier to gear innovation. New gear components, gear monitoring technology, adaptation of the innovation to current gear, and the testing process are expensive in both actual cost and staff time, which present a barrier to many vessels. Innovations are funded in large part by fishery participants themselves and can also be wholly or partially funded through competitive grant programs, such as the NOAA Bycatch Reduction Engineering Program (BREP), Saltonstall-Kennedy Program, National Fish and Wildlife Fund (NFWF), or North Pacific Research Board (NPRB). Funding sources can also vary in availability, timing, and priorities, and may not be available on an annual basis. Additionally, applying for and possibly receiving external funding can be a long process that requires sufficient knowledge and time to put an application package together. This can take several years from the research planning phase to application and funding, to testing and analysis, and synthesis of results.

Generally, project applicants with pilot phase data already in hand at the time of application are more competitive, but not all projects fit into the funding opportunity objectives or priorities. For example, in the most recent FY2025 NOAA BREP funding opportunity, the application opened in October 2024, the pre-proposal was due December 2024, with full proposals due March 2025. Craig Rose (FishNext Research) has conducted research through the BREP program for a few years on an active-selection (ActSel) bycatch reduction device used in the Alaska pollock fishery and Pacific hake fishery and has published initial results (Rose and Barbee, 2022). Further testing and development of this device has been recommended for funding through BREP of approximately $200,000 to explore interactions of the ActSel systems with various bycatch excluder devices and vessel configurations during normal fishing practices, working closely with industry partners to get feedback.

Funding mechanisms to support innovation in gear modifications, gear revisions, or monitoring technologies can also come in the form of regulated fee structures, such as those in the Trawl EM program. Participating vessels must pay a fee that is calculated annually based on the "catch to which the full coverage trawl EM fee will apply; the ex-vessel value of that catch; and the costs directly related to the EM data collection, EM data review, VMP approval, and trawl EM category data" (§679.56). This cost burden for the monitoring program is borne by fishery participants and varies across sectors and regions. Nonetheless, the fee structure is viewed as an incentive by some participants. For example, the incentive for the BS shoreside pollock fishery comes from a reduction in total vessel monitoring costs through EM implementation versus the costs associated with 100% observer coverage (Trawl EM Committee Cooperative Research Plan, March 2019). This incentive may not be viewed the same in the GOA region due to different vessel sizes, coverage requirements, and the degree to which they prosecute multiple fisheries.

Many fishery participants that provided feedback for this paper also described funding limitations for gear or monitoring technology that would help improve their daily operations and allow for additional impromptu innovative adjustments to their fishing practices that are responsive to fishing and weather conditions. For example, while some vessels can afford live feed camera systems to actively monitor catch and net condition, others shared that the price is prohibitive to use for their scale of operations (one estimated equipment and installation costs to be approximately $125,000 to $150,000).

As mentioned previously, timeline expectations and mismatches are another possible limitation to gear innovation. The scale and complexity of gear modification or monitoring technology implementation is an important consideration. In addition to funding timelines mentioned above, expectations for testing and implementation should consider the scale of application (e.g., by closure area, fleet, sector, multiple sectors, fleet-wide, fishery-wide, etc.), whether the gear revision or technology requirements are case-dependent (e.g., closure area only; vessels using Trawl EM), and what additional mechanisms must be put into place for application, funding, monitoring, and enforcement (e.g., application to participate in Trawl EM program, contracting EM providers and servicers, and additional observer sampling required at processors). The entire process, from Council action to rule implementation can take years depending on the requirements and complexity (see Section 4).

3 Technological limitations, current research, and innovations

Current gear innovation research with pelagic trawl gear includes bycatch reduction devices, gear modifications, seafloor contact and benthic disturbance estimations, and sensor technology to detect net behavior. The examples provided below in Sections 3.2 and 3.4 are all currently going through the Council process in some form and align with stated objectives in this motion (minimizing bycatch, impacts to benthic habitat, unobserved mortality; improving fishing efficiency; adapting to new technologies). This list is not exhaustive, but rather meant to be representative of the objectives outlined in the motion. Note that the current pelagic trawl gear definition does not allow instrumentation for data collection (e.g., bottom contact sensors) other than a single net sounder. Many of the efforts outlined here require exemptions to the current pelagic trawl gear definition; however, if one or more options under Alternative 2 are adopted in the EA/RIR analysis to revise the pelagic trawl gear definition, exemptions may no longer be necessary for some of these efforts.

3.1 Monitoring technology and limitations

Monitoring technology is already used by many vessels to gather information about aspects such as the net position and shape (e.g., net sounders, door sensors, flow sensors), fish in the net (e.g., live feed camera systems, catch sensors, trawl sonars), and position in the water column (e.g., trawl sonars, bottom contact sensors). Sensors are available to attach at several points along the gear (doors, headrope, footrope, intermediate section, and codend). Here we focus on technological applications and limitations as they pertain to bottom contact sensors and cameras in trawl gear.

3.1.1 Seafloor contact detection methods

There are a variety of methods used in research to characterize the contact of gear on the seafloor, each with associated limitations. None of the monitoring technology or sensing methods are required by regulation, and therefore regulation that does directly limit bottom contact cannot currently be enforced because there is no way to judge whether vessels are meeting restrictions on bottom contact (§679.24(b)(3); see Section 2.2 on Enforcement constraints).

Model-based

Bottom contact *area* can be estimated through models. For example, the Fishing Effects Model (FEM; see Section 3.2.1 for further detail), provides the best available estimate of the impacts of Alaska federal fisheries on Essential Fish Habitat. The FEM uses a *contact adjustment,* which is a proportion between 0 - 1 that adjusts the *swept area* (i.e., estimated areal coverage over which any fishing activity may occur) of fishing gear to estimate a *bottom contact area* (i.e., a fraction of the swept area; Figure 2). The FEM does not provide direct measurements of bottom contact; it provides an estimate of bottom contact area based on contact adjustment estimations pulled from interviews that are specific to a combination of gear, target, depth, season, vessel length, etc. Fishermen were asked to estimate the proportion of the trawl net that is on the bottom. Skipper estimates were then compiled and provided by their respective organizations. Contact adjustment estimates were not specific to a tow or even a vessel but were instead provided as feasible ranges for each combination of factors considered likely to affect contact (e.g., fleet, season, depth, target). A wide variety of answers were provided for each combination of gear and conditions; therefore, the FEM uses multiple contact adjustment values for each combination (or row in the FEM gear table; see Appendix 2 in Zaleski et al., 2024). Estimates are conservative contact adjustment values that over-estimate contact and are then used in the model's estimations of habitat disturbance. Model-based results such as these are useful to estimate habitat disturbance on a larger spatiotemporal scale (e.g., monthly on a 5 km x 5 km grid cell in the Bering Sea), but are not representative of vessel- and tow-specific bottom contact. Eigaard et al. (2016) used a model-based approach to estimate the footprint of bottom trawling in European waters through logbook and VMS information at a grid cell resolution of 1 x 1 min longitude and latitude. Swept area (not adjusted with any contact adjustment proportion) was estimated on a mean annual basis. Model-based estimations of bottom contact would not be useful if real-time detection of bottom contact were desired. Estimations could be improved with additional data on gear characteristics, net behavior, bottom contact performance, and improved habitat information, but would still not be suitable to provide estimates of habitat disturbance from fishing impacts at the vessel level in real-time.

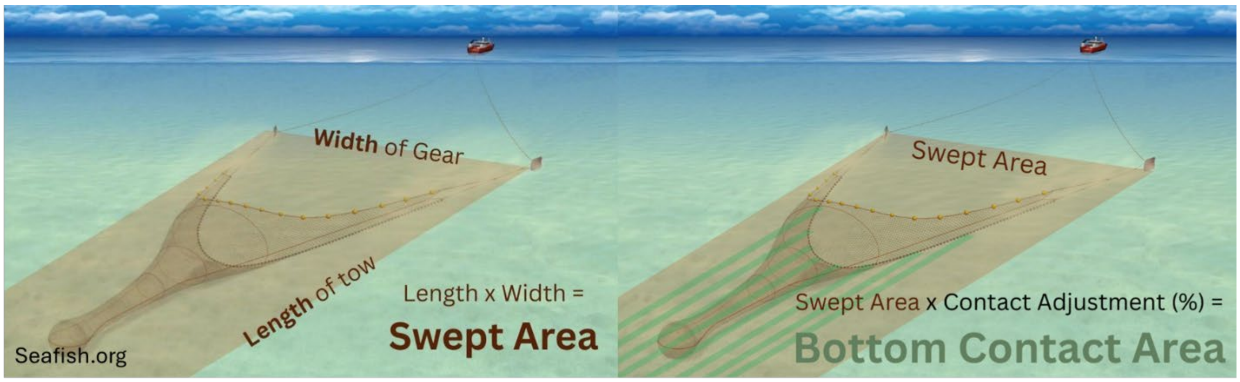

Figure 2 Swept area (tan) and bottom contact area (green), as demonstrated by a nonpelagic trawl net diagram. Bottom contact area is a fraction of the swept area. Lines are shown here to demonstrate how contact is not uniform and can vary across the footrope and length of tow. Bottom contact area varies by gear type and other factors.

Physical wear

Another method to detect bottom contact is through a physical proxy. During the fishing process, seafloor contact can wear elements of the fishing gear, which are visually noticeable. Commonly used indicators are worn net or footrope elements, and the degree of 'shininess' (i.e., abrasion) on chain links in the footrope. Chain links can rust quickly when back in the seawater, so researchers are able to examine chain elements for 'shininess' after each tow. For example, in the Trident footrope modification EFP (Figure 3; 2024-02), the project leads will use chain shininess as a metric for bottom contact between wingtips, and possibly for clearance after further testing. The chain segments will be photographed and the amount of 'shininess' will be measured. Further testing will also involve varying the spacing and the total number of chain segments to maintain net spread and fishing efficiency while minimizing contact (N. Yochum, pers. comm.). This method could provide a simple, observable way for real-time detection; however, more research is needed to understand variability across configurations and fishing conditions, the change in chain 'shininess' per tow, and whether this would be a useful method to detect contact and seafloor clearance across the entirety of the swept area.

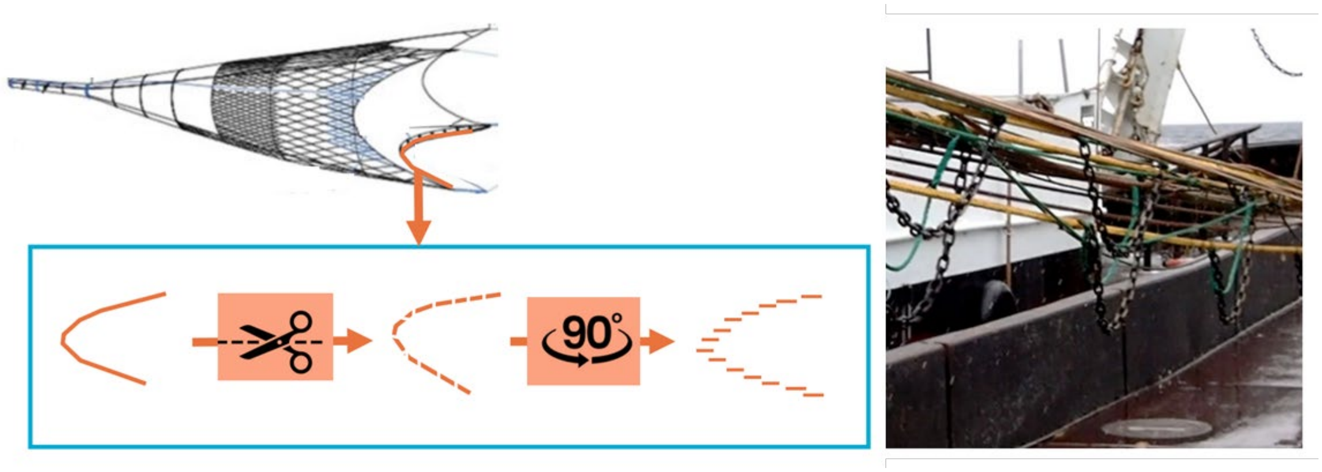

Figure 3. Trident EFP footrope modification (pelagic trawl footrope marked in orange) and a picture of the footrope chain segments (Trident EFP presentation, October 2024).

Tilt sensors

There are various types of sensors that may be deployed on a net, but for seafloor contact measurement, they typically fall into two categories: tilt and acoustic. Tilt sensors record temperature, depth (pressure), and acceleration derived tilt on three axes (X, Y, Z). These instruments must be kept stable (no rolling), protected in extremely durable housing, and attached to the footrope using durable materials (e.g., shackles) that stay intact, do not bend or warp, and do not bind on the attachment surface. Consideration of placement location and the number of sensors across the footrope is also an important factor to better describe the net behavior. The raw data is stored on the device for later retrieval and post-processing (mathematical conversion of tilt angles to clearance values). These devices can provide detailed data but require calibration, data cleaning, and analysis. The NOAA Groundfish Assessment Program Bottom Trawl Survey deploys a bottom contact sensor in a custom housing on the center of the footrope to detect on/off bottom (Hobo Pendant G accelerometer), but does not utilize it to measure footrope clearance off the seafloor. They are, however, calibrating the sensor for clearance measurements as they test new gear in ongoing survey modernization efforts (N. Charriere, pers. comm.).

Bottom contact sensors vary widely and should be tailored to the vessel and gear in use. Figure 4 (FAST Lab, 2025) demonstrates the different customized bottom contact sensors used in four different projects from 2016 - 2025 to measure bottom contact and seafloor clearance. Every sensor, associated protective housing, and attachment method were different and customized to the research project needs, vessel type, and gear type (Images source: FAST Lab, 2025). For example, a study in New Zealand was conducted to determine gear-seafloor contact on a demersal or bottom trawl net smaller in size than those used in Alaska (Figure 4, 3rd picture). This project built on master's research completed by King et al. (2019) with pelagic trawl gear in Alaska (Figure 4, 3nd picture), with a goal to build an empirical baseline understanding of gear behavior on the seafloor (Wilson et al., 2023). The New Zealand study deployed tilt sensors that were encased in a customized plastic housing (vs a welded metal housing with the King et al, 2019). Zebratech tilt sensors were attached at several points across the demersal gear (center of footrope, wingtips, sweeps), whereas the King et al. study deployed several Star Oddi tilt sensors across the footrope portion of pelagic gear. The most recent project in Northern Ireland (McGonigle et al., 2025;Figure 4, 4th picture) deployed eleven Zebratech tilt sensors at equal intervals across the footrope of a Nephrops bottom trawl, which is again, smaller in size than those used in Alaska. The sensor was encased in a housing that was lighter to account for the smaller net and attached via rope lashings to minimize binding.

Regardless of trawl gear type (pelagic vs bottom), considerable time was spent in all projects to produce a custom protective housing design as the durability and stability affect tilt data and the ability to safely deploy and retrieve the sensors. All concluded that further research was required for improvements to materials and attachment points. For example, in the most recent Northern Ireland project, when the sensors were reeled up with the net, the housing was bent and not useable. When usable and footage was visible, video imagery was paired with the sensors to verify tilt sensor behavior, and to correspond the range of tilt values to different contact states through a model of clearance, where 'on' is seafloor contact with gear, 'near' is no contact with the gear but the sensor housing is in contact, and 'off' is no contact with gear or sensor housing. These three broad categories ('on', 'near', and 'off') are used because better resolution is not feasible or available at this time. Results from both the pelagic trawl net project (King et al., 2019) and the demersal trawl net project in New Zealand (Wilson et al., 2023) demonstrated dynamic net behavior across the width of the gear measured and during the tow, indicating that the gear does not contact the seafloor as one broad sweep, but flies through the water and makes contact in a variable way. The intensive process of deploying tilt sensors, processing data, and analyzing results may provide a baseline understanding of gear behavior during a tow, and may also be able to be incorporated into future Fishing Effects Model work. However, these types of sensors may not provide real-time data accessible in the wheelhouse and will require testing across different vessel types and gear configurations to improve understanding and functionality.

Figure 4. Tilt sensor development to measure bottom contact and seafloor clearance from four projects starting in 2016 through 2025. Every sensor, associated protective housing, and attachment method were different and customized to the research project needs, vessel type, and gear type. (Images source: FAST Lab, 2025).

Acoustic sensors

Acoustic sensors, such as multi-beam wide-beam trawl sonars, are attached to the headrope and can be used to forward scan, profile the net, or act as a downsounder. These systems send acoustic data through a third wire system to a receiving unit, allowing the user to determine net opening and geometry, door position, fish entering the net, and distance from the headrope to the footrope and to the seafloor. Some systems have additional wireless capabilities but require separate paired receivers. Trawl sonars operate at a variety of frequencies depending on the application (e.g., 110 – 500KHz), with lower frequencies better suited for larger nets, and higher frequencies smaller nets and higher resolution. These systems are commonly used and provide data in real-time while fishing. They are also able to provide an indication of when a portion or the entirety of the net is on bottom. However, the echo return from the seafloor is very strong and obscures indications of anything else in the sonar beam that is at a similar range. Wider sonar beams allow for objects further above the seafloor to be obscured, which particularly affects the assessment of clearance of the footrope. As trawls approach the seafloor, captains will see the footrope image merge with the seafloor image even when the footrope remains significantly above the seafloor. This has been observed during research tows where different tools (e.g., tilt sensors, video cameras, acoustic altimeters) were used to directly observe the relationship between the gear and the seafloor. All of the methods showed clearances above the seafloor when the trawl sonar display indicated contact between the trawl and the seafloor (C. Rose, pers. comm.). This is termed the acoustic or sonar 'deadzone', which can also obscure fish in that same range (Figure 5). As with other sensor technology, the precision of the instrument will also factor into determinations of clearance from the seafloor. In some trawl sonar systems, the precision is +/- a meter or more (N. Yochum, pers. comm.). Further research may be needed to validate clearance data provided by acoustic sensors, including across various gear and fishing conditions.

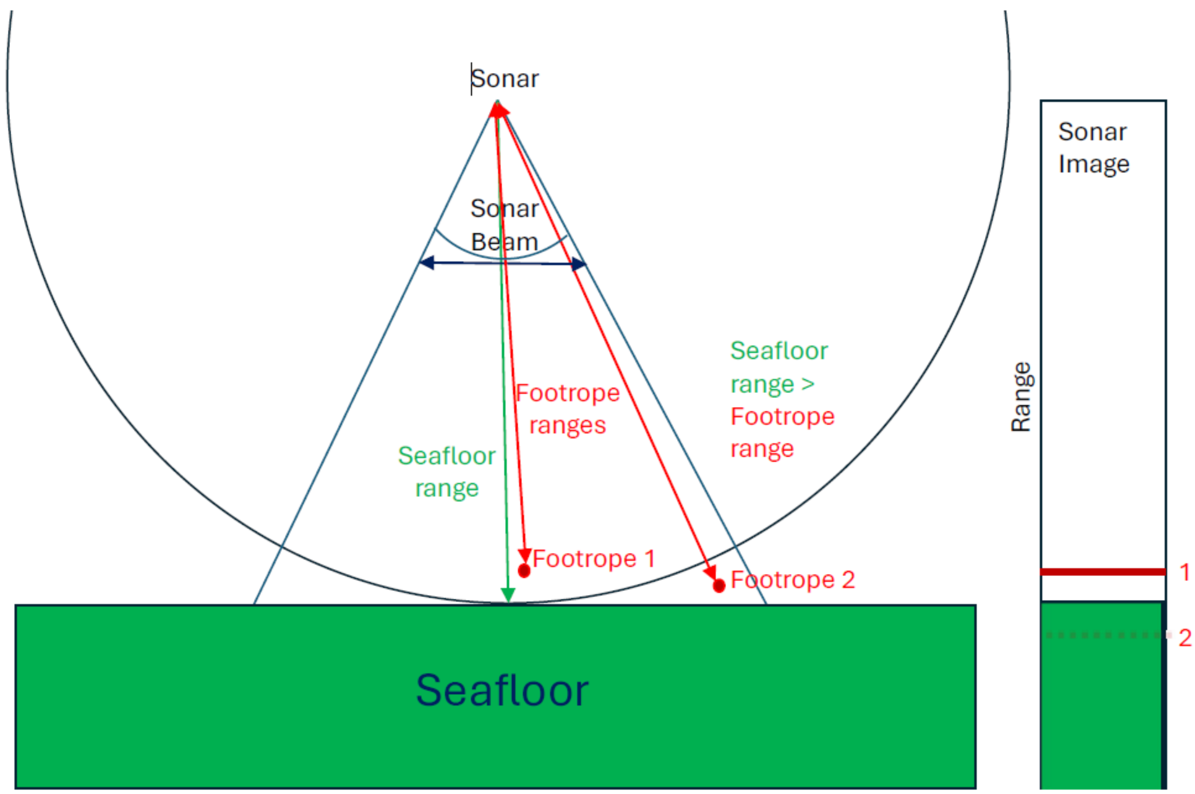

Figure 5 Conceptual diagram of the acoustic deadzone effect that can obscure the footrope due to the strong echo return of the acoustic signal from the seafloor. Footrope 1 is nearly centered under the sonar beam, is closer in range than the seafloor, and is therefore not obscured. Footrope 2 is off-center from the sonar beam, is further in range than the seafloor, and is therefore obscured. (C. Rose)

3.1.2 Camera systems

Camera systems are used to monitor catch performance on deck and in the net, bycatch excluder performance, gear compliance, and to validate bottom contact sensor data. Electronic monitoring (EM) systems are used for catch-accounting and have strict regulatory requirements for installation, maintenance, and data review. EM systems can also be used as a supplemental enforcement tool to detect for more obvious elements of gear on deck (e.g., bobbins, discs, chafing gear, presence of floatation), those elements that allow for a quick delineation between nonpelagic and pelagic gear. Live feed camera systems are a valuable tool to monitor catch performance in the net and to allow vessel operators to move locations if PSC is high. They are also used to quantify PSC and target catch composition in bycatch excluder performance (see examples in Section 3.4). Cameras are planned for use in the chum salmon bycatch excluder EFP (2025-01) and live feed cameras are already in use for the ActSel bycatch reduction project (Rose and Barbee, 2022). Cameras were noted to be an important validation tool when deployed during bottom contact sensor testing, as sensors may experience various erratic movements (e.g., fluttering, rolling, flipping, binding) due to hydrodynamic forces on the footrope (King et al. 2019; Wilson et al., 2023). However, the dark and sometimes turbid conditions on the seafloor can create challenges for camera validation.

3.2 Seafloor contact

3.2.1 Fishing Effects Model

The **Fishing Effects Model (FEM)** is a modeling tool that helps to understand fishing impacts and subsequent cumulative habitat disturbance on a seascape-scale (e.g., Bering Sea; Smeltz et al. 2019; Zaleski et al. 2024). EFH Component #2 (see Section 5) largely relies on the FEM, and the model is also employed in a variety of other habitat-related considerations, to analyze potential Council management actions, to test efficacy of past policy (e.g., C2 BBRKC EA/RIR, Feb 2024; habitat reduction from trawl sweep modifications), and for research (e.g., Pollock Gear Project, Gear Innovation Initiative).

The FEM incorporates the following information:

- Spatial distribution of habitat types on a 5 km x 5km grid, representative of the resolution of available information. Sediment survey information was parsed into 5 different sediment-based habitat types, and after analysis, resulted in a presence-absence sediment layer.
- The spatial extent of fishing effort from the NMFS Catch-in-Areas database, consisting of VMS GPS data and associated fishing activity information (e.g., total catch, target, vessel size, gear types, etc).
- A gear parameter table with additional information on nominal width and contact adjustment for 73 gear types (2017 and 2022 EFH 5-year Reviews). These parameters were estimated in 2017 with input from industry and reviewed by NMFS staff for the 2022 fishing effects evaluation but are not yet empirically measured. Due to the variety of values collected per gear configuration, a conservative range of low to high values were recorded. In Appendix 2 of Zaleski et al. (2024), four different combinations of gear and fishery indicate GOA pelagic trawls range from 50-100 m nominal width, and contact adjustments range from 0 - 1. For the BS, twenty-four different combinations of pelagic gear and vessel type indicated a range of 50-166 m for nominal width, and a contact adjustment range of 0.2 - 1.
- Susceptibility and recovery parameters of structure-forming habitat features, based on methods from Grabowski et al (2014) and updated when new parameters are derived from literature that becomes available (see Fishing Gear Effects on Marine Habitats Database). These values are ranges for structural seabed features associated with each habitat type.

The FEM has two modules: a Fishing Module and a Habitat Module. The Fishing Module provides intermediate model outputs – meaning those that do not account for the susceptibility and recovery of benthic organisms - include swept area (nominal gear width x length of fishing) and bottom contact area (contact adjusted swept area). These outputs help to understand where fishing occurs and overlaps, and a represent a conservative estimate to which fishing gear may interact with the seafloor. Maps of bottom contact, such as Figure 5 in the concurrent EA/RIR analysis to clarify the definition of pelagic trawl gear, demonstrate the mean annual estimate of bottom contact of pelagic gear from January 2013 to August 2022 and show fishing hotspots, but do not account for impact and recovery dynamics over time. This type of broad-scale map with averaged data is useful to see patterns of fishing and potential bottom contact area, but obscures other factors (e.g., seasonality, changes to gear or vessel use, changes in fishing patterns, variable contact adjustments, etc.) and is not useful for understanding habitat disturbance from fishing gear.

The FEM Habitat Module incorporates results from the Fishing Module and information on susceptibility and recovery of benthic organisms to produce the model's final output – an estimate of cumulative disturbance from fishing gear, represented as a percent of the specified spatial extent. For example, in August 2022, the estimated habitat disturbance by region was 0.90% (Gulf of Alaska), 2.46% (Aleutian Islands), 0.28% (Northern Bering Sea) and 5.33% (Southern Bering Sea) (ESR 2023 GOA; ESR 2023 AI; ESR 2023 EBS). Note that cumulative habitat disturbance means effects accumulate over time but are not strictly increasing. Habitat disturbance is a continual accumulation of impacts, which increase disturbance, and recovery, which decreases it. Thus, an estimate of habitat disturbance for any given point in time reflects the entire history of impacts and recovery at that location.

3.2.2 Pollock Gear Project and the Gear Innovation Initiative

During the February 2024 Council meeting, Dr. Brad Harris (FAST Lab, APU) presented on the Fishing Effects Model and the **Pollock Gear Project** (B1 presentation). The Pollock Gear Project is a research project with a goal to address ongoing concerns regarding seafloor contact and the need for higher resolution spatiotemporal gear impacts data from the Fishing Effects Model. The project initially started with Bering Sea pollock CPs in 2022 and has since expanded to CPs and CVs in the BSAI and GOA regions (see Gear Innovation Initiative below). Core components of the work include:

- Gear database/catalog (master's thesis) – updated vessel information, gear configurations, gear specifications, and gear modifications collected from industry participants to update the FEM gear parameters table and inform gear simulations
- Fishing Practices Profiles (master's thesis) – operators were surveyed to understand fishing practices during specific scenarios and other important considerations that may affect gear deployment
- Fishing simulations (Memorial University) – industry-derived gear specifications, gear geometry data (e.g., headrope height from trawl sonar), and fishing practices will inform trawl software simulations in DynamiT to improve understanding of net behavior and seafloor contact dynamics

Contingent upon funding, research plans include a) gathering more information using haul logs to verify net geometry, and (b) validating simulations and field work to measure gear-seabed interactions through the use of bottom contact sensors, building off other APU bottom contact research (Section 3.1.1; Alaska, New Zealand, and Northern Ireland projects).

During the October 2024 Council meeting, the Pelagic Trawl Gear Industry Working Group (member companies: Alaska Groundfish Data Bank, At-Sea Processors Association, Alaska Whitefish Trawlers Association, Midwater Trawlers Cooperative, Peninsula Fishermen's Coalition, United Catcher Boats), presented research plans during testimony for the **Gear Innovation Initiative (GII)**. This initiative represents an expansion of the existing Pollock Gear Project and includes collaborative fleet participation from pollock trawl CVs in BSAI, Western, and Central GOA regions. The group outlined plans for ongoing and future collaborative research efforts with APU from 2022-2026 across pollock CPs and CVs in response to ongoing concern regarding pelagic gear impacts. Contingent upon funding, future plans include the same as those outlined above for the Pollock Gear Project, and include exploration of gear modifications, if warranted. According to this testimony presentation and an ADN opinion article (Oct 2024), the industry representatives met with leadership from the Alaska Department of Fish and Game and NOAA Fisheries Alaska Regional Office to discuss ongoing research and were encouraged to identify measures to mitigate impacts from fishing gear on the seafloor. Expected outcomes from the Pollock Gear Project and Gear Innovation Initiative include the refinement of bottom contact area estimates and updated habitat disturbance analyses, and an improved understanding of pelagic trawl net behavior above and on the seafloor.

3.2.3 Pelagic gear footrope modification (EFP 2024-02)

In October 2024, the Council received a presentation from Dr. Noëlle Yochum and Shannon Carroll from Trident Seafoods discussing ongoing pelagic trawl gear research requiring an EFP to use gear that would otherwise be prohibited from paragraph (14)(vii) of "authorized fishing gear" in § 679.2. In 2023, with approval from NOAA Fisheries, Trident began work to test a footrope modification as a proof of concept for safety, operations, and initial performance. In December 2024, the EFP permit was approved and issued. This EFP is a continuation of this work, with a goal to test iterations of the design across various vessel types and net configurations. The project employs modified footrope designs aimed at maintaining catch efficiency while minimizing seafloor contact by the footrope when targeting pollock on or near the seafloor. An overarching goal in this work is to develop a method by which bottom contact can be determined through visual inspection and physical measurements without the use of sensors. In a pelagic trawl net, the footrope acts as a counter-weight system to ensure the mouth of the net stays open, while the midwater doors spread the net horizontally. The footrope is usually weighted with a length of chain running between bridles to weight the net. In this EFP project, the same amount of weight is rotated 90 degrees with two footropes made of rope materials that are connected from wingtip to wingtip, and smaller sections of chain connecting them, similar to the rungs on a ladder except the chain 'rungs' loop down.

Project leads expect that seafloor contact will be reduced as the chains are smaller sections with a width of 2 inches and spaced at least 2 meters apart across the footrope. EFP testing will include varying the number of chains, distance between the chain 'rungs', and total overall weight, while maintaining or improving catch efficiency. Project leads plan to test for bottom contact by measurement and documentation of chain 'shininess' after each tow, i.e., the amount of chain surface that is shiny due to abrasion from to seafloor contact. In this design, the amount of shininess on the chain equates to the height or clearance of the footrope from the seafloor, not increased contact (N. Yochum, pers. comm.). Future plans include data sharing with Alaska Pacific University and ongoing efforts to simulate gear performance and understand impacts to benthic habitats in the Pollock Gear Project and Gear Innovation Initiative.

3.2.4 Other examples

Gear innovation also occurs outside of the official Council and EFP process. For example, midwater trawl doors are now widely used across pelagic and nonpelagic trawl fleets to minimize or reduce seafloor contact (S. Webster, P. O'Donnell, K. Cochran, J. Bonney, pers. comm.). The switch to midwater doors mainly occurred between 2007 and 2011, before the implementation of BSAI Amendment 94 (requiring the use of trawl sweep modifications). For the nonpelagic A80 fleet, this occurred due to a change in net-to-sweep ratio, where nets became smaller and sweeps longer to increase efficiency. The shifted ratio necessitated the use of midwater doors to lift and spread the net opening. Midwater doors are oriented so they are parallel to the direction of water flow, so if contact is made, the footprint is reduced relative to the footprint from the prior use of bottom doors (S. Webster, pers. comm.). In the GOA, operators are not restricted on gear type by target and can therefore decide to switch between pelagic and nonpelagic fishing. The adoption of midwater doors allowed those operators to increase efficiency when switching gear types and fishing, while decreasing water resistance, fuel costs, and bottom contact. One operator noted that midwater doors are easy to use with pelagic gear but require constant monitoring when used with nonpelagic gear to ensure that the doors stay upright (P. O'Donnell, pers. comm.). Another operator noted that with a live feed camera system and manufacturer net plans, it was possible to get the gear geometry just right so the net wasn't digging into the bottom. If the gear was under- or overspreading, the camera would be clouded with turbid water, but if spread the right amount, the view from the camera would be clear (K. Cochran, pers. comm.).

3.3 Unobserved mortality

There are no examples of unobserved fishing mortality (UFM) research currently in the Council or EFP process. However, unobserved mortality may be indirectly reduced through actions focused on the minimization or reduction of seafloor contact. The **Unobserved Fishing Mortality Working Group** was formed by the Council in June 2023 in response to a SSC request. The interagency working group met in October and November 2023 to discuss unobserved fishing mortality data gaps and recommendations related to the "big three" crab stocks – Eastern Bering Sea snow crab, Bristol Bay red king crab, and Eastern Bering Sea Tanner crab. The final report, presented to the Council in June 2024, indicated that estimating UFM for all gear types is a high priority, but acquiring the necessary information will require substantial research effort. Table 1 in the UFM Final Report highlights research priorities by gear type, including pots, hook-and-line, nonpelagic trawl gear, and pelagic trawl gear. The report contributors rated the research priority for "lethality" of pelagic trawl gear as 'high' due to lack of available information, recommending that field experiments be conducted and estimated they would take three to five years. The priority rating for bottom contact area was 'medium' as the data was available and would require data mining on a timeline of up to 1 year. Table 2 of the UFM Final Report indicates that one of the highest priority needs for mortality rate (when encountered) are further 'under-bag' experiments, similar to Rose et al. (2012), as mortality is difficult to assess and requires direct observation and experimental work, including with direct video observation in the trawl. The working group agreed that further working group meetings would likely not be fruitful until additional research was completed to fill in some of the identified data gaps. Should the Council suggest additional meetings, it is the working group's recommendation that these meetings include a broader range of experts, such as gear experts or industry personnel, to fill in some knowledge gaps.

Dr. Craig Rose and Dr. Brad Harris presented fishing gear research to the Council in February 2024. Dr. Rose presented on past research testing for nonpelagic gear impacts to the seafloor and impacts to unobserved crab mortality using recapture nets or 'underbags'. Two smaller recapture nets were used to determine unobserved mortality for three species of crab (Tanner crab, snow crab, red king crab), and unobserved mortality was found to decrease with the use of raised trawl sweeps (Rose et al., 2012). A separate project used a single large recapture net that covered the full footrope to test different footrope designs (Hammond et al., 2013). Unobserved mortality rates of Tanner and snow crab decreased with the use of newer footrope designs but varied by footrope type and sex of the crab.

3.4 Bycatch reduction

The examples listed below highlight some methods to reduce bycatch in pelagic trawl gear, including EFPs and other fleet innovations under development. Bycatch excluders are commonly used to reduce the bycatch of PSC species while maintaining target catch efficiency. The action alternatives analyzed in the concurrent EA/RIR analysis are intended to update the regulatory definition of pelagic trawls in Alaska to clearly allow commonly used components in codends and bycatch excluder devices, allow instrumentation necessary to monitor and adjust net performance, and remove unnecessary outdated text.

3.4.1 Active selection (ActSel) bycatch reduction device

Dr. Craig Rose and Mr. David Barbee are currently working on further testing and development of an active selection (ActSel) bycatch reduction device, funded by the NOAA BREP program. This work was mentioned in Dr. Rose's testimony for C6 Pelagic Trawl Gear Definition and is an example of an iterative project with industry collaboration. An active selection bycatch reduction device allows operators to selectively release unwanted fish by triggering the movement of a mesh panel that covers a release opening. The custom bycatch reduction device is a system that includes a mesh panel attached to a hydrodynamic kite, control lines to adjust the kite's orientation, a live feed camera system via a third wire, and an electromechanical reel to control the system (i.e., the trigger mechanism). The operator must continuously monitor real-time video feed to determine when to trigger the release mechanism. This bycatch reduction device involves active selection, meaning operators can open and close the mesh panel at will, as compared to other passive systems where there is no trigger mechanism. It has been tested in the Pacific hake fishery and the Alaska pollock fishery, and initial results were published (Rose and Barbee, 2022). Further testing will include interactions of the ActSel systems with various bycatch excluder devices and vessel configurations during normal fishing practices, working closely with industry partners to get feedback. The publication indicated that the speed at which the operator could shift between capture and release modes (i.e., opening and closing the mesh panel; ~10 sec) was likely not fast enough for individual fish selection but would be useful for releasing fish that linger in the target area, when the proportion of bycatch is high, or during setting and retrieval. The authors also indicate that the system would be greatly enhanced if video analysis was automated, alleviating the need to continuously monitor trawl videos.

3.4.2 Chum salmon excluder

In April 2025, the Council reviewed an application for an EFP submitted by Mr. John Gauvin, under contract with North Pacific Fisheries Research Foundation (EFP 2025-01). The applicant proposes to develop and test salmon excluders in the BS pollock fishery to optimize salmon escapement under summer fishing conditions where chum salmon is the primary salmon species encountered as bycatch in the pollock fishery. The applicant proposes to conduct field testing in July and August 2025 during the fishery's "B" season. The applicant proposes to test a new excluder design that will be installed further forward in the net, compared to currently available salmon excluders. The new excluder will be located where the diameter of the trawl net is much larger and the main focus for EFP testing will be on determining the best location for the new excluder in terms of creating an improved opportunity for salmon escapement while minimizing pollock loss. The applicant will deploy cameras, echosounders, and light meters in various sections of the net to help understand how fish move through different sections of the net. This should better allow salmon to access the escapement portal(s) because there is more room and less congestion for salmon to find their way to the exit portal as they move back through the net with the target catch. As described in the application, the applicant plans to start by testing the salmon excluder in aft sections of the net (likely 8-inch mesh) and move forward to larger mesh sections, no larger than 32-inch mesh. This EFP will use data collected in the field from vessel's headrope sonar, an echosounder located in the mesh sections of interest, and cameras to make decisions for each EFP vessel regarding assessment of how fish move through the net and eventually where to cut out the excluder portals for preliminary assessment of escapement potential for this new excluder design.

3.4.3 Other examples

Industry innovations also include work on bycatch reduction, whether that is through the development, testing, and use of a bycatch reduction device, or through changes to fishing behavior on a daily basis. To reduce encounters with salmon and other PSC species, the Alaska Groundfish Data Bank (AGDB) has worked with TIMEZERO to tailor a plotter software interface as a means to track participating vessels, to identify hotspots, and to implement temporary closures in their pollock and rockfish fisheries. Participating vessels that have TIMEZERO software are able to instantaneously see the information on their plotter and upload information or update bathymetric maps. In conjunction with TIMEZERO, AGDB coordinates through WhatsApp on a daily basis (C. Radell, K. Cochran, pers. comm.). This system is similar to the rolling hotspot monitoring program that facilitates salmon avoidance plans described in the Bering Sea pollock Incentive Plan Agreements. Participating Bering Sea pollock cooperative members utilize real-time spatial catch/bycatch third-party data management and internal accountability measures to minimize bycatch with dynamic tools while remaining under an overall PSC cap on Chinook salmon.

4 Process for revising gear

The regulatory gear revision process can include several components, depending on the type of revision under consideration: Council action, research planning and testing (including simulation modelling), scale-model testing and development at a flume tank, full-scale experimental testing at-sea under EFP, analysis of results, feedback from NOAA entities, reporting results, and collaborative and iterative communication with industry participants and management entities. The timing of each component can vary; however, the gear revision process can often take several years and be extended depending on the scale of application (e.g., fleet-wide vs fishery-wide). See the timeline graphic (Figure 6) for a worked example of the 6-year life cycle of a BSAI fleet-wide nonpelagic trawl sweep gear modification, from Council action to publication of the final rule (BSAI Amendment 94). The timeline does not include the subsequent testing and adoption of these gear modifications in the GOA nonpelagic trawl fleets under Amendment 89 three years later. Research projects listed in Section 3 are at some point in this process, several of which are being conducted under EFPs.

The EFP component of the gear revision process (50 CFR 679.6 and 50 CFR 600.745) is a regulatory means to allow for fishing for limited experimental purposes that would otherwise be prohibited under 50 CFR part 679, and supports projects that could benefit fisheries and the environment. EFP issuance usually takes anywhere from 3-12 months depending on the complexity of the project. EFP applicants should also consider the Council schedule so that the EFP can be aligned with a Council meeting. The EFP timeline and process can vary based on the complexity of the proposed project (e.g., the level of NEPA analysis required or if the project requires an ESA consultation).

Steps in the EFP process include:

- EFP application development – applicant contacts NMFS AK Region with a proposed experimental design and schedules a meeting to discuss project complexity and develop a permit issuance timeline. Applicants work with agency staff before the applicant submits a draft application. AK Region staff then work with the applicant to finalize the application.

- EFP application review – NEPA analysis (EA or categorical exclusion (CE)), ESA Consultation (if needed), AFSC review, notification to other agencies as appropriate, Federal Register notice and public comment period (15-30 days) usually timed with a Council meeting for Council consultation.

- EFP permit development and issuance – AK Region drafts permit, reviewed by NMFS OLE, Observer Program, and applicant, EA or CE finalized via NEPA Coordinator, AK Region, General Counsel (GC) and OLE review and provide clearance, final signatures from applicant and AK Region Administrator

- EFP fishing activities – notification to NMFS of EFP fishing, non-performance, and/or any issues impacting EFP activities

- EFP reporting requirements – interim and final reports; if requested results are presented to the Council

- EFP modifications – the applicant may request minor changes, but major changes may require a new application

After the EFP process is complete, there are several practical process aspects that could be considered based on lessons learned from the Trawl EM program to improve any future proposed regulatory language and enforceability.

- Minimum technological and testing requirements across multiple vessel and gear configurations, with additional considerations for camera/sensor/modification placement and performance. Testing the durability of a new camera, sensor, or gear modification takes time to test before implementation.
- Standards for procurement, installation, maintenance – the Trawl EM program requires vessels to use a NMFS permitted EM provider to furnish these services.
- Data storage, screening, and analytical requirements – the Trawl EM program contracts with an EM service provider to review, interpret, or analyze EM data as it is work-intensive. Time and resources involved at this juncture could vary widely depending on the type(s) of data and post-processing requirements. Weighing the cost of both the technology and the review is important to understand a new technology's effectiveness in meeting a data need.
- Staffing resources for real-time or remote enforcement.

Similar aspects should be considered for approved gear modifications and innovations (e.g., bycatch excluders, raising elements). Insights can be gained from the development and implementation of nonpelagic trawl sweep modifications in the BSAI and GOA regions (see Section 4.1; Amendments 94 and 89, respectively).

4.1 Gear revision examples in the Council process

The implementation of a fleet-wide trawl sweep modifications to nonpelagic trawl gear in the BSAI region (FMP Amendment 94) and subsequent extension in the GOA region (FMP Amendment 89) is an example of the entire life cycle of a gear revision. As illustrated in the timeline graphic (Figure 6) the life cycle of this gear revision from initial Council action to publication of the final rule was six years. The timeline does not include the subsequent testing and adoption of the same gear modifications in the GOA nonpelagic trawl fleets under Amendment 89 three years later.

A major component of the analysis for BSAI Amendment 89 EA, which focused on a suite of measures for Bering Sea Habitat Conservation, was the analysis of trawl sweep modification in the nonpelagic trawl flatfish fishery. While the Council supported gear modification as an effective tool to minimize adverse impacts on seafloor habitat and reduction of unobserved bycatch mortality, they felt that further research and refinement of the specific details of the gear modification were required before it could be implemented. The Council adopted other protection measures including substantial area closures but deferred the modification and implementation until June 2008 with the intention of reopening a portion of the newly-created Northern Bering Sea Research Area (NBSRA) to the trawl flatfish fishery once trawl gear modification was implemented. The potential to re-open the flatfish trawl fishery in a portion of the NBSRA was incentive for the fishing industry to continue to work out technological and implementation issues associated with trawl sweep gear modification. Amendment 94 was the vehicle to implement what had been deferred from Amendment 89 because of the lack of sufficient information.

This research project was led by Craig Rose, Carwyn Hammond, and John Gauvin between 2005 and 2011. The aspects of the gear revision process included fleet participation in all project stages, including the research planning, field research, gear development and testing, review and presentation of results to management, and preparation for implementation. Several meetings and workshops along the way not only included industry participants, but also gear manufacturers, enforcement, NOAA staff, and Council staff. Research tested flatfish herding efficiency, effects on structure-forming benthic habitat features with a camera and sonar, and an examination of unobserved crab mortality.

The Trawl EM program on catcher vessels fishing with pelagic gear and associated tender vessels delivering pollock to shoreside processors or stationary floating processors (BSAI Amendment 126 and GOA Amendment 114) went into effect in 2024 and is another example of a broadly applied technological monitoring program that evolved through collaboration with industry participants. The process began in 2018 with initial testing on volunteer pelagic trawl CVs, then testing was formalized through an EFP (2019-03) on 79 CVs. The process involved formation and formal feedback from the newly formed Trawl EM Committee, three years of data gathered through the EFP process, and public input. After Council review of the draft EA/RIR in 2022, the final rule was published in August of 2024.

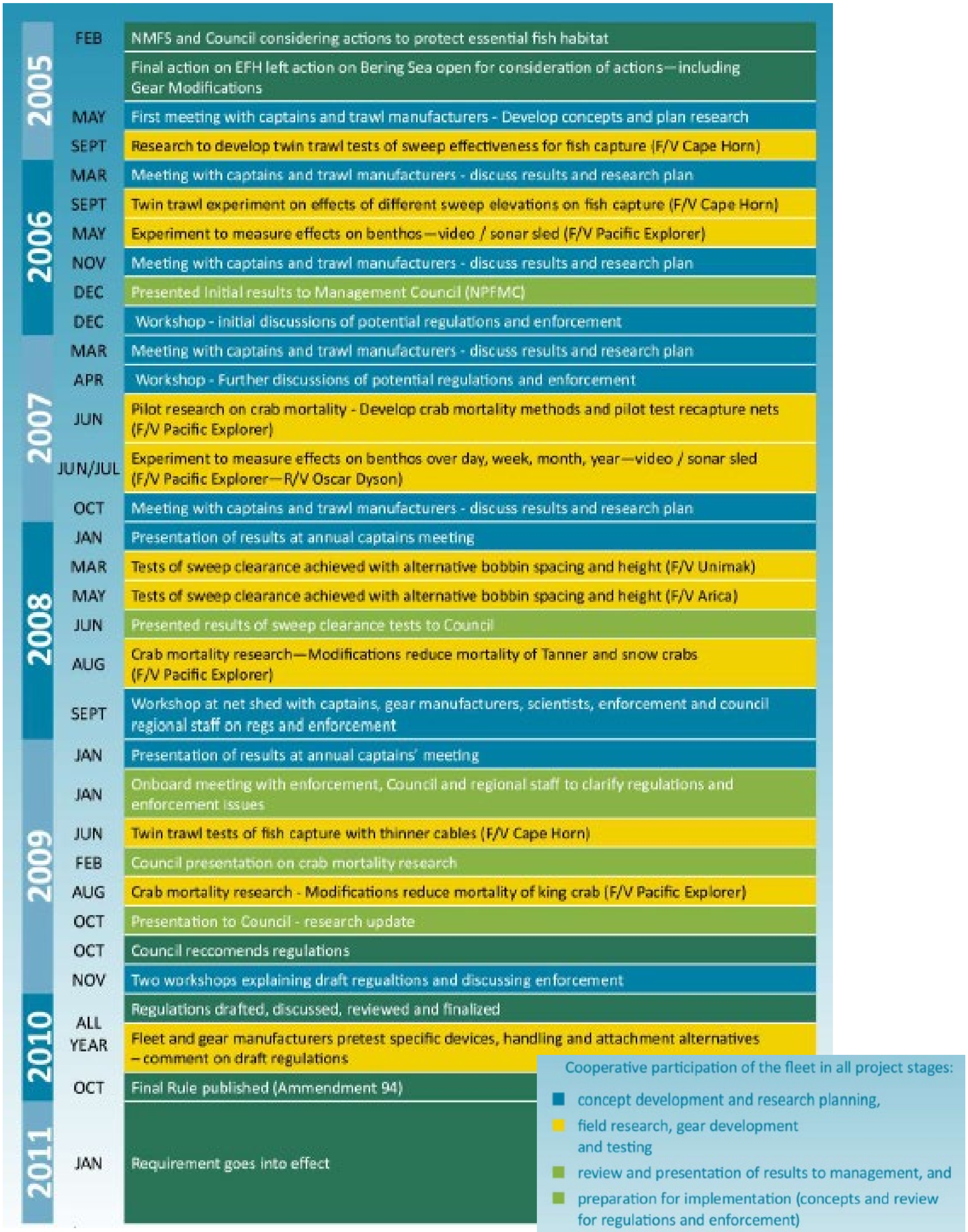

Figure 6 Life cycle timeline of BSAI nonpelagic trawl sweep modifications from initial Council actions on EFH to final implementation of FMP Amendment 94 (figure copied from Craig Rose AFS poster, 2011). The same gear modification requirements were put into effect via GOA FMP Amendment 89 three years later (2014).

5 Management tools to inform metrics to achieve Council objectives

Below are seven management tools - EFPs, the EFH 5-year Review, the FEM, ad hoc committees, Incentive Plan Agreements, performance standards, outreach - that may help to inform metrics to achieve Council objectives for this action. The process and timeline vary for each tool, and some tools may be used in combination.

Exempted Fishing Permits (EFPs) allow for limited experimental fishing to test gear modifications. More detail on the EFP process can be found in Section 4 of this analysis, including estimated timelines for permit issuance and general timelines for the gear revision process. This is a management tool to allow for testing of gear that may provide metrics for which the Council can determine if they have achieved objectives.

The Magnuson-Stevens Fishery Conservation and Management Act defines essential fish habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" ((16 U.S.C. 1802(10)); NMFS further interprets EFH in the guidelines under 50 CFR 600 Subparts J and K). The **EFH 5-year Review** process is a mechanism to ensure NOAA and Fishery Management Councils incorporate the most recent and best science for EFH into Fishery Management Plans (FMPs). The ten EFH components of FMPs are reviewed and EFH information is revised or amended as warranted. The review evaluates published or unpublished scientific literature or scientific data that meet acceptable standards of scientific review. The most recent EFH 5-year Review was completed in 2024, and the next EFH 5-year Review cycle is planned to launch at the October 2025 Council meeting.

Within the 5-year review cycle, fishing activities that may adversely affect EFH (Component #2; 50 CFR 600.815(a)(2)) must be examined. Each FMP must contain an evaluation of the potential adverse effects of fishing on EFH designated under the FMP. Each FMP must also minimize to the extent practicable those adverse effects. Councils must act to prevent, mitigate, or minimize any adverse effects from fishing to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature.

EFH Component #2 largely relies on the **Fishing Effects Model (FEM)**, a tool that helps to understand fishing impacts and subsequent habitat disturbance (FAST Lab, Alaska Pacific University). The FEM is also employed in a variety of other EFH consultations and Council actions (e.g., C2 BBRKC EA/RIR, Feb 2024). This modelling tool incorporates information on the spatial extent of fishing effort (Catch-in-Areas database), types and configurations of fishing gear, fishing practices based on target and season, habitat susceptibility to fishing impacts, the rate at which habitat recovers, and information on the spatial extent of habitat types. Model outputs include swept area (nominal gear width x length of fishing), bottom contact (contact adjusted swept area), and cumulative habitat disturbance from fishing gear impacts provided as a % by monthly basis for a selected area of analysis. See Section 3.2.1 for further detail on this model.

During the most recent Fishing Effects Evaluation (Zaleski et al. 2024), stock authors reviewed results from the FEM to evaluate whether fishing adversely impacted each stock if and were able to provide an FE evaluation to determine if fishing adversely impacted their stock if $\geq$ 10% of the core EFH area (CEA) was disturbed. None of the authors concluded that habitat disturbance within the core EFH area for each species were affecting each stock in ways that were more than minimal or not temporary. None of the stock authors or the Council recommended elevating the species for mitigation measures against impacts of fishing for any EFH 5-year Review period since implementation. These assessments and conclusions are reviewed by appropriate Plan Teams and Council advisory bodies.

The FEM is also a core component of the Pollock Gear Project and the industry-led Gear Innovation Initiative (see Section 3.2.2 for further detail). Gear configuration and fishing practices information supplied by several industry groups from the BSAI and GOA regions are currently being incorporated into the FEM gear table inputs. Industry-derived information and model results will inform simulations to improve understanding of net behavior and physical seafloor contact dynamics. If funding is available, the project team plans to verify simulation outputs in flume tanks and eventually test bottom contact sensors at sea. The Trident Seafoods modified footrope EFP research (see Section 3.2.3) is complementary to the Gear Innovation Initiative. Information from deployment of the modified pelagic footrope on CPs and CVs will be provided to the FAST Lab at Alaska Pacific University for incorporation into the gear tables and simulations.

Ad hoc committees or working groups are temporary in nature and can be convened or re-convened to examine specific issues as warranted by the Council. Working groups can make informed recommendations and report results to Plan Teams and advisory bodies of the Council to support decision-making. For example, the Unobserved Fishing Mortality Working Group (UFMWG) met in the Fall of 2023 to respond to Council requests: develop a framework for estimating unobserved fishing mortality and explicitly incorporating estimates into stock assessments, report on specific research priorities and data needs, and recommend approaches to investigate spatial/temporal extent of unobserved mortality over fisheries and gear types to the extent practicable. The UFMWG Report emphasized substantial data deficiencies and necessary research to overcome data gaps and agreed that further working group meetings would not be fruitful until additional research was completed. If the Council suggested further meetings, the UFMWG recommended inclusion of a broader range of experts.

Incentive Plan Agreements are developed and implemented by industry in response to incentives that achieve specific management tools (e.g., reducing Chinook salmon bycatch to maintain a more flexible hard cap). Incentive plan agreements must be submitted and approved by NMFS and publicly posted (e.g., 50 CFR 679.21(f)(12)(iii)(E)). More than one IPA may be approved by NMFS in an FMP area and offers flexibility by allowing amendments. For example, the AFA CP sector's IPA follows mandates from BSAI Amendments 91 (2011) and 110 (2017) in the BS pollock fishery to incentivize vessel-level salmon bycatch reduction (see 2024 Annual Report). The plan requires the use of bycatch excluder devices and penalizes those vessels with consistently high bycatch rates as compared to other vessels. Vessels that are successful are allowed increased access to fishing grounds, while vessels with poor performance are restricted in fishing opportunities, affecting operating costs and profits. This IPA has encouraged use of technology and gear innovation. All AFA CP vessels now use a live feed camera system to assist in real-time bycatch monitoring, and AFA CP vessels are currently participating in the development of two excluder devices (NOAA BREP funded ActSel; chum salmon excluder EFP; see Section 3.4).

Performance standards themselves, if designed, drafted, and implemented correctly, are another example of a management tool that can provide the metrics to determine whether Council objectives are achieved. The tools providing the metrics must be tested to ensure that they provide the required data and metrics (See Sections 2.1 and 2.2).

Outreach to fisheries participants is an important management tool in which feedback can be gathered to inform metrics and promote collaborative working relationships and knowledge sharing and is usually iterative. Outreach can come in the form of informational meetings, presentations during Council meetings (e.g., B Reports or evening meetings), presentations during Committee or Plan Team meetings, workshops (e.g., Climate Scenarios Workshop, June 2024), and webinars (e.g., NPFMC Climate Readiness Webinar, March 2025); however, this list is not comprehensive. Some form of outreach is important during any efforts for gear restrictions or revisions as regulations "should incorporate industry best practices and consider industry recommendations" (Enforcement Committee Precepts, 2015). NOAA OLE and the Council hosted the Trawl Performance Standards Workshop during the October 2023 Council meeting to solicit feedback from the public and fishery participants on BSAI pelagic trawl gear performance standards.

6 Considerations with respect to future action on revising gear definitions or performance standards

6.1 Closure areas dependent on the definition of pelagic trawl gear

Numerous regulations within part 679 rely upon the pelagic and nonpelagic trawl definitions as a foundation for subsequent management measures. These regulations pertain to various topics including directed fishing allowances, area and gear closures, bycatch and prohibited species catch (PSC) limits, and recordkeeping and reporting requirements. While the Bering Sea pollock fishery is required to use pelagic trawl gear (§ 679.24), there is no similar requirement for vessels targeting other groundfish or pollock in the Gulf of Alaska. However, certain area and gear closures restrict nonpelagic trawls and limit trawling activity to vessels using pelagic trawl gear within the confines of that specific area. Several regulations involving area closures for the protection of seamounts and corals rely upon the mobile bottom contact gear and bottom contact gear definitions, which are in turn based upon the pelagic and nonpelagic gear definitions. A comprehensive list is included in the pelagic trawl gear definition analysis, and the following lists the various types of closure areas in the BSAI and GOA that are dependent on a definition of pelagic trawl gear with respect to fishing access (see also NPFMC summary of closure areas, 2023):

- Bering Sea – protection areas for corals and seamounts, habitat protection areas to freeze the footprint of trawl fishing, habitat conservation areas around coastal communities, crab closure areas.
- Gulf of Alaska – crab protection areas, coral and slope habitat protection areas

6.2 Gear limitations and prohibitions for trawl gear in regulation

Additionally, there are also 50 CFR 679 regulations that are specific to trawl gear limitations and performance standards, which would need to be considered should the Council want to initiate follow up action on regulating pelagic gear to achieve Council objectives. The following highlights particularly relevant elements:

- BSAI trawl gear performance standard: Except for catcher vessels in the trawl EM category, use a vessel to participate in a directed fishery for pollock using trawl gear and have on board the vessel, at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension.
- GOA trawl gear performance standard: Except for catcher vessels in the trawl EM category, use a vessel to participate in a directed fishery for pollock using trawl gear when directed fishing for pollock with nonpelagic trawl gear is closed and have on board the vessel, at any particular time, 20 or more crabs of any species that have a carapace width of more than 1.5 inches (38 mm) at the widest dimension.
- Trawl footrope: 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.
- BSAI pollock nonpelagic trawl prohibition: No person may use nonpelagic trawl gear to engage in directed fishing for pollock in the BSAI (§ 679.24 “Gear Limitations”).

6.3 Analysis of displacement/spillover impacts

In February 2024, the analysis that considered closures as a measure to protect BBRKC identified that the Council should consider how groundfish effort might be redistributed spatially and temporally in response to the potential area closures (see section 3.3 of that analysis). Spillover impacts, such as changes to catch-per-unit-effort (CPUE) or PSC rates from displaced fishing effort should be considered if a change to the pelagic gear definition occurs, as that may change fishing access to closure areas (see Section 6.1). Similarly, these aspects should be examined if gear innovations and research lead to new regulations or a re-evaluation of performance standards.

7 Council action at this meeting

The Council will review the discussion paper and may choose to take further action on this issue. Further action on this issue could include a request for an expanded discussion paper with a specific list of requests. The Council could also establish a Purpose and Need statement for this action and a suite of alternatives for analysis, including analyses of innovation incentives and options for modifications to the current performance standard. The Council could also decline to take further action on this issue.

8 Persons consulted

Agency staff

- Rachel Baker, Karla Bush, Kendall Henry (Alaska Department of Fish and Game)
- Nicole Charriere (NMFS AFSC)
- Mike Fey (AKFIN)
- Josh Fortenbery (NOAA GC)
- Taylor Holman, Diana Evans (North Pacific Fishery Management Council)
- Alicia Miller, Caleb Taylor, Maggie Chan, Josh Keaton (NMFS AKRO SF)
- Alex Perry (NOAA OLE)
- Molly Zaleski (NMFS AKRO HCD)

Others

- Julie Bonney, Chelsae Radell, Shelby Bacus (Alaska Groundfish Data Bank)
- Brad Harris, Felipe Restrepo (FAST Lab, Alaska Pacific University)
- Andrea Keikkala, Susie Zagorski (United Catcher Boats)
- Stephanie Madsen, Caitlin Yeager, Austin Estabrooks (At-Sea Processors Association)
- Heather Mann, Kurt Cochran (Midwater Trawlers Cooperative)
- Craig Rose (FishNext Research)
- Rebecca Skinner, Patrick O'Donnell (Alaska Whitefish Trawlers Association)
- Sarah Webster, John Gauvin (Alaska Seafood Cooperative)
- Noëlle Yochum, Shannon Carroll (Trident Seafoods)

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