Gear Innovation Initiative

BSAI/GOA Pollock Trawl Catcher Processor and Catcher Vessels

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Introduction

Increased dialogue around how pelagic trawls in the pollock fishery operate and their associated bottom contact has prompted further consideration of the pelagic trawl gear definition by the North Pacific Fishery Management Council (NPFMC). This *Gear Innovation Initiative* is an effort to better understand pelagic trawl gear interactions with benthic habitat, potential unobserved mortality on crab, and enforceability of bottom contact characteristics of pelagic trawl gear.

Background

Evaluating the potential impacts of commercial fishing to benthic habitat is an important component of the Essential Fish Habitat (EFH) 5-year review process[1]. Regional fishery management councils are required under the MSA to 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." The North Pacific Fisheries utilize a state-of-the-art Fishing Effects (FE) model to evaluate fishing effects on EFH for species of groundfish and crabs, including 27 AI species, 34 EBS species, and 42 GOA species. The NPFMC's Joint Groundfish Plan Team, Crab Plan Team, and Science and Statistical Committee reviewed the FE evaluations during the 2022 EFH Review and concluded that fishing effects were minimal and temporary and therefore no species were recommended for elevation to the NPFMC for possible mitigation to reduce fishing effects to EFH.

In April 2024, leadership from the State of Alaska Department of Fish & Game and NOAA Fisheries Alaska Region requested to meet with representatives from the pollock fleet to discuss pelagic trawl gear operations. State of Alaska and NOAA leadership encouraged the fleet to identify verifiable measures to mitigate the potential effects of bottom contact in areas of particular concern.

The NPFMC motion under the Bristol Bay Red King Crab Closure Area action in February 2024 provides clear guidance on the objectives the pollock fleet should consider when

[1] Most recent 5-year EFH review occurred in 2022.

examining the bottom contact characteristics of pelagic trawl gear and the potential for future innovation. This guidance forms the basis of our *Gear Innovation Initiative*:

The Council tasks staff with a discussion paper to inform options for incentivizing pelagic trawl gear innovation with the following objectives:

- *minimizing bycatch to the extent practicable*
- *minimizing the impacts of pelagic trawl gear on sensitive benthic habitat and unobserved mortality of stocks that rely on such habitat*
- *improving or maintaining fishing efficiency*
- *flexibility for trawl gear innovation within the constraints of other objectives (e.g., adapting to new technologies)*

The Alaska pollock industry, as the local knowledge holders on gear, is committed to working on the identified concerns and objectives outlined in the Council motion.

Overview

This *Gear Innovation Initiative* covers both Gulf of Alaska (GOA) and Eastern Bering Sea (EBS) pelagic trawl fisheries. The trawl vessels operating across these two areas are diverse in size and horsepower and will likely require different approaches on varying timelines. The categories of work are provided below:

1. *Applied research to empirically measure the extent of bottom contact by pelagic trawl gear*:

The FE model is currently the best available science to estimate impact of bottom contact from pelagic trawl gear. The FE model estimates are informed by the gear tables and have substantial uncertainty owing to the lack of empirical field studies. The FE model gear tables were populated using expert knowledge provided by members of the gear design, fishing and conservation engineering communities. Consistent with the nature of the expert-derived information, bottom contact estimates were incorporated as ranges, from which the FE model draws at random, including the highest contact values provided following the precautionary principle. It is notable that the results of the only empirical work done on this gear type (King 2019 assessed a CV pelagic pollock trawl), suggest the values in the FE gear tables may be overestimates of bottom contact by pelagic trawl gear. The existing FE model can also be a useful tool for managers to understand existing pelagic trawl gear benthic habitat disturbance across space and time. With more precise gear tables and contact adjustment ratios, estimates of benthic habitat disturbance by pelagic trawl gear will be more accurately reflected in the model outputs and is a primary goal of this *Gear Innovation Initiative.*

This project encompasses three stages: (1) gear cataloging, (2) gear modeling, and (3) empirical measurement of seafloor contact. A target timeline has been developed and is included in this document.

This work is critical in addressing the Council's motion as it will (1) provide a more precise

baseline for understanding impacts to sensitive benthic habitat and potential unobserved mortality; and (2) inform any necessary gear innovation work.

2. *Gear Innovation*:

The *Gear Innovation Initiative* will result in more accurate estimates of total seafloor contact by pelagic trawl gear that could possibly change FE model outputs. The confidence in our estimates of FE model outputs will be improved. Adjustments or modifications to gear may require that CVs and CPs apply for an Exempted Fishing Permit (EFP) to test innovative pelagic trawl gear designs that are not presently allowed.

Any gear modifications will also need to consider other elements of the NPFMC motion:

- 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 process for gear innovation will vary by region and sector but includes work with captains, gear experts, agency and State staff, with the goal of meeting the four Council objectives listed above. Gear innovation is complex and in addition to fieldwork, will likely require flume tank experiments and Exempted Fishing Permits (EFP), depending on the design.

A critical component to addressing gear/benthic interactions is developing a science-based approach to understanding impacts from bottom contact in the context of fishing efficiency and bycatch/PSC avoidance. Current FE modeling capacity includes quantifying fishing footprint, bottom contact and estimating the cumulative impacts to support EFH adverse impact determinations. The FE model framework will be used to explore the implications of innovative gear designs with respect to footprint, contact and EFH. While the recent state of the science regarding species-specific gear impacts, including unobserved crab mortality, precludes quantifying these effects (e.g., see Unobserved Fishing Mortality Working Group Report) the *Gear Innovation Initiative* will provide information essential to enhance and improve the precision of inputs to the FE model.

Other Research and Considerations

In parallel with industry efforts, the SSC has prioritized a research need to “Quantify the magnitude of fishing gear impacts on crab and their associated benthic habitat and develop fishing gear innovations where needed (Research Priority ID# 809).” Industry will seek to provide support through research proposals, use of fishing vessels, or other

methods to advance this parallel track research priority.

Enforceability: Enforceability is a component of any gear definition or policy objective. Enforcement can be achieved through gear definitions, technology, or fishing effort controls.

Funding: This *Gear Innovation Initiative* will require significant funding and personnel resourcing. Funds may be available through the North Pacific Fisheries Research Foundation.

Appendix I. GII Target Timeline

Pelagic Trawl Gear Industry Working Group (PTGIWG)
Gear Innovation Initiative (GII) Project *Target* Timeline - July 2024

Year	Sector	Project Element	Details	Funding Secured?
2022	**CPs**	**Project Planning**	CPs commenced participation in the Alaska Pacific University (APU) project, *"Assessment of pollock trawl-seabed interactions to inform fishery management."* The work plan includes three project elements: Element 1: Cataloging Gear Specifications (1a) & Refining with Fishing Practices Survey (1b) Element 2: Numerical Simulations Element 3: Gear-Seabed Contact Field Study	Y
2023	**CPs**	**Element 1a**	CPs began Element 1: Cataloging gear specifications.	Y
	CVs	**Project Planning**	BSAI CV fleet committed to participation in the APU project.	n/a
1st Quarter 2024	**CPs**	**Element 1a**	The base gear catalog architecture for the CPs is complete. The pollock industry partners have provided full or partial gear information for 33 CP pollock trawls (8 models), being used on 12 vessels. The CPs next steps are to confirm the use of each net model on board, any modifications, and then understand how each of the nets are being deployed given different fishing conditions.	Y
1st Quarter 2024	**CPs**	**Element 1b**	Development of a fishing practices survey is underway to gather information directly from vessel operators to refine event-level bottom contact estimates and guide the development of gear deployment scenarios for Element 2.: ●	Y
		Element 2	Numerical gear simulation-work is also simultaneously underway**.** ● *"A generic 320 m headline wide-body trawl simulation was constructed based on common characteristics of EBS pollock catcher-processor gear. Example mid-water and demersal fishing scenarios were modeled for this generic gear to ensure the data incorporated into the gear catalog was sufficient to support the simulations."*	Y
2nd Quarter 2024	**CVs**	**Project Planning**	APU Project was expanded to include pollock trawl CVs in the Central and Western GOA. UCB, MTC, AGDB, AWTA, and PFC are coordinating collaboratively as "CVs" for the project.	n/a
3rd Quarter 2024	**CVs**	**Element 1**	Element 1 funding has been secured for the BSAI/GOA CVs Contact information for the BSAI and CV fleets is provided; work began to determine an appropriate vessel subsampling approach given there are 126 CVs in the BSAI and GOA combined. By the end of August gear cataloging begins.	Y

Year	Sector	Project Element	Details	Funding Secured?
3rd Quarter 2024	**CPs**	**Element 1b**	CPs complete fishing practices survey.	Y
	CVs	**Element 1a**	CV gear cataloging begins.	Y
4th Quarter 2024	**CPs**	**Element 2**	CPs underway with Element 2, conducting simulations based on Element 1.	Y
	CVs	**Element 1a**	CVs continue gear cataloging; targeting completion towards end of quarter so refinements may begin.	N
1st-2nd Quarter 2025	**CPs**	**Element 3**	Design seabed contact field study based on Element 1 and 2 results. Will include determining number of tilt sensors or other technology needed, placement on the gear, number of vessels and nets to be sampled, fishing seasons, fishing conditions, etc. **Funding has been secured for APU staff, but other funding will be needed.*	N*
	CVs	**Element 1b**	CVs begin the fishing practices survey in Q1 and continue through Q2.	N
		Element 2	Gear simulations will begin in Q2, simultaneously while the survey is completed. CV fleet may be stratified by vessel size/horsepower based on information from gear catalog and fishing practices survey to determine which gears should be simulated.	N
3rd-4th Quarter 2025	**CPs**	**Element 3**	Empirically measure seafloor contact under normal fishing conditions, test a range of trawl nets on CP vessels. If needed, an EFP will be developed for the September EFP cycle.	N
	CVs	**Element 2**	CVs continue simulations in order to accurately represent the vessel diversity of the CV fleet.	N
		Element 3	In Q4, the CVs will begin Element 3 to design a seabed contact field study based on the simulations that have already been completed in Element 2. The study will be similar to the CP study design (including other elements of NPFMC motion) but tailored for any differences in vessel size/horsepower based on what was learned in Elements 1 and 2.	N
1st Quarter 2026	**CPs**	**Element 3**	CPs will continue to empirically measure seafloor contact during the A Season.	N
	CVs	**Element 2**	CVs will finish final gear simulations.	N
		Element 3	CVs will continue to develop the seabed contact field study based on what was learned in Elements 1 and 2.	N
2nd-4th Quarter 2026	**CPs**	**Element 4- Gear Modification**	If gear modifications are warranted given the updated fishing effects modeling outputs CVs and CPs may develop an EFP to submit for the May EFP cycle to test new pelagic trawl gear designs that may not meet the current regulatory standard. The gear modifications will consider other elements of the NPFMC motion: ● 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.	N
	CPs	**Element 4- Gear Modification**		N

Year	Sector	Project Element	Details	Funding Secured?
			• Flexibility for trawl gear innovation within the constraints of other objectives (e.g. adapting to new technologies). This may also include flume tank testing/modifications.	
	CVs	**Element 4- Gear Modification**	See CP description above. If an EFP is warranted, BSAI CVs would begin when their B Season opens June 10; GOA CVs will begin when their B Season opens Sept 1. CVs would continue to follow the same process, under similar timeframes but slightly behind the CP work.	N

GII *Target* Timeline, At A Glance

	2022	2023	1st Q 2024	2nd Q 2024	3rd Q 2024	4th Q 2024	1st Q 2025	2nd Q 2025	3rd Q 2025	4th Q 2025	1st Q 2026	2nd Q 2026	3rd Q 2026	4th Q 2026
Project Starts	CP													
		CV[1]		CV[2]										
#1a Gear Catalog		CP	CP											
					CV	CV								
#1b Fishing Practices Survey				CP	CP									
							CV	CV						
#2 Simulation				CP	CP	CP	CP							
								CV	CV	CV	CV			
#3 Field Study							CP	CP	CP	CP	CP			
										CV	CV	CV		
#4 Gear Modification (EFP)												*CP*	*CP*	*CP*
												CV	*CV*	*CV*

CV1: BSAI CVs are added to the project.
CV2: GOA CVs are added to the project

Appendix II. Full Project Description

Assessment of pollock trawl – seabed interactions to inform fishery management

(*Updated 1.3.24*)

Fisheries, Aquatic Science & Technology Laboratory – Alaska Pacific University
Leads: Drs. Brad Harris, Scott Smeltz, Robert Murphy, Suresh Sethi, and M.Sc. Student - Katherine Yahnke

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The ongoing and growing discussion in the fisheries management arena and the public domain regarding trawl gears serves to demonstrate the scope and magnitude of current knowledge gaps and the corresponding perceptions of trawl – seabed interactions. In 2022, we initiated work with the catcher-processor fleet to ensure scientifically robust gear information was available to support fishery management actions. In 2023, the project was expanded to include pollock catcher vessel gears.

The workplan includes three elements: 1) cataloging gear specifications, 2) numerical simulations, and 3) gear-seabed contact field study design. Each focus area provides new insights to support robust fishery-level predictions of pollock gear-seabed interactions needed to inform fishery scientists, managers, and the public. Further, we aim to refine and expand this workflow towards including all North Pacific fishing gears which interact with the seabed including bottom trawls, and fixed gears (pots, hook and line).

1) *Cataloging the Gear*: The goal of this project element is to improve our understanding of the interaction between pollock trawl gear and the benthos as a function of specific gear characteristics and fishing practices in the Eastern Bering Sea pollock fishery. This requires the structured documentation of the designs (e.g., individual net plans), materials (e.g., footrope chain dimensions), configurations (e.g., doors, bridle length, set back, size and location of wing weights), and modifications (e.g., salmon excluders) used by the fleet. Highest priority is on gears in active use with eventual inclusion of gears used since 2003.

Following the cataloging of physical gear characteristics, in-person surveys will be used to gather fishing practice information directly from fishers to refine estimates of event-level bottom contact and to guide the development of gear deployment scenarios during the gear simulation project element (see below). Operators will be asked to provide input on their level of intended bottom contact as a function of fishing conditions including depth, season, time of day, bycatch/PSC, and product mix. They will be asked if/ how these factors influence on-the water changes to the gear configuration (e.g., increase wing weights) or deployment practices (e.g., wire scope). Operators will have the opportunity to identify other factors that may influence fishing event-level bottom contact.

We created the Fishing Effect (FE) Model to estimate the cumulative impacts of fishing gear-seabed interactions on Essential Fish Habitat and for characterizing the footprint of fishing activities associated with current and proposed spatiotemporal fishery management actions (e.g., Proposed Red King Crab Emergency Actions) in the North Pacific (see Smeltz et al., 2019, see: NPFMC Effects of Fishing on EFH Discussion Paper 2022). The FE Model uses the NMFS Catch-in-Areas database to link individual spatially resolved fishing events derived from VMS and Observer Program data to fishery sector and to gear dimensional and expected seabed contact information solicited from fishing industry experts. These information products allow the estimation of bottom contact at a monthly level in Federal waters off Alaska

at a 5km resolution since 2003 from which fishing footprint, bottom contact estimates can be made for any month or location in the FE Model domain. These estimates along with literature-derived habitat impact and recovery parameters are used to predict the cumulative area disturbed by federally managed fisheries in the Gulf of Alaska, the Aleutian Islands and Bering Sea. The gear catalog information gathered in this project element will be used to update the pollock trawl dimensional and contact estimates underpinning FE Model predictions taking account of the fishing practice factors outlined above. FE Model runs will be constructed for all North Pacific gears and for pollock-only gear scenarios to quantify and map the fishing footprint, bottom contact, and cumulative habitat impacts resulting from the updated gear information relative to the gear information used in the 2022 EFH assessment.

Status (1.3.24): The base gear catalog architecture development is complete. To date the pollock industry partners have provided full or partial gear information for 33 catcher-processor pollock trawls (8 models) being used on 12 vessels. Development of the fishing practices survey is underway. Next steps include refinement to the catalog format to accommodate the hierarchy of forthcoming gear information. For example, a single vessel typically uses several trawls, a single trawl may be deployed with variable configurations and fishing practices depending on fishing condition factors.

2) *Simulating the Gear*: The dynamic behavior of towed fishing gear (e.g., trawls) is affected by myriad factors including the design, materials, rigging, and the hydrodynamic and frictional forces experienced during fishing. Numerical modeling has emerged as an essential step in the process of understanding and predicting important parameters including trawl geometry, resistance, and mechanical stress/downward force on the seabed (see Winger et. al 2016). Using the information gathered in project element one above, we will construct numerical models of the trawls used to target pollock in the Bering Sea. The trawl simulation software package DynamiT is best suited for this study due to its performance compared to field data and flume tank tests and its ability to model gear-seabed interactions and estimate ground friction. Gear geometry data (e.g., door spread, wing spread, headrope height) from the gear catalog and fisher input as well as on-board trawl mensuration systems like Marport and Scanmar will be incorporated into the numerical models using generalized fishing scenarios consistent with real fishing practices. The model-derived estimates of trawl geometry, and seabed contact as well as horizontal and vertical forces generated for these scenarios will be used along with information on the temporal and spatial distribution of these fishing scenarios to further refine the pollock gear specifications used in the FE model runs. Scenario-based 3-D gear visualizations (still images and videos) will also be generated to illustrate potential interactions between the gear and the benthos. We expect these products to be helpful in addressing gear knowledge gaps and misperceptions that can arise in the management process. This trawl simulation work will be done in collaboration with the fishing gear technology and conservation engineering team led by Dr. Paul Winger at the Fisheries and Marine Institute (FMI) at Memorial University of Newfoundland, Canada. Drs. Winger and Harris have established a formal agreement between APU and FMI that includes the gear model development and scenario simulations in the DynamiT software package.

Status (1.3.24): First a generic headline wide-body trawl simulation was constructed based on common characteristics of EBS pollock catcher-processor gear. Example mid-water and demersal fishing scenarios were modeled for this generic gear to ensure the data incorporated into the gear catalog was sufficient to support the simulations. Next, three trawls from the catalog were selected for initial model construction and performance evaluations. Selection was based on expected frequency of use in the fleet and evidence of differences in design and material characteristics. Net plans and specifications for these trawls have been provided to the simulation team and model construction is underway. The most complex

of these gears was selected for simulation performance testing. This included modeling the gear with the highest resolution supported by the software followed by progressively less complex models to explore the tradeoffs in computation time and model performance. Specifically, we are seeking to understand how the choice of simulation model resolution related to the model's accuracy and precision relative to the full resolution model. For example, the full resolution runs incorporate complex shaping in trawls seams while the simplified runs replace these with continuous tapers. The simplified models reduce the number of calculations by modeling webbing meshes with increasing large "block" parameters while tracking the loss of granularity on the forward and ground gear sections of the trawl. The optimal simulation resolution identified in this process will be employed for all simulations to support trawl and scenario – level comparisons. The simulation performance testing is also important for characterizing uncertainty associated with parameter estimation.

3) *Gear - seabed contact field study design*: Cataloging gear and constructing realistic simulations of gear performance representative of actual pollock fishing are essential steps for estimating pollock gear – seabed interactions but do not supplant the need to directly measure the seabed contact and clearance of these gears under real fishing conditions. Our previous work with tilt sensors deployed on a pollock CV gear (Hampidjan Gloria Wide body 672) showed that direct ground gear contact/ clearance measurements are possible (± 5cm), that realized contact was lower and substantially more variable than fishers expected, and that substantial technological and logistical challenges still limit data collection during active commercial fishing operations. The third project element involves both the performance evaluation of available sensors, as well as the development of an appropriate sampling design (e.g., number of monitored tows by trawl size, location, and season) to support inferences from a subset of sampled tows to the commercial pollock fishery. Contact sensor performance, durability, ease of use, and cost are evolving rapidly, and we are continuing to collaborate with vendors (e.g., Star-Oddi, Simrad) and other research partners (e.g., Fisheries Inshore New Zealand Ltd) to track these developments. Further, we will continue to work with PCC companies and vessel crew to determine minimum requirements for safe and efficient sensor deployment and recovery. We expect that project elements 1 and 2 above will elucidate the degree of variability in gears and fishing practices currently in use to guide the construction of a robust field sampling program to provide fishery-level pollock trawl-seabed interaction estimates in the future. For example, footrope contact sampling and monitoring are fundamental to estimating the influences of trawl gear design, materials and fishing practices on time and area-specific fishing footprint, bottom contact, habitat effects and unobserved crab mortality.

Status (1.3.24): This project element is focused on gathering the information products needed to design an effective field sampling program in the future and thus will commence when elements 1 and 2 are completed. Analyses to date have been limited to data gathered in our previous work using tilt sensors deployed on a pollock CV gear. Under our agreement with the catcher vessel fleet, this trawl will be included in the catalog and simulated. Once this is completed, we will compare contact characteristics derived from the gear catalog and simulations with tilt-sensor seabed contact observations from the field.

Appendix III. Contributors

Julie Bonney, Alaska Groundfish Data Bank
Chelsae Radell, Alaska Groundfish Data Bank
Austin Estabrooks, At-sea Processors Association
Stephanie Madsen, At-sea Processors Association
Patrick O'Donnell, Alaska Whitefish Trawlers Association
Rebecca Skinner, Alaska Whitefish Trawlers Association
Heather Munro Mann, Midwater Trawlers Cooperative
Ben Ley, Peninsula Fishermen's Coalition
Kiley Thompson, Peninsula Fishermen's Coalition
Brent Paine, United Catcher Boats
Susie Zagorski, United Catcher Boats