Alaska Marine Conservation Council

The Myth of "Mid-water" in the Alaska Pollock Fishery

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Introduction

The Alaska Marine Conservation Council is dedicated to protecting the long-term health of Alaska's marine ecosystems which sustain vibrant fishery-dependent communities. Our members include fishermen, subsistence harvesters, marine scientists, small business owners and diverse fishing families. Our ways of life, livelihoods and local economies depend on the sustainable fishing practices that contribute to healthy ecosystems.

Fisheries management in Alaska is often referred to as the "gold star" standard. Sustainability is written into Alaska's constitution, and the identity of its diverse and productive fisheries. But how sound is this designation? This paper discusses current policies and practices within the Alaska Pollock Fishery, with focus on trawl gear contact with the seafloor. Government, industry and certification institutions have consistently described pelagic trawl gear as fished off the bottom, or "mid-water", with minimal or no interaction with seafloor habitat and benthic animals. Analysis recently highlighted at the North Pacific Fisheries Management Council, however, indicates that this fishery — the largest food fishery on the planet — contacts the seafloor on average from 40% to 80% of the time, with rates up to 100% on factory ships. Parallel to this, iconic species in dramatic decline in the Bering Sea indicate a broader benthic collapse. Considering the footprint of the pollock fishery, and decades of unmitigated seafloor contact, it is likely that long-term damage to sensitive habitat and benthic organisms are contributing drivers of ecosystem degradation. Such impacts and their potential solutions, however, are currently underrepresented in analysis, due in part to the assignment of arbitrary recovery and susceptibility rates. The combined impact of unassessed contact and inaccurate recovery metrics imply significant consequences for essential habitat and other critical components of biodiversity and climate resilience. Individual species suffering from significant declines — while often framed as isolated climate casualties — are ecosystem stress indicators showing that status quo approaches to habitat protections and ecosystem interactions are insufficient. With an expanded understanding of the scope of mobile gear contact with the seafloor, there is a need for ecosystem-wide assessment of the consequences of historic and ongoing behavior, enforced minimization of impacts to benthic ecosystems, and greater sophistication of assessment and monitoring.

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Gear Definition

Over the years many documented statements have claimed that pelagic trawl (PTR) gear is fished off the bottom, or is “mid-water” i.e.:

- **Fishwatch[1]** U.S. Seafood Facts Wild Caught FAQs: Fishing methods vary in scale and operation depending on species and area being fished. For example fishermen tow large trawl nets through the water column to harvest schools of Alaska pollock.
- **At-Sea Processors Association[2]** The Alaska Pollock Fishery *A Case Study of Successful Fisheries Management:* Pollock vessels tow cone-shaped, mid-water trawl nets to harvest the resource. Pollock swim in large schools above the ocean floor. The fishing nets do not drag along the ocean bottom. In fact, federal regulations prohibit “bottom trawling” for pollock.
- **At-Sea Processors Association[3]** *Avoiding Incidental Catch of Non-Pollock Species*: Pollock aggregate in enormous schools and are harvested using “midwater" trawl nets that are not dragged along the ocean floor. As a result, the pollock fishery is a very “clean" fishery, that is, non-pollock species account for about 1% of the catch.
- **Midwater Trawl Cooperative[4]** *Let’s Talk Trawling*: Our member vessels pull conical nets either in the middle of the water column (midwater) or closer to the bottom – depending upon the species targeted.
- **NOAA Fisheries[5]** *Fishing Gear Midwater Trawls:* Midwater trawling is a fishing practice that herds and captures the target species by towing a net through the water column.
- **Marine Stewardship Council[6]** *Pelagic Trawl*: Pelagic trawls are generally much larger than bottom trawls. They are designed to target fish in the mid- and surface water. Midwater trawls have no contact with the seabed.

Understanding the discrepancy between these statements and recent analysis from the North Pacific Fishery Management Council (NPFMC), which indicates that pelagic gear can be in contact with the seafloor *upwards of 100% of the time during tows*, is best illuminated by studying history.

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[1]https://www.fishwatch.gov/sustainable-seafood/faqs
[2]https://static1.squarespace.com/static/5a625f328a02c7a950486d60/t/5aa08aa54192022702834a0c/1520470698279/pollock+fishery+description.pdf
[3]https://www.google.com/url?q=https://www.atsea.org/read-more&sa=D&source=docs&ust=1673567071249009&usg=AOvVaw1qxJxPfNOQCx54KQEJ4zSV
[4] https://www.midwatertrawlers.org/category/issues/
[5] https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-midwater-trawls
[6] https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/pelagic-trawls

A "performance standard" for PTR gear was developed to determine adherence to the intent of the gear definition[7]. The definition of "pelagic trawl", which differentiates the gear from "non-pelagic trawl" (NPT) or *bottom trawl* (a gear type which is generally prohibited from use for the BSAI pollock fishery[8]), has changed in recent decades in response to restrictions in the catch of prohibited species, and currently rests upon a performance standard which prohibits having more than 20 crab (described also as infauna[9]) on board at any one time. The regulation states that "crabs were chosen for the standard because they inhabit the seabed and, if caught with trawl gear, indicate that the trawl has been in contact with the bottom." The Stock Author refers to this in the 2023 Essential Fish Habitat review:

> Presently the fishery is closely monitored for bottom contact by the mandatory pelagic trawls. If bottom contact were to increase substantially (based on infauna within sets) then this should be evaluated further[10].

When reviewing the gear itself, however, it becomes apparent that **crab catch is not a suitable standard for determining bottom contact**. In fact, prior to implementation of this performance standard, *the definition of pelagic trawl gear once explicitly referenced bottom contact*. Before a regulatory change in 1990, the definition of pelagic trawl was as follows:

> Pelagic trawl means a trawl on which neither the net nor the trawl doors (or other trawl-spreading device) operates in contact with the seabed, and which does not have attached to it protective devices, such as rollers or bobbins, that would make it suitable for fishing in contact with the seabed[11].

Amidst extensive consideration by the NPFMC of measures to conserve crab and halibut at a point when those species were experiencing drastic declines, changes were made to the definition of PTR. This included removing references to seabed contact and adding a panel of wide meshes, presumably to avoid restrictions resulting from Prohibited Species Catch (PSC) encounters that the NPT fleet was likely to realize (emphasis added):

> *Prohibitions on parts of the pelagic trawl contacting the bottom that are part of the current definition are not enforceable and therefore should not be part of the pelagic trawl gear definition*. Rather, pelagic trawl gear should be defined to reflect the way it is fished. Pelagic trawl gear is not fished on the bottom, *but may contact the bottom* at

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[7] Fisheries of the Exclusive Economic Zone Off Alaska; Prohibition of Nonpelagic Trawl Gear in the Bering Sea and Aleutian Islands Pollock Fishery

[8] § 679.24 Gear limitations. (4) BSAI pollock non pelagic trawl prohibition. No person may use non pelagic trawl gear to engage in directed fishing for non-CDQ pollock in the BSAI.

[9] Invertebrates living within the matrix of aquatic sediments and including small crustaceans..

[10] Evaluation of Fishing Effects on Essential Fish Habitat January 2023

[11] EA/RIR/Initial Regulatory Flexibility Analysis for Revised Amendment 21 to the FMP for Groundfish of the GOA and Revised Amendment 16 to the FMP for Groundfish of the Bering Sea/Aleutian Islands

times. The above restrictions [note: the definition referenced above] about parts of the trawl not contacting the seabed were intended to minimize the bycatches of halibut and crab. Ideally, however, trawl gear definitions should allow for maximum groundfish catches while catching minimal prohibited species catches (PSC) of halibut and crab[11].

Subsequently, the definition was expanded to incorporate meshes of 64 inches which allowed for prohibited species catch to fall through the first portion of the net. A comment letter from this action in 1990 states directly that "because a pelagic trawl is commonly fished in frequent contact with the seabed, the larger mesh size is intended to enhance release of halibut and crab if captured[12]." At this time in NPFMC proceedings, analysis makes no mention of "unobserved mortality," or mortality resulting from fishing effort that cannot be accounted for in hauls that come aboard, such as crab that are crushed under the weight of mobile trawl gear.

A recent document from the NPFMC on Salmon Bycatch Frequently Asked Questions describes the current configuration of PTR nets (*emphasis added*):

> Pelagic trawls are constructed to achieve large openings with minimum drag, and herd pollock into the back of the net (codend) where they are captured. Pelagic trawls typically have an opening of 160-400' wide by 40-100' high depending on the horsepower of the vessel. *Mesh size of a pelagic trawl can be 100' at the opening*, progressively getting smaller towards the codend[13]

Local knowledge of pollock behavior is helpful to illuminate how this gear functions in action: while pollock generally live above the seafloor ("at least for a significant period during early life and spawning[8]"), pollock are known by fishermen to be on the seafloor at night and slightly above the seafloor during the day, with Pacific cod in an inverse relationship. Pollock are also known to dive in response to threats. Pollock behavior incentivizes use of PTR gear on the seafloor. Indeed, this was described explicitly in 1990 when the definition of PTR was slated for revision. For any infauna such as crab - which cannot move quickly to avoid the net or swim away - that manages to pass over the footrope (Figure 1)[14] and might get caught in the opening of the net, it is virtually guaranteed to fall out of the first series of meshes.

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[12] Federal Register: 56 Fed Reg. 2665 (January 24,1991)
[13] Salmon Bycatch Frequently Asked Questions
[14] Red King Crab Savings Area December 2022

Pelagic Trawl Gear

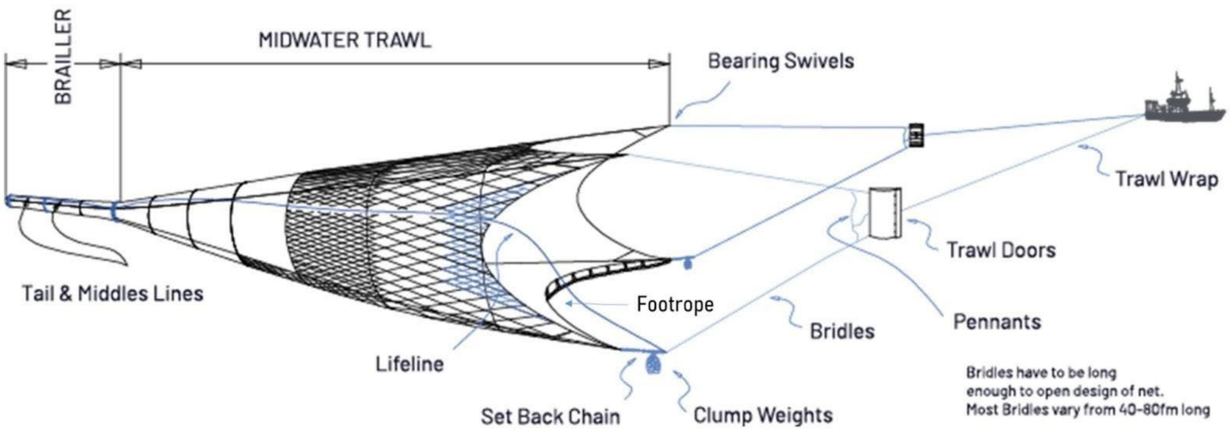

Figure 1. Example of pelagic trawl gear configuration.

Currently, the legal definition of PTR gear actively prohibits meshes smaller than 20 inches between knots in the forward part of the net, and 15 inches between knots in the aft part of the net[15]. The Bering Sea Aleutian Island Fishery Management Plan (FMP) for groundfish confirms this intent by describing the capacity for animals to swim *into and out of* the net from the seafloor, but fails to consider the intent of this gear modification with regards to reducing harm to PSC such as crab:

> These nets have a large enough mesh size in the forward sections that few, if any, benthic organisms that actively swim upward would be retained in the net. Thus, benthic animals that were found in other studies to be separated from the bottom and removed by trawls with small-diameter footropes would be returned to the seafloor immediately by the Alaska pelagic trawls[16].

The FMP continues to describe benthic interactions, characterizing the use of large mesh size as a mechanism for reducing impacts to large living organisms that provide habitat, but also describes the leveling effect of the net (*emphasis added*):

[15] Federal Register
[16] FMP for Groundfish of the BSIA Management Area

> Sessile[17] organisms that create structural habitat may be uprooted or pass under pelagic trawl footropes, while those that are more mobile or attached to light substrates may pass over the footrope, with less resulting damage. Non-living structures may be more affected by pelagic trawl footropes than by bottom trawl footropes because of the *continuous contact and smaller, more concentrated, surfaces over which weight and towing force are applied*. In contrast, bottom trawls may capture and remove more of the large organisms that provide structural habitat than pelagic trawls because of their smaller mesh sizes. The bottom trawl doors and footropes could add complexity to sedimentary bedforms as mentioned previously, while *pelagic trawls have an almost entirely smoothing effect*.

Crab catch is a drastically insufficient means of assessing bottom contact due largely to gear design. Even though the design is purported to benefit species like crab by allowing them to fall through the meshes, it is clear that the gear has a leveling effect. While PTR gear is distinguished from NPT gear *in regulation*, it is known that *in practice* both have substantial bottom contact - with PTR absent mitigation measures that address its impact.

Benthic Impacts

Unlike NPT gear, PTR gear does not have any gear modifications, such as rollers or bobbins, to prevent damage to benthic habitat and infauna. We focus this section first on crab, as a commercially valuable species with relatively considerable study as a representative of infauna health; the latter section will focus on benthic habitat more broadly, with emphasis on a slow-growing octocoral and its consideration within Essential Fish Habitat reviews.

As described previously, the absence of rollers and bobbins was originally intended to disincentivize PTR seafloor contact. Despite a performance standard that would indicate this has been a success for vulnerable species like crab, the NPFMC has recently documented rates that have alarmed fisheries participants, particularly those affected by the collapses of snow crab and red king crab in the Bering Sea, to the point of soliciting emergency action. These contact rates also call into focus the need for gear modification if the gear continues to be fished how and where it currently is.

[17] Permanently attached or established: not free to move about; merriam-webster.com/dictionary/sessile

The estimated bottom contact values from the NPFMC's February 2022 Effects of Fishing on Essential Fish Habitat (EFH) Discussion Paper[18] for the pelagic pollock fleet is as follows:

Vessel Type	**Season**	**Contact Adjustment (Low)**	**Contact Adjustment (High)**
Bering Sea Pelagic Pollock Trawl			
Catcher Vessels	A[19]	20%	60%
Catcher Vessels	B[20]	20%	60%
Catcher Processors	A	70%	90%
Catcher Processors	B	80%	100%
Gulf of Alaska Pelagic Pollock Trawl			
Catcher Vessels		0%	40%

While there is opportunity to further explore the reasons for variance in these rates so that best practices can be realized, we can turn again to recognized pollock behavior to understand likely explanations for the differences: Catcher Processors have the capacity to operate both day and night, using vessels and gear that have a greater capacity for wear and tear; and pollock behavior varies between the Bering Sea and Gulf of Alaska (GOA), for reasons that may include habitat variation and life stages. However, observer rates in the GOA are just 23%, leaving room to question the accuracy of those values[18].

To corroborate evidence of PTR contact with the seafloor, the NPFMC December 2022 Red King Crab Savings Area[21] discussion paper reported the rate of metal pots used in other fisheries that were caught with PTR gear in the Red King Crab Savings Area (RKCSA) over the past 10 years. Observer data shows that 9-21% of PTR tows in the Catcher Processor (CP) sector and 0-21% of tows in the Catcher Vessel (CV) sector intercepted pot gear, which sits on the seafloor when deployed. Comparatively, the rates for NPT gear ranged from 2-12% of tows in the CP

[18] Effects of Fishing on EFH February 2022
[19] January to June
[20] June to October
[21] Considering a Closure to the Red King Crab Savings Area for all Gear Types December 2022

sector and an annual average of 0% of tows in the CV sector. On average, 1 out of every 11 PTR tows captures at least one pot, a rate that is greater than NPT pot captures rates.

The RKCSA was designed to protect an area known to be consistently important for red king crab, especially during molting and mating, by excluding NPT - recognizing that mobile gear damages crab and their habitat. In 2022, an emergency action was sought by red king crab fishery participants to close the RKCSA to all gear types for the 2023 molting and mating season, citing the need to conserve the remaining population of crab and the recognized importance of that area for crab. This request was ultimately not recommended for adoption by the NPFMC and denied by the National Marine Fisheries Service due in large part to the regulatory definition of an emergency, suggesting that a consistent decline in red king crab abundance does not constitute an unforeseen event and therefore is not viable for emergency action.

Both within and outside of the RKCSA, a consistent pattern of PTR bottom contact presents a significant, and virtually unaddressed, management concern. We have attached figures specific to pelagic trawl habitat disturbance, including within the RKCSA, that we believe should be considered (Figure 1 and 2) to protect species that have declined to the point where directed fisheries are closed, even if stocks do not have protected status under the Endangered Species Act.

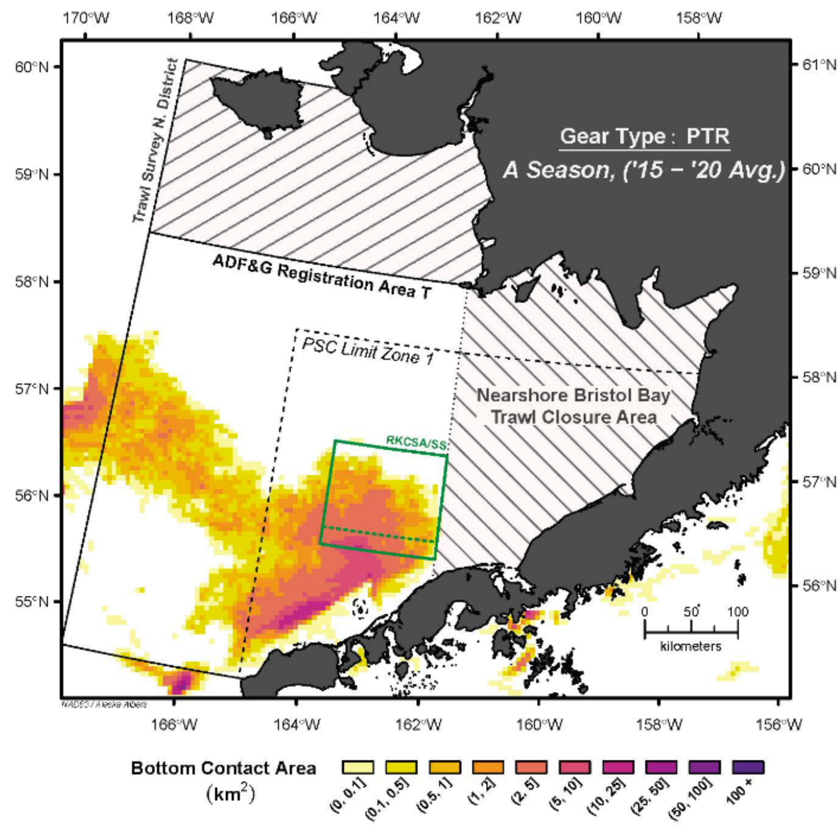

Figure 1 Pelagic trawl average bottom contact area 2015-2020 during A season which includes when crab are molting (soft-shelled) and mating (Source APU FAST Lab).

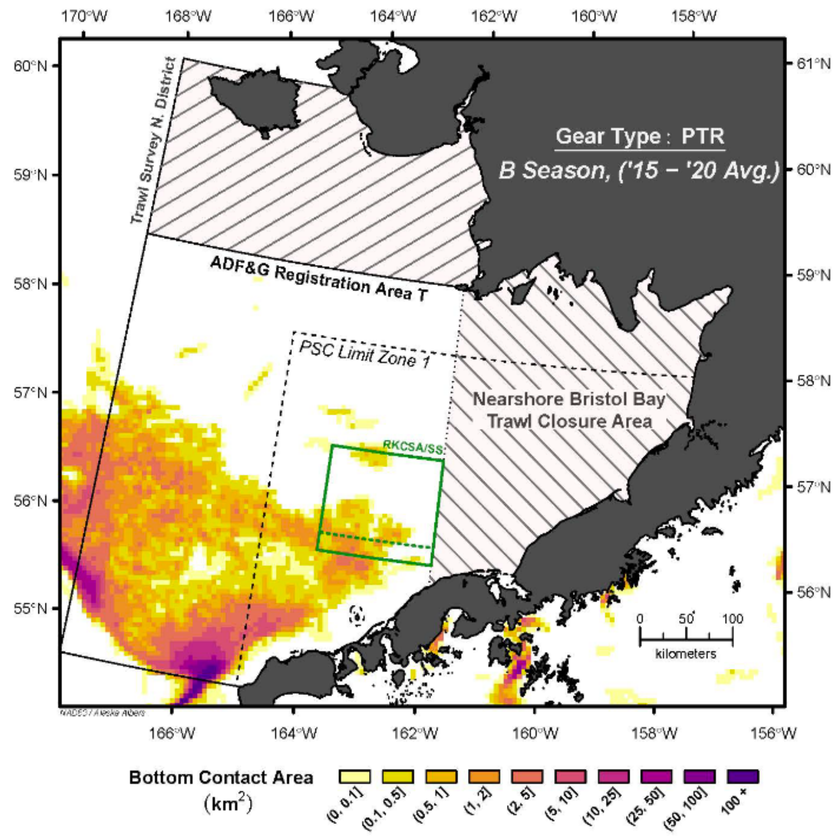

Figure 2 Pelagic trawl average bottom contact area 2015-2020 during B season (Source APU FAST Lab).

Consequences of PTR bottom contact include mortality of crab that is unaccounted for, and this has been the case since the PTR definition was revised in response to crab crashes more than thirty years ago. Some, if not most, crab mortality is not observable and is not currently reported directly in mortality rates which inform stock assessments, though it is known that not all crabs that encounter trawl gear are captured or avoided[22]. Crab can be injured or killed by contact with any section of trawl gear: doors, sweeps, footropes (thick steel chains or cables), footrope gear and net. Aside from contact, they can also be affected by the silt cloud stirred up by trawl gear dragging across the ocean floor. Rose et. al 2012 provided a limited study of unobserved mortality of tanner, snow, and red king crabs from interaction with bottom trawl gear. Recapture nets were used to retain crab that interacted with the gear but did not end up in the primary net. They found that mortality rates of tanner and snow crab ranged from 4%-15%, and red king crab mortality rates ranging from 9% to 32%[23]. It could be estimated that

[22] Crab Bycatch in the Bering Sea/Aleutian Islands Fisheries June 2010

[23] Quantification and reduction of unobserved mortality rates for snow, southern Tanner, and red king crabs (*Chionoecetes opilio, C. bairdi, and Paralithodes camtschaticus*) after encounters with trawls on the seafloor

those rates could be higher for pelagic trawl nets considering their lack of contact mitigation gear, and the substantial "smoothing" capacity of the steel footrope. Regardless, this demonstrates confidence in a range of statistically significant numbers that could and should be associated with unobserved crab mortality by pelagic trawl gear. **However, the current rate of unobserved mortality accounted for in crab stock assessments and considered in pelagic trawl management standards is 0[24].**

In 2009, NPFMC added a gear modification requirement to NPT in order to raise sweeps off the bottom and reduce negative impacts to benthic animals. This gear modification reduced the mortality rates of crab for the NPT fleet and further reduced their benthic habitat impact. No gear modifications were mandated for the pelagic fleet due to the assumption of mid-water fishing resulting from the PTR performance standard. The pelagic trawl fleet continues to function without these mitigation measures, despite compelling documentation of duration and impact of seafloor contact. Consequences of the continued downward trend of crab stocks and subsequent fishery closures affect crab fishermen and crew, their communities and communities adjacent to that fishery that provide processing services.

We are concerned that red king crab and snow crab, both in dramatic decline in the Bering Sea, may be indicator species of broader benthic collapse resulting from human activity. Infauna are considered to be engineers of the seafloor, and besides crab includes bivalves and marine worms, all of which are important for nutrient exchange and essential cycles of sediment stabilization and destabilization. In addition to infauna, benthic habitat in the Bering Sea also includes slow-growing octocorals, sponges and more; categorized most broadly as megafauna (analogous to trees on land) and macrofauna (analogous to weeds[25]). These species provide greater ecosystem benefits than protective shelter alone, including: medicinal nutrients when consumed, which is increasingly important for species at greater risk of disease with changing water temperatures; and biogeochemical cycling, or pathways by which matter is circulated, which contributes to benthic-pelagic coupling - considered a distinct biological feature of the Bering Sea ecosystem[26] which is broadly regarded as the natal grounds for many juvenile species. As changing ocean temperatures affect benthic-pelagic coupling resulting from sea ice, it is likely of increased importance to protect species that contribute to biogeochemical cycling.

[24] Bristol Bay Red King Crab Information April 2022
[25] Sampling nearshore Infaunal 'weeds' rather than 'trees': Does this orthodoxy undervalue importance of sedimentary biomes?
[26] Projected future biophysical states of the Bering Sea

Unfortunately, absent consistent non-invasive habitat surveys, the diminishing sophistication of marine habitats is measured by annual bottom trawl surveys - a gear type known to damage habitat - and Fishing Effects models, which we will discuss in the next section. Signs of collapse are therefore most likely to be made visible through the disappearance of commercially valuable indicator species, such as crab - though attributing a cause to collapse within a system that requires “Best Scientific Information Available” becomes difficult without comprehensive documentation of the interconnectedness of ecosystems.

Ecosystem Consequences

We have shown substantial evidence that bottom contact of PTR gear is significantly higher than what would be expected given the gear definition and performance standard, and remain deeply concerned about the consequences for vulnerable long-lived species that comprise habitat.

Of particular concern to us is a species of megafauna found in the Bering Sea called a sea pen, or sea whip, named Halipteris willemoesi. This sea whip is a large octocoral, a colonial organism fed by polyps that work cooperatively; together, these colonies form forest-like patches of biogenic habitat. According to local knowledge, these soft-coral colonies are some of the only structures found in the soft-bottom habitat of the Bering Sea which provide substantial vertical relief. Some assurances have been made within the NPFMC process that seafloor disturbance from trawl gear is akin to disturbance from seasonal storms. However, these slow-growing, long-lived octocorals inherently give evidence to the contrary. Dislodging them, tow by tow, is analogous to clear-cutting. Such disturbance is not adequately considered in Essential Fish Habitat considerations, as those models consider the only long-lived species to be hard corals, which attach to hard structures, and which are considered to exist at depths greater than 300 meters in depth. The likely reason for this discrepancy in consideration is that distribution of Essential Fish Habitat (EFH) features is modeled based upon seafloor sediment type, not informed by observed habitat. As a result, presumably due to the widespread distribution of the soft sediment preferred by H. willemoesi and relatively uncommon distribution of hard structures at depths greater than 300 meters that experience fishing pressure, estimated Fishing Effects calculations defy best available science and grossly overstate the recoverability and susceptibility of sea whips from disturbance (Table 1).

A study published in 2002 using axial rod diameters of 12 sea whips indicated slow growth rates in the coral’s first ten years of life, about 4 cm per year; a slightly increased growth rate of about 6 cm per year until the colony is about twenty years old, and then slow again to 4 cm per year from the thirty to fifty years of the oldest colonies studied[27]. This study concludes that

[27] Axial rod growth and age estimation of the sea pen, Halipteris willemoesi Kölliker

“the longevity of these organisms and the biogenic habitat they may provide to other species makes it essential that fishing related impacts be studied in detail, particularly as fishing activities reach greater depths and fish stocks decline.” In alignment with the iterative nature of the scientific process, the study concludes that “it remains to be seen if the growth rates and age estimates determined in this study are accurate; however, in light of their importance as biogenic habitat, it is prudent to take heed of the high estimated longevity of H. willemoesi, which may approach or exceed 50 years.” Cohesive groves of these corals, effectively old-growth forests of the sea, could likely take more than a century to re-establish.

Additionally, a controlled study[28] published in 2009 assigned colonies to 1 control group and 3 treatment groups, designed to mimic trawl damage including:

> dislodgement, fracture of the axial rod, and soft tissue abrasion. Fifty percent of dislodged colonies demonstrated the ability to rebury their peduncles and recover to an erect position. Most of these colonies eventually became dislodged again without further disturbance and only one was erect at the final observation. None of the fractured colonies were able to repair their axial rods and only one was erect at the experiment's conclusion. [...] Tissue losses among the dislodged and fractured sea whips increased throughout the experimental period and were mainly due to predation by the nudibranch Tritonia diomedea, which appeared to react with a strong scavenging response to sea whips lying on the seafloor. The presence of predators in areas where sea whips are disturbed may exacerbate trawl effects since damaged or dislodged colonies are more vulnerable to predation.

The impacts described above are serious and increasingly irreversible considering repeated and unmitigated disturbance. Accuracy of assessments measuring the sustainability of the pollock fishery, including but not limited to the Marine Stewardship Council certification, are contingent upon the quality of data layers including fishing effort and habitat classification[29], which are demonstrably assumptive and potentially misleading within the NPFMC’s EFH process. Sensitive habitat and benthic organisms are being damaged at an alarming rate, with arbitrary rates of recoverability and susceptibility applied in modeling of fishing effects. Those impacts continue without any opportunity for recovery.

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[28] Response of the sea whip Halipteris willemoesi to simulated trawl disturbance and its vulnerability to subsequent predation

[29] The effect of habitat and fishing-effort data resolution on the outcome of seabed status assessment in bottom trawl fisheries

While the sustainability of the pollock fishery as a single species fishery has been globally celebrated, the ecosystem around this fishery is in peril. Failing to fully consider the significant bottom contact of PTR means ignoring long-term damage to important habitat features — like slow-growing octocorals, Modiolus beds and various highly productive seafloor sediments — that underpin a complex and increasingly fragile ecosystem, and provide irreplaceable resources for resilience and recovery at times of ecosystem stress. Habitat loss and climate change are influencing biodiversity in ways that are difficult to anticipate. Individual species suffering from significant declines are not isolated casualties of the climate, but are instead stress indicators that signal a need for scrutiny and conservation by other harvests within that same ecosystem, including careful consideration of their impact on EFH and other components of that ecosystem matrix. Even without considering the ongoing impacts of climate change, improvements are warranted in this fishery considering habitat impacts alone. However, *particularly* in a time of climate change, due diligence in assessing habitat damage is needed to protect food web integrity, recovery resources for collapsed species, the ongoing productivity of other species (i.e. trophic cascade), and perhaps most importantly the integrity of ocean biodiversity inextricably linked to intact, healthy habitat. These are the most critical, baseline tools of resilience in the ocean.

Advancements in technology have been incentivized and applied for decades to increase the efficiency of harvesting fish, and it is questionable whether an appropriate counterbalance of consistent, non-invasive monitoring has been engineered to support habitat integrity and biodiversity: most of the information that informs EFH analysis comes from bottom trawl surveys. We are concerned about the diminished sophistication and understanding of marine habitats, which inevitably results in collapses and that are generally only made visible with the disappearance of commercially valuable species. Status quo approaches to habitat protections and ecosystem interactions are insufficient. In the long term, they require greater sophistication of assessment and monitoring, and in the short term they require mitigation of historically unaddressed and serious impacts.

Potential Actions

A substantial focus of pollock management is not over-harvesting the target species, which has been a success. However, we have demonstrated that there are substantial shortcomings of current management processes that require remediation.

We call for pollock industry participants including fishermen, managers and sustainability proponents, to reconsider the accuracy of calculations of habitat disturbance and to enforce a prohibition on seafloor contact of the doors, footrope, net and other components of the pelagic trawl gear used in the pollock fishery. If PTR gear incorporated bottom sensors and was fished at least three meters off the seafloor, we may begin the century-long process of healing benthic habitat to return functionality to the entire ecosystem. Absent these modifications, the only appropriate alternative to mitigate damage to seafloor habitat is to enact the same fishing area closures for PTR gear as NPT gear and to require similar gear modifications to raise various components off the seafloor.

We recognize the concerns from industry that change can constrain the fleet, and potentially increase costs or decrease revenue. Those impacts are challenging; however, it is recognized across time and space that healthy habitat is essential to biodiversity, which supports the greater marine ecosystem. Skillful, evolving stewardship is of the utmost importance, especially considering the increasing stressors these ecosystems are experiencing.

Continuous review of current fishing impacts on stock health, and comprehensive ecological analysis to support responsible decision-making, is critical to maintain a viable ocean commons.

Table 1. Recovery and susceptibility values for each benthic habitat feature included in the Fishing Effects model. Low and high impact estimates represent the lower and upper bounds for recovery and susceptibility based on the ranges used the 2022 NPFMC EFH review.

	Habitat feature	Low impact estimate parameters		High impact estimate parameters	
		Recovery (years)	Susceptibility (proportion)	Recovery (years)	Susceptibility (proportion)
Geological	Bedforms	0	0.25	1	0.5
	Biogenic burrows	0	0.25	1	0.5
	Biogenic depressions	0	0.25	1	0.5
	Boulder, piled	5	0.25	10	0.5
	Boulder, scattered, in sand	0	0	1	0.1
	Cobble, pavement	0	0.1	1	0.25
	Cobble, piled	5	0.5	10	1
	Cobble, scattered in sand	0	0.1	1	0.25
	Granule-pebble, pavement	0	0.1	1	0.25
	Granule-pebble, scattered, in sand	2	0.1	5	0.25
	Sediments, surface/subsurface	0	0.25	1	0.5
	Shell deposits	2	0.1	5	0.25
Biological	Amphipods, tube-dwelling	0	.1	1	0.25
	Anemones, actinarian	2	0.25	5	0.5
	Anemones, cerianthid burrowing	2	0.25	5	0.5
	Ascidians	1	0.25	2	0.5
	Brachiopods	2	0.25	5	0.5
	Bryozoans	1	0.1	2	0.25
	Corals, sea pens	2	0.25	5	0.5
	Hydroids	1	0.1	2	0.25
	Macroalgae	1	0.1	2	0.25
	Mollusks, epifaunal bivalve, *Modiolus modiolus*	5	0.25	10	0.5
	Mollusks, epifaunal bivalve, *Placopecten magellanicus*	2	0.25	5	0.5
	Polychaetes, *Filograna implexa*	2	0.25	5	0.5
	Polychaetes, other tube-dwelling	1	0.25	2	0.5
	Sponges	2	0.25	5	0.5
	Long lived corals	10	0.5	50	1

Table 1