Revised application for an exempted fishing permit (EFP) to develop a chum-salmon focused salmon excluder

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Excluder design: Captain David Irvine, former captain of CP Starbound; Seamus Melly, Swan Nets USA

Summary: An exempted fishing permit (EFP) is requested to support initial at-sea trials of a new concept for a salmon excluder. This novel design is being developed expressly for summer pollock fishing in the Bering Sea when chum salmon (*Oncorhynchus keta*) is the primary salmon species encountered. Our new excluder idea originated from a pollock captain with decades of experience with salmon excluder design and testing. That idea was discussed at the North Pacific Fishery Research Foundation's (NPFRF) November 2024 salmon excluder workshop where attendees reviewed the status of salmon excluder development and agreed that this new excluder concept should be the priority for the NPFRF's efforts to improve chum salmon excluders.

What makes the new excluder different is that it is designed to be installed further forward in Bering Sea pollock nets where the diameter of the trawl is much larger.

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. This is intended to address a problem seen over numerous salmon excluder EFP trials where dense aggregations of pollock passing though the excluder section in the intermediate effectively block or mask access to the escapement pathway for salmon. Candidate locations for our new excluder are between the eight-inch and 32-inch mesh size sections of a Bering Sea pollock net. Net diameter in those sections during towing is several times larger compared to where current salmon excluders are installed (four-inch mesh sections just ahead of the codend).

The objective of this EFP is a preliminary evaluation of this new salmon excluder concept. The main focus for EFP trials will be on determining the best location for the new excluder in terms of creating an improved opportunity for chum salmon escapement while minimizing pollock loss.

Based on input from NPFRF's workshop and advice from Alaska Fishery Science Center reviewers, focusing initial assessment of the new excluder on these practical aspects helps ensure feasibility in the early development phase. Focusing first on feasibility is important not only for economic and practical aspects of excluder sue but also to avoid high pollock escapement rates that might require additional fishing to make up for lost catches, possibly negating the bycatch reduction benefits of the excluder. EFP trials will therefore be focused on a better understanding of how catch moves back through the net in the area of interest for this excluder and how relatively aggregated the catch is in the various net locations of interest for this new excluder. This first objective of the EFP will then inform the starting location for a preliminary evaluation of escapement potential in the second objective of the EFP work. Both objectives will be addressed in the 2025 B season field testing.

To help resolve scaling and water flow issues ahead of the EFP fieldwork, pollock fishermen and gear manufacturers will participate in flume tank work. This work will use scale models of pollock trawls in April 2025 to prepare for the EFP trials this summer.

EFP fishing will be conducted in areas with typical B season pollock fishing conditions during July-August 2025. Vessels for these trials will be selected by the RACE Division of the Alaska Fishery Science Center. Three EFP vessels, one in each of three horsepower classes for the Bering Sea pollock fishery will be selected covering the following categories: lower horsepower CVs (<1600HP, higher horsepower CV's (>=1600HP), and Catcher Processors. The need for separate testing on pollock vessels of different horsepower reflects differences in towing power, water flow, speed, and other characteristics that reflect how fish move through pollock nets.

During the at-sea trials the EFP personnel will use both a recording echo-sounder and underwater cameras to collect behavioral information on pollock and salmon within the sections of the trawl net that are of interest for the new excluder. Echo-sounders should improve our understanding of how aggregations of catch (presumably mostly pollock) move through these larger sections of the net where visibility limitations of cameras would not be efficient for this purpose. Echo-sounders are, however, not effective for distinguishing pollock from salmon. To address this, NPFRF's specialized cameras will be used to help understand salmon behavior in relative proximity (typically 1-3 meters) to the camera locations near the escapement portal. Our EFP trials will also evaluate the relative size of escapement portals for creating chum salmon escapement opportunity while minimizing pollock escapement rates. What is learned in the initial portion of this EFP will be used to inform the best location for the excluder during the latter part of each vessel's EFP trial. EFP tows with the excluder portal installed will provide a preliminary look at escapement relative to expectations allowing us to better comprehend fish behavior in response to the water flow and expected updraft associated with the excluder. This information will be essential for making informed decisions on the next steps for this new excluder approach.

Given we are in an initial stage of development for this new excluder design and reflecting the AFSC review comments on first draft of this application, conducting trials in areas of relatively high chum encounters is not needed for this initial assessment of excluder feasibility. If our initial evaluation of the new excluder concept is promising and rigorous measurement of escapement performance with statistical significance is deemed worthwhile, NPFRF want to conduct a trial of the new excluder in areas of relatively high chum abundance. However, this early stage of EFP work on the new excluder requires only normal pollock catch rates along with an expectation for fishery-average rates of chum encounters. Having some chum encounters will be important to provide an initial visual assessment of chum behavior in response to the escapement opportunity.

Following the fieldwork in summer of 2025, NPFRF will hold a workshop with pollock fishermen et al. to get feedback on 1) what was learned from 2025 B Season trials and, 2) input on next steps. Following the second workshop, the PI will draft a final report describing outcomes and suggest possible next steps.

This application requests that the Alaska Regional office of NMFS, in consultation with the North Pacific Fishery Management Council, grant exemptions from catch handling and fishery monitoring procedures and rules as explained below. Exemptions to areas open to pollock fishing (e.g. "rolling hotspot program closures", "chum salmon savings areas", "salmon bycatch avoidance areas" and the catcher vessel operational area or "CVOA" area) are also requested to allow trials on all EFP vessels to access all fishing areas with appropriate conditions for the objectives of the EFP. Given the annual and in-season variability of chum bycatch, the requested allowance to test in any area with appropriate conditions is needed to ensure sufficient chum encounters in the EFP. If summer 2025 fishing conditions mirror 2024 when chum encounters were at low rates and only in patchy areas, exemption from hotspot closures will be very important for the EFP to meet the objective of learning about chum salmon behavior. If conditions during our EFP this summer allow us to attain reasonable levels of chum encounters outside the rolling hotspot areas, then the EFP fishing will not take place in those chum closure areas.

Additionally, this application requests an allowance of Bering Sea pollock and associated groundfish allowances that will not be counted against the 2025 total allowable catch (TAC) to help EFP vessels cover added fuel expenses and operational slowdowns from following the EFP testing protocols and data collection procedures.

Following the EFP trials, the PI will, in consultation with RACE reviewers, draft a written report detailing what was learned from the fieldwork and proposed next steps. After review, the final report will be submitted to the Alaska Region of NMFS and the PI will notify the North Pacific Fishery Management Council (NPFMC) of the report's availability. The PI will be available to present the findings to the NPFMC as needed.

Given the unknowns associated with the degree of success with the new excluder design at this early stage, this application limits the scope of the proposed EFP trials to a single field season. PI and collaborators may, however, request a continuation or extension of the exemptions if results suggest that additional work is needed to fully accomplish EFP objectives.

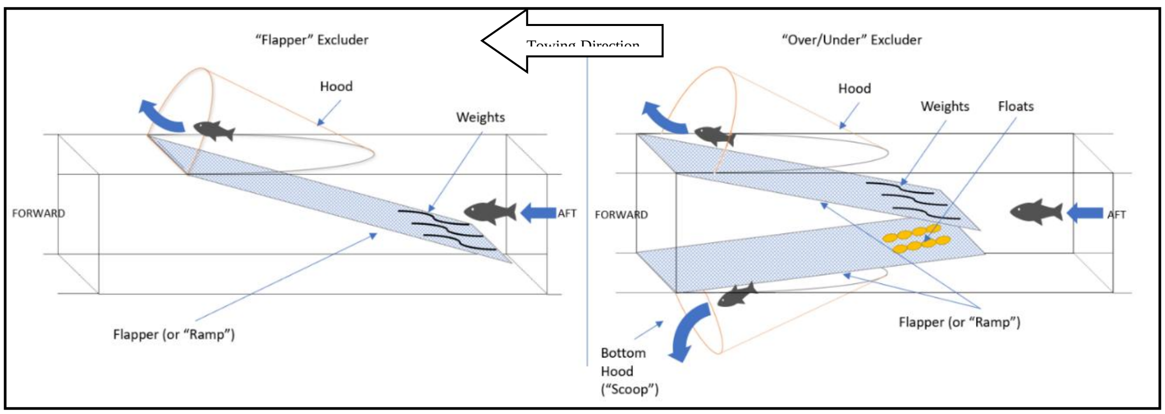
<u>Important context for this EFP application</u>

Salmon excluders are modifications to pollock nets designed to allow salmon to escape while maintaining feasible pollock catch rates. Salmon excluders have been developed based on swimming and other behavioral differences between target and bycatch species. Specifically, walleye pollock (*Gadus chalcogrammus*) is a demersal groundfish that spend their entire life in the ocean. In the adult stage, pollock tend to remain closely associated with the seafloor especially during daylight hours. Pacific salmon are anadromous pelagic fishes that spend years of their life in the ocean, feeding and growing to maturity. While in their ocean phase they orient toward the surface and at the end of their ocean phase are adapted to journey up rivers and streams to spawn. Salmon, usually larger than pollock, also tend to be stronger swimmers than pollock. These life history and swimming differences should mean pollock are less likely than salmon to take advantage of the escapement opportunity created by a salmon excluder.

Currently, all common designs for salmon excluders in the Bering Sea pollock fishery use an additional panel made of netting, sometimes two, installed in the intermediate section of the net. Weight or floatation is added to these panels to slow down water flow to help salmon make use of the escapement opportunity. Located adjacent to the escapement portal or portal(s) these panels create a "lee" of slower water flow which is a resting place outside of the main pathway of fish moving back through the net. The concept is that salmon will make use of the lee to get out of the flow of fish as the catch moves back through the net then swim forward along the escapement pathway and eventually swim out of the net through the portal. Also, salmon that fail to escape as they move back the first time can swim forward from the back end of the net to utilize the escapement opportunity they did not utilize earlier.

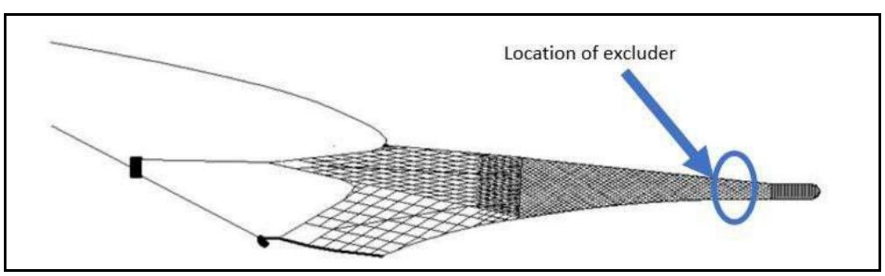
Depending on the specific excluder design, salmon may make their way out the top of the net (flapper excluder) or out the top <u>and</u> bottom if the excluder is an "over and under" design. The two basic designs for salmon excluders commonly found in the Bering Sea pollock fishery are illustrated below (Figure 1). Note there are several different variations of these designs in use as well.

Figure 1. Single panel (Flapper) and Double panel (Over and Under) excluder designs



Excluders utilizing this general design are typically installed in the last few sections of the tapered intermediate section of pollock nets or farther back in the straight tube section. In both cases, this means they are relatively close to the codend (Figure 2).

Figure 2. General location of salmon excluder in use in the Bering Sea pollock fishery today



<u>Available information on performance of salmon excluders in the Bering Sea pollock fishery:</u>

Previous research confirms the utility of excluders for salmon bycatch reduction in Alaska pollock fishing. Final reports from past EFPs detail the evolution of escapement rates for salmon and pollock resulting from a series of tests of different approaches to excluder devices. These tests have included different horsepower classes of vessels in the Bering Sea pollock fishery. Differences in horsepower allow towing nets of different sizes at different towing speeds, causing differences in the water flow through the net, as well as utilizing different fishing areas, etc., all of which are generally recognized by fishermen to affect salmon excluder performance and in turn affect preferences for different excluders among captains of different sized vessels.

Overall, salmon excluder EFP studies over the past two decades have shown that escapement rates for salmon have generally improved. Early excluder designs had limited escapement (e.g. 3-13% by number) and pollock loss rates of up to 5% or more (by weight). During the second decade of salmon excluder EFPs (2013 to 2023) salmon escapement rates in the range of ~20-35% (by number) were obtained with even better performance in a few individual tests. At the same time, pollock escapement rates in the last decade have consistently remained under 2% (by weight)[1,2].

It is important to recognize that these results pertain mostly to escapement of Chinook salmon (*Oncorhynchus tshawytscha*) which was the species commonly encountered during the winter when most of the EFP tests occurred, especially over the last decade.

Past research to understand the specific factors influencing salmon escapement performance has been largely unsuccessful. Specifically, EFP 18-03 and some earlier studies sought to improve understanding of the factors (a.k.a. covariates) of excluder design or deployment that most affect salmon escapement rates. These factors included: rate of water flow through the net near the excluder, vessel towing speeds (GPS speed over ground), relative amount of light where the excluder was installed, and instantaneous amount of pollock moving through the net when escapements occurred (evaluating whether congestion from pollock affects salmon escapement). Understanding how all these factors impact salmon escapement was prioritized to assist future excluder development efforts and recommend ways to optimally adjust fishing practices, however, it proved more challenging than anticipated.

[1] https://repository.library.noaa.gov/view/noaa/19220/noaa_19220_DS1.pdf?download-document-submit=Download (pgs. 18-20).

[2] See Final Report from EFP 18-03 pgs. 19-39 available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=663fc707-15c5-402f-9106-d53d0ec841bc.pdf&fileName=D1d EFP Final Report.pdf

The final report for EFP 18-03 concluded that factors affecting escapement remain largely unknown based on measurement limitations. For example, temporal and spatial mismatches likely occurred during data collection efforts. Escapement data was only collected at the escapement portals, while other factors likely to affect escapement occurred at other locations in the net that were not observable [3].

Context for a pollock B-season "chum-focused" salmon excluder

Past salmon excluder development and testing has focused mostly on winter months when Chinook salmon is the predominant species encountered in the pollock fishery. Conditions in the winter pollock fishery are different from summer. For example, the amount of daylight in winter in the Bering Sea is limited to a few hours per day and this translates to low or no visible light at fishing depths for a large fraction of tows in winter pollock fishing. Additionally, pollock are often tightly schooled in winter months prior to spawning, hence relatively high pollock catch rates occur (e.g. 100 mt per hour) and tows are generally of a shorter duration relative to the summer fishery. Summer pollock fishing has more daylight hours, more light at towing depths, and considerably lower catch rates for pollock. These seasonal fishery differences could be very important when developing a salmon excluder specifically designed to work in summer pollock fishing conditions.

The design of salmon excluders in use today includes weighted (and floated) mesh panels to create a slower water "resting place" for salmon adjacent to an escapement pathway forward. However, the size and location of these panels also reflects the need to reduce access of pollock to the escapement pathway under high catch per hour rates. This is accomplished by making the distance that a pollock would need to swim forward to escape too great for most pollock.

These design elements have allowed for meaningful escapement rates for Chinook salmon while minimizing pollock loss in typical winter pollock fishing when there are high volumes of pollock moving back through the net over a short period of time. As was noted in EFP trials for earlier versions of excluders evaluated in the past, an excluder lacking such a panel(s) or equipped with a much shorter ones can allow a large amount of pollock to escape the net during normal winter fishing conditions.

A salmon excluder designed specifically for use in summer pollock fishing through consideration of additional daylight (hence more ambient light at fishing depths) and different diel migrations, and typically much lower pollock catch rates (hence more diffuse pollock aggregations) might be quite different from excluders in use today. Such as excluder might be able to improve salmon escapement rates

[3] See "Outcomes for Objective 2 pgs. 40-49 in EFP 18-03 Final report available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=663fc707-15c5-402f-9106-d53d0ec841bc.pdf&fileName=D1d%20EFP%20Final%20Report.pdf

relative to using an excluder designed for winter pollock fishing during summer pollock fishing.

For example, a salmon excluder designed for summer pollock fishing conditions might not need a panel to block pollock access to the escapement hole (or may need a shorter one) and still be able to retain a high fraction of the pollock while letting salmon escape. An excluder for summer pollock fishing might be located further forward in the net where there is less congestion from pollock due to the larger circumference of the net. This might also allow for an excluder design that doesn't require salmon to swim forward against the flow to escape or one that has a much shorter distance for salmon to reach the escapement portal.

This effort to develop a summer fishing, chum-focused excluder is not motivated by any specific or definitive information on differences in salmon behavior by species (e.g.: one species may be stronger swimmers or more attracted to light). In this regard, our review of the literature on Pacific salmon behavior found just one scientific paper directly relevant to understanding salmon behavior inside a trawl (Bryan et al., 2024)[4]. That study found salmon generally appeared to be fatigued when observed in and around the net's codend. This matches what was seen in many EFP trials evaluating excluders located just ahead of the codend. Our expectation, however, is that salmon will be less likely to be fatigued when passing through locations further forward in the net, the area of focus for this EFP.

Additionally, we did not find studies of salmon behavior that would help us understand whether there are differences between Chinook and chum salmon that are directly relevant to excluder design and function. Our review did uncover some behavioral studies on Pacific salmon in reaction to stimuli such as encountering a dam or blocked passageway but these were all conducted in-river or within estuaries and not necessarily relevant to behavior in ocean life phases where the environment is quite different. We also found some useful general information on chum salmon behavior in their ocean phase as juveniles and sub-adults.

One study of interest looked at temperature preferences and depth distributions across all species of Pacific salmon in their ocean phase in the context of how climate change may affect migration patterns for different species[5]. Depth preference was of interest to better understand where salmon are most densely aggregated in the water column, and therefore most likely to encounter a pollock trawl.

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[4] D. Bryan, Yochum, N, and Wilson, K. 2024. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. 2024;16:e10306. | 1 of 15 https://doi.org/10.1002/mcf2.10306

[5] See: Langan et al. "Opening the black box: New insights into the role of temperature in the marine distributions of Pacific salmon" Fish and Fisheries. 2024;25:551–568

We also found several papers describing seasonal movements of chum and other salmon species, migration timing, and spatial distribution patterns. From these studies (and from practical experience) we know that chum tend to be found on the eastern Bering Sea shelf as juveniles and sub-adults during June through August and that is mainly when they are taken as bycatch in the eastern Bering Sea pollock fishery. Because Chinook are rarely taken as bycatch at that time, it is reasonable to assume Chinook do not co-mingle with chums in summer months on the Bering Sea shelf.[6] This is fortuitous because it avoids the possibility of tradeoffs fishermen might face if the two species were encountered simultaneously and research to develop an effective summer pollock fishing, chum-focused excluder achieved worse outcomes for Chinook salmon.

More refined spatial patterns for chum salmon from Asian countries versus those from western Alaska and other North American stocks in their ocean phase is also becoming available[7]. These studies use genetic samples collected in the eastern Bering Sea pollock fishery, demonstrating that stocks from several countries overlap in the eastern Bering Sea in the summer. While chum salmon spatial distributions by stock of origin is important for bycatch management, there is no information to suggest excluder performance will differ for chum salmon from different regions.

Additional information on chum salmon depth preference during their ocean phase was also available from a study using archival and satellite tag studies on maturing chum salmon from the central basin of the Bering Sea. This work suggests that chum of Asian origin generally swim at depths between 50 and 100 m in ocean waters but can occupy depths over 300 meters as they approach coastal areas. Additionally, chums in their ocean phase were shown to make strong diel vertical depth migrations although sample size for this study is quite limited. [8].

Data on depth of pollock fishing effort and catch from NMFS observers on Bering Sea pollock boats was examined to compare fishing depths of hauls in the pollock fishery with bycatch rates for chum salmon. The goal of examining chum salmon depth preferences was to consider changes in fishing practices to avoid catching

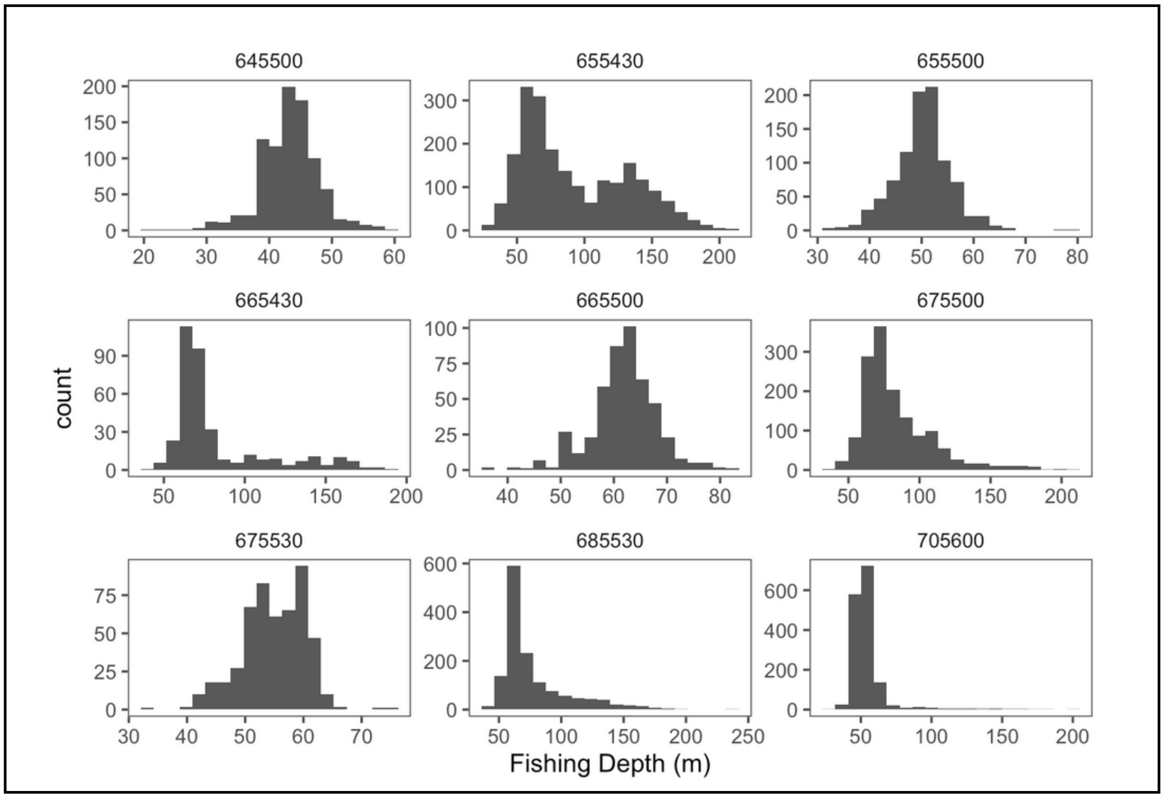
[6]Preliminary Draft Environmental Impact Statement Bering Sea Chum Salmon Bycatch Management March 11, 2024. Available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=7c6ea9b3-af3f-4ba9-b857-5f1434d22b12.pdf&fileName=C2%20Chum%20Salmon%20Bycatch%20Draft%20Environmental%20Impact%20Statement.pdf

[7] See: Preliminary Draft Environmental Impact Statement Bering Sea Chum Salmon Bycatch Management March 11, 2024 pgs 134-137

[8] Walker, Robert & Davis, Nancy & Myers, Katherine & Helle, John. (2005). New information from archival tags from Bering Sea tagging, 1998-2004. NPAFC Technical Report No. 6 at: https://www.researchgate.net/publication/228756140

chums, as well as being relevant in the context of achieving better selectivity for fishing gear modifications.   Observer data were evaluated across the Alaska Department of Fish and Game statistical areas to determine the areas that have had the highest relative chum salmon bycatch rates from 2011-2023. Based on this, hauls at depths from 40-70 meters account for most of the chum bycatch but hauls with chum bycatch also occur in depths down to ~150 meters (Figure 3)[9]. Overall, depths preferred by chum salmon in the limited tagging studies appear to overlap well with recorded haul depths that encountered higher rates of chum salmon bycatch in observer data.

Figure 3. Fishing depth records for Bering Sea pollock hauls with chum salmon bycatch 2011-2023 by ADFG statistical areas.



Despite summer pollock fishing depths corresponding well to chum salmon depth preference in the literature, there may still be behavioral differences related to depth preference that are useful for gear modifications to reduce bycatch. For example, anecdotal observations from Alaska pollock fishermen on catcher processor vessels in the mid-2010s pointed out that chum salmon seem to aggregate higher in the water column than pollock. This inference came from several salmon excluder workshops where catcher-processor captains noted higher chum bycatch rates for hauls where nets were “short wired”. The term “short

[9] Personal communication Dr. Jim Ianelli, Alaska Fisheries Science Center

wiring" at the time meant towing a net near the surface and in a manner where the mouth of the net remains open. The purpose for short-wiring nets is for efficiency so that at-sea processing operations have a steady supply of fish. When this observation was reported, however, short wiring was done with the net entrance open. Today if nets are "short-wired" this is done with the trawl doors out of the water therefore closing off the entrance to minimize salmon bycatch.

Another anecdotal piece of information on chum salmon behavior from the summer pollock fishing grounds comes from a salmon excluder EFP more than a decade ago before excluders were generally in use in the pollock fishery. That test focused on a lightly-weighted "flapper" salmon excluder where the pathway for escapement was only open when the vessel slowed to approximately one-half of normal towing speed. Cameras at the escapement portal recorded an impressive number of chum escapes during slowdowns but ironically, it was noted that the actual bycatch rate (number of salmon caught per ton of pollock) for the EFP vessel was quite similar to pollock vessels without excluders fishing adjacent to the test vessel. The captain of the EFP vessel attributed this to the operational aspects of that excluder where the net spent more time shallower in the water column than where pollock are fished. This occurred because during the slowdowns trawl cables needed to be hauled back to keep the doors spread and maintain the net's normal shape so salmon could escape. This meant that during each 10-minute slowdown the net spent more time closer to the surface. By significantly increasing the time spent "above the fish", the captain felt the EFP excluder device was "catching more chums in order to let some of them escape".

The possibility of failing to achieve an actual reduction in salmon per ton of pollock and the impracticality of so much idle time led to the abandonment of that early version of a flapper excluder; flappers today are rigged with more weight to allow escapement at normal towing speeds. But this experience does provide additional information suggesting chums tend to prefer shallower depths than pollock on the summer pollock fishing grounds.

This anecdotal information could mean chums tend to be shallower than pollock and therefore may occupy the upper section of a pollock net as they enter the net's front section before the taper of the net compresses the catch into the narrower aft sections of the net. If true, it may be possible to create an escapement pathway in the upper part of the forward section of pollock nets that "ushers" chums out the top while hopefully retaining pollock.

<u>Differences between salmon excluders and Active Selection (ActSel)</u>

For the past five years, some interested pollock fishermen have been working with science collaborators to develop "active exclusion devices" to reduce salmon bycatch. Given confusion arising with regard to these different approaches to reducing salmon bycatch, the difference between passive salmon excluders and active selection (ActSel) devices is that salmon excluders work "passively" through differences in fish behavior whereas ActSel devices are mechanically deployed panels that attempt to force unwanted catch out of the net as the fish move back. ActSel uses live-feed camera systems to help fishermen monitor the fish moving through the net and exclusion is accomplished through an electronically-triggered mechanical system that releases a panel to divert all catch out of the net prior to reaching the codend.

In the current state of development, ActSel systems require personnel on the vessel bridge to continuously watch video feed and make decisions to trigger the exclusion device. In contrast, salmon excluder shaping and confirmation of effectiveness is often done with recording cameras, but usage of a salmon excluder does not require a camera or a decision made on the vessel's bridge to trigger the escapement process.

Based on performance reports to date, active exclusion in pollock nets is more likely to be effective for events with relatively large numbers of salmon moving back through the net all at once. That said, triggering the release with individual salmon moving past the camera might be possible if there were relatively few pollock moving through at that time so the salmon would be visible in the video feed. Ultimately the time needed to open and close the escapement diverter panel is going to be critical for performance with individual or small numbers of salmon seen moving back in the live-feed video. But triggering the panel for any and every salmon sighting if they are surrounded by pollock still might not be practical because not all salmon will be visible and there is currently ~12 seconds needed (for the current version of the system) to open and close the panel.

Another important distinction between excluders and the ActSel system is that the use of the latter is currently only possible for pollock vessels with Simrad FX 80 systems installed. This is because active exclusion requires a 4th wire cable and Simrad's FX 80 hub to transfer the signal and video feed from the net to the wheelhouse. These are relatively expensive and space-consuming elements that at this point may make active exclusion less practical for some operations given the 4th wire winch requirement and other elements of the system. Given that most Bering Sea pollock fishermen do not have live-feed cameras and other capabilities needed for Active Selection at this time, this EFP is focused on improving salmon excluders for reducing chum salmon bycatch via a new design detailed below.

<u>A new direction for salmon excluder development:</u>

Considering the information on salmon excluder performance summarized above, salmon escapement rates over the last three salmon excluder EFPs (2013-2022) have been in the 20-35% range (by number) for Chinook salmon escapement. While excluders are providing a meaningful rate of bycatch reduction escapement, rates seen in recent EFPs have essentially plateaued despite considerable adjustments to excluders intended to increase performance.

As is stressed in EFP final reports[10], one of the main challenges has been providing salmon better access to the escapement portals because their pathway to that escapement opportunity is often blocked by dense clusters of pollock moving through the net. Another focus for improvement has been how to get salmon that do make their way to the escapement portal to swim out. Based on copious hours of video camera footage looking at excluder escapement portals many salmon that do make their way to the edge of the escapement portal tend to swim in the lee of the hood or scoop but fail to swim out and eventually end up back in the net. The tendency to pause at the precipice of escapement remains common despite several adjustments to increase escapement including bigger cut-backs to the scoops and hoods, and artificial light intended to draw salmon out of the net.

All of the above was discussed at NPFRF's November 2024 workshop. This led to consensus to refocus NPFRF's new excluder work on locating the excluder further forward in the net where congestion from pollock is very likely to be lower and salmon may be less fatigued and more likely to swim completely out of the net. An advantage to this is that such an excluder might function in a way that no longer requires salmon to swim forward to escape. And it might avoid the need to have a weighted or floated panel to create a lee in the water flow, simplifying excluder design and reducing the need for tuning. The trick would be to figure out where to place the new excluder where pollock are not in close proximity to the escape portal and where chum salmon moving through the net would sense an updraft of water flow out of the net created by the hole to escape.

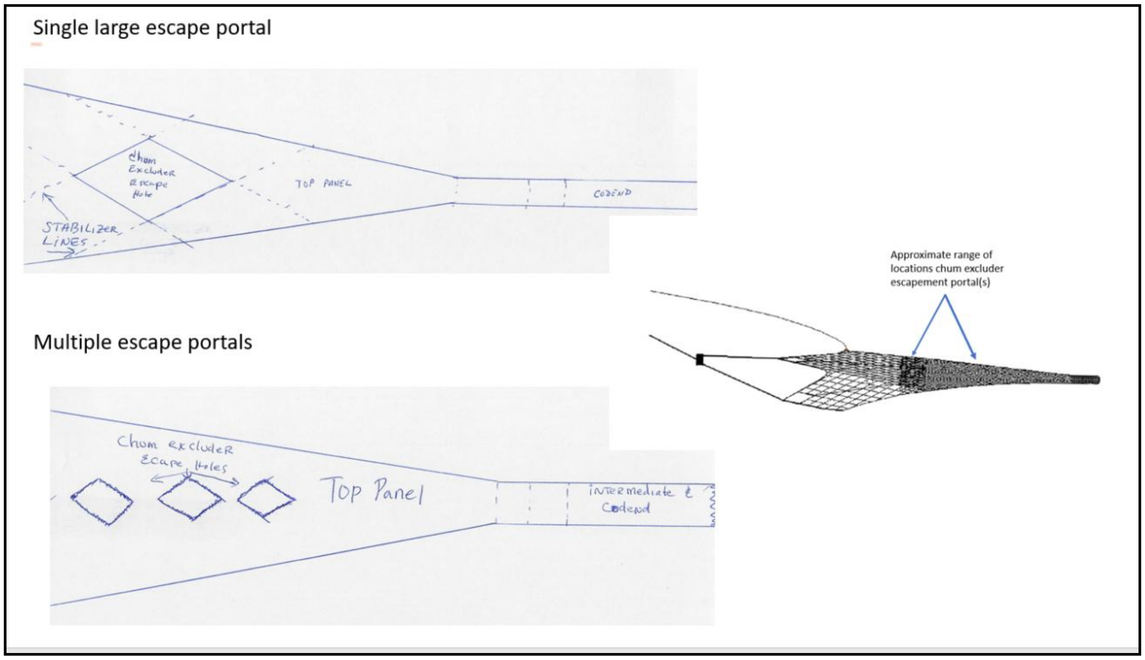
Depending on the reaction of pollock and chum salmon to an updraft in water flow, ideas for increasing their escapement while mitigating pollock loss were also discussed at the workshop. These might include use of floatation or weight (float rope or lead line) at the back edge of the portal to increase or reduce the updraft of water flow as necessary for desired function. There was also discussion of using artificial light to attract chums to the escapement portal(s) but steps to validate actual attraction to light would need to be done before this would be attempted.

To the best of our knowledge, salmon excluder placement in the forward sections of pollock nets has never been attempted before. Noting that this concept for a chum excluder was novel, the drawings from the workshop included below are "conceptual" (Figure 4). The interest level in exploring this concept was high but attendees also stressed the need to start with finding a location that was practical in

[10] See "Results" section in EFP 18-03 Final report available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=663fc707-15c5-402f-9106-d53d0ec841bc.pdf&fileName=D1d%20EFP%20Final%20Report.pdf

terms of pollock escapement then look at adjustments to the size and shape of the excluder to optimize chum escapement.

Figure 4. Conceptual design for a chum excluder with large escape portal(s) in the upper forward panel.



<u>EFP Objective 1: Evaluate location feasibility, size of escapement portal(s) relative to net diameter, and pollock and chum salmon behavior in candidate sections for new excluder</u>

Work on this objective will start with deployments of an echo-sounder and cameras in candidate locations of the net to evaluate relative density of pollock moving in each location and relative distance of catch to the net's top panel in each section using the candidate locations from the flume tank work. Placements of the cameras will most likely be on the top panels of the net and the echo-sounder locations may be installed on any of the panels.

For each location where our sonar or cameras is installed, sheets of smaller mesh webbing will need to be installed to stabilize equipment and help prevent it from tangling in the larger meshes during setting. At this point we plan to start in aft sections (likely 8-inch mesh) and move forward to larger mesh sections, no larger than 32-in mesh. This plan is based on the expectation that camera and sonar installations will become incrementally more challenging as we move forward into larger mesh sections of the net.

The echo-sounder output will be viewed on a screen in the vessel's wheelhouse in real time as well as recorded and archived on a hard drive. The real time feed will allow EFP personnel and captain or mate to evaluate how aggregations of catch move from the net entrance, where they can be seen on the vessel's scanning sonar (headrope net sounder or third wire) to the sections of the net of interest for the excluder. Output from the scanning sonar will also be archived on a data storage drive. The captain's experience with interpretation of the headrope sounder's signal will be vital to help us understand the echo-sounder signal. For instance, we will be interested in observing clusters of fish entering the net and whether they: 1) remain aggregated as they move back or disperse, 2) stay in their vertical position when entering the net, or 3) dive down or swim up. Timing for how long it takes for fish to move back through the net will also help us understand whether the fish in the net are engaged in forward movement to avoid capture or simply moving back at the towing speed of the vessel. All of this will help us evaluate the implications of different candidate locations for our new excluder. In addition to evaluating the echo-sounder information in real time, all the data will be archived for each haul to allow for a more comprehensive and scientific analysis following the at-sea trials, discussed below.

Camera footage from deployments in the net sections with the echo-sounder will provide information on fish behavior, species identification, and to some extent help us evaluate if fish size is related to position in the net. Cameras for this work are single recording cameras. Matching up the headrope scanning sonar, echo-sounder data and video images will be done using the time stamps. This will allow for more comprehensive analysis when a more rigorous data analysis occurs following the at-sea trials.

We will, however, do a "fast forward" preliminary review of the data on the EFP vessels for a portion of the camera deployments to help us interpret the fish flow data from the echo-sounder that was viewed in the wheelhouse. This will help confirm things like distance of pollock from the net's upper panel, speed at which catch moves through the net, whether fish are actively attempting to swim forward or dropping back at the pace of the net moving through the water.

Additionally, because we are conducting our testing in areas where we can expect some chum encounters to occur this should provide for some preliminary observations of chum salmon behavior for salmon in visible range of the cameras (normally 1-3 meters depending on water clarity).

To make informed decisions on the best candidate sections of the net for the initial excluder testing (Objective 2) we will deploy our echo-sounder and cameras starting in the 8-inch section and then moving forward to 16-inch, to possibly 32-inch sections. This stepwise evaluation of how catch moves through different sections of the net has not, to our knowledge, ever been attempted before. For this reason, our methods may need some adjustments as we learn more. Likewise, we expect that the number of observations of behavior for chum salmon could be higher in the smaller-diameter sections of the net simply because the smaller diameter of the net increases ability to see across the entire diameter of the net.

For our work on catcher vessels, time steaming to/from port between trips and offloading will allow for a more detailed review of some of the video data in conjunction with the echo-sounder to inform selection of locations with additional information on chum behavior.

Because horsepower affects net mesh opening size, water flow, and other factors, we will use this same approach to learning how fish move back through the net on each vessel selected for the EFP. We expect the density of catch, speed at which fish move back through the net, and possibly distance of catch to the top panel of the net in different sections to differ by vessel. This expectation comes from past video work on salmon excluder EFPs (in locations further aft) where we observed these differences across horsepower classes. Likewise, we expect some variation in the way catch moves through the net by fishing depth and daylight or night conditions. For this reason, we will install light meters in sections where the echo-sounder and cameras are installed (far enough from the equipment such that camera lights will not affect the light sensors). This will help us evaluate whether we can detect any diel behavior differences in pollock and salmon as they move through the net.

Specific methods for our more in-depth analysis of data from headrope sounder, echo-sounder, and fish observed in cameras will be developed in consultation with AFSC's RACE and MACE Divisions. Based on the very helpful input from AFSC personnel in coming up with the planned methods for this EFP, we expect their experience with techniques to evaluate fish behavior in survey trawls will be quite useful for helping us analyze our data following the EFP.

<u>Objective 2: Preliminary assessment of escapement behavior for pollock and chum salmon with new excluder installed</u>

Following our work on the first objective we will undertake a preliminary assessment of the new excluder installed in the net of each vessel participating in the EFP. To do this, the diamond-shaped escapement portal(s) will be cut out of the top panels of EFP vessels starting in the locations identified in the first phase for balancing the objectives of maximizing chum salmon escapement and avoiding infeasible amounts of pollock loss. At the start of this second phase, the EFP PI, our gear expertise collaborators, and the vessel captain will discuss candidate location(s). If more than one location is deemed to be a viable candidate, the location further aft will be the starting point. Only one excluder cut out will be evaluated at a time (the netting for the first one would be replaced before installing another).

Hauls for this phase of the EFP will include similar deployments of echo-sounder and cameras for the selected location(s). While this initial look at escapement potential will not be definitive or attempt to incorporate a sufficient number of fishing conditions to be applicable to the fishery in general, it will still be an important first look at excluder function. One specific subject of interest will be whether cutting out the escapement portal does actually create a difference in pollock flow based on what was observed using the echo-sounder during Objective 1. Likewise, we will be looking for behavior differences in any chum salmon we observe in the cameras relative to what was seen before the portal was cut out. All this is very important for taking a look at our assumption that an updraft in water flow will occur.

<u>Data analyses and development of report with preliminary findings.</u>

As noted above, this EFP will use data collected in the field from vessel's headrope sonar, our echo-sounder, 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 our preliminary assessment of escapement potential for this new excluder design. These data will help us understand if our initial look at the data and observations on catch flow through the net and reasoning for selecting installation location(s) for the excluder produces the expected effect in terms of avoiding infeasible amounts of pollock loss yet observations of chum that might help us understand whether updraft of water flow is creating an escapement response. Twine streamers will also be used to evaluate water flow around the escapement holes.

All the data we collect from the headrope sounder, echo-sounder located in the mesh sections of interest, and camera data will be placed on storage drives for a more in-depth evaluation of how fish move through the net and escapement behavior. For the more thorough analysis we will work with AFSC scientists on methods to learn as much as possible to comprehend how pollock and salmon move through pollock nets as well as other behavioral information useful for salmon escapement and selectivity improvements.

The types of analyses we expect to produce in the full analysis of the data include whether the selected location(s) during the EFP trials were actually the most promising ones for our new excluder and whether variability from day/night differences or different pollock CPUEs have implications for expected performance of our new excluder design. These will be of great value for determining next steps for research on this current excluder design or moving to other ideas for improving selectivity for salmon bycatch reduction with gear modification.

The table below presents our best estimate of timing for each component of the EFP.

Figure 5. Proposed timeline for EFP components

	2024						2025												2026			
Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Chum excluder ideas workshop with pollock captains etc. (organize, recruit participants, convene)			x	x	x																	
NMFS review of EFP application with NPFMC input			x	x	x	x	x	x	x	x												
Turn excluder ideas into designs, scale drawings, evalate flow and sizing					x	x	x	x	x													
Preparation for and flume tank trip and construction of models						x	x	x	x	x												
Consult with RACE reviewers on vessel selection criteria and RFP to solicit applications						x	x	x	x													
Draft RFP for vessel selection and solicit applications									x	x												
RACE reviews and selects EFP vessels										x	x											
Preparation for at-sea trials, hire EFP field techs, ship equipment, coordinate start times and field seasons											x	x										
Fieldwork for EFP vessels													x	x								
Data analysis, second excluder workshop to review EFP results														x	x	x						
Work with AFSC on more exhaustive data analysis and report drafting																		x	x			
Schedule and present findings to NPFMC, submit final report, consider next steps																			x	x	x	x

Rationale for requesting catch outside of the 2025 TAC and annual catch allowances for vessels participating in the EFP

Our request for groundfish allowances that do not count against the 2025 pollock TAC (pollock and incidental amounts of groundfish species) is based on our past experience with successful use of EFPs to do research under conditions closely resembling actual operations in the pollock fishery. NPFRF has been undertaking salmon excluder EFPs since 2003 and our previous work has consistently obtained credible performance evaluations for different designs of salmon excluders. From this experience we understand that adherence to testing protocols can greatly slow down and otherwise impact operations for participating vessels, resulting in significantly lower catch rates per day, and increased fuel, increased crew labor, and other inefficiencies. Additionally, EFP vessels incur significant disruptions in how they normally operate with extra time needed to install and remove equipment for research and stand downs to repair or adjust equipment to work correctly.

Another important rationale for providing additional groundfish catch for EFP participant is to allow them to devote full attention to the testing and data collection protocols. From our experience, it’s simply not possible for a pollock vessel facing today's high fuel and other operational costs to devote sufficient time and energy to working under an EFP protocol that likely will take hours longer to set and retrieve nets than under normal commercial fishing operations. Likewise, other slowdowns such as battery charging and data downloading from EFP equipment installed on the net will occur. Attempting to do this work as a "ride along" on a regular pollock fishing trip would likely lead to very few hauls being done under the testing protocol before the vessel aborts the research due to effects on operations or processing plant delivery schedules etc. This type of research might be done as a vessel charter but that would be considerably more costly and less likely to achieve our objective of evaluating the new excluder under actual summer pollock fishing conditions in the Bering Sea.

Rationale for the specific requested amounts of groundfish catch:

This EFP requests a total of 3,000 mt of groundfish in the Bering Sea pollock target fishery for this summer of 2025. This will be divided between the three EFP vessels to provide approximately 15 EFP hauls per vessel. These will be further divided between hauls for the first objective (understanding how catch moves through the net sections of interest) and the hauls under the second objective (to get a preliminary assessment of escapement rates for pollock and escapement behavior for salmon).

On the CV vessel selected in the larger horsepower category, this should allow us to conduct EFP trials during three trips where all hauls will be EFP hauls. For the smaller CV vessel, this will allow 3-4 trips with all hauls being EFP. Based on past salmon excluder EFPs, we feel this amount of EFP fishing will spread our evaluations across a range of fishing conditions (e.g. day/night; different levels of pollock CPUE).

Some of the initial EFP hauls on catcher vessels will target smaller catch per haul amounts than are normal in the fishery but these will still be representative catch volumes of actual fishery conditions. These will be needed to validate that each piece of equipment is functioning correctly as well as for tuning the settings of the echo-sounder and cameras.

For trials on the catcher processor vessel selected for the EFP, the request for proposals to engage CP vessel will explain that we are looking a vessel willing to integrate the EFP into one of its normal AFA or CDQ trips. Pollock CPs normally do approximately 50-60 hauls per trip. For our work, it would be beneficial to do blocks of EFP hauls for a few days then suspend EFP hauls and let the vessel return to AFA or CDQ fishing to give EFP personnel time to do a preliminary evaluation of the fish behavior video before restarting EFP work. This would be done for work on both objectives of the EFP to help provide time for initial data analysis during the trip and thereby better-informed decisions on placement of cameras and other equipment for work under the two objectives.

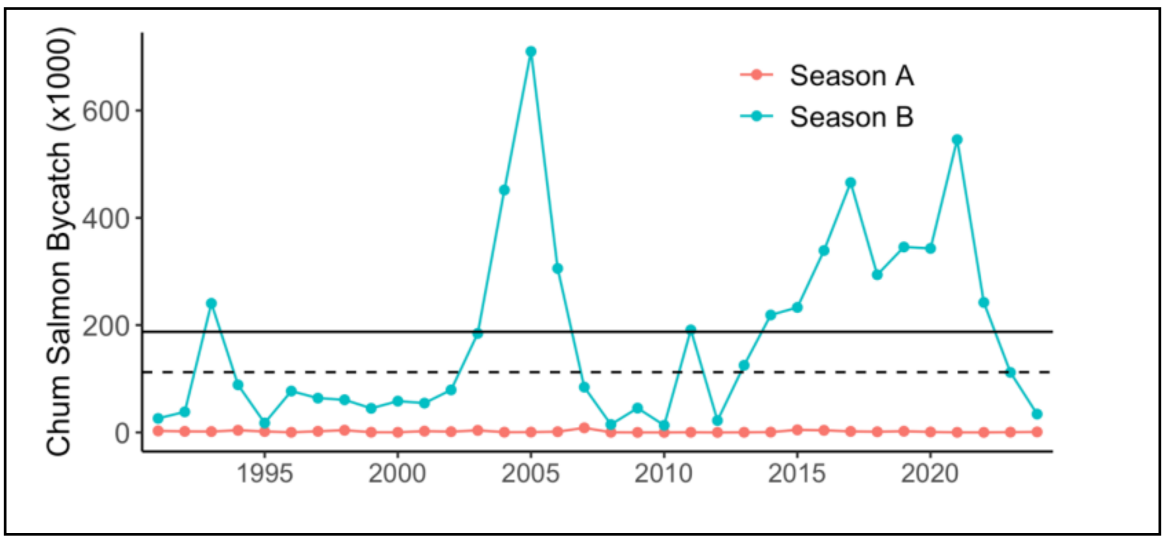
The ability to integrate EFP hauls into a normal pollock trip is something that the Alaska Region has allowed in past salmon excluder EFPs with testing on CP vessels. This is possible because NMFS' official catch accounting is done on CP vessels instead of at a separate processing plant as is the case for catcher vessels. The ability to integrate the EFP fishing into a full pollock trip also mirrors current practices where CPs are allowed to integrate AFA and CDQ fishing into the same trip. Integration of EFP into a pollock trip also makes participation for CPs in the EFP more feasible. This is because the ~1,000 mt of EFP groundfish is insufficient for a trip (normally ~3,000 mt of groundfish catch) and coming back to port to drop off or pick up the EFP personnel for a partial trip would be very costly given normal B season fishing locations.

Note: Specifics of observer sampling, catch accounting, and making chum salmon available for observer accounting and genetic sampling during the EFP work on CVs and CPs selected by AFSC are discussed below.

<u>Estimated numbers of chum salmon caught during the EFP</u>.

Estimating the number of additional chum salmon caught for the additional 3,000 mt of groundfish in this EFP is difficult given the interannual variability in chum bycatch rates in the pollock fishery. This variability is depicted in Figure 5 below borrowed from the April 2025 NPFMC C2: "Chum Salmon Bycatch Report" (full title: "Genetic Stock Composition Analysis of Chum Salmon from the Prohibited Species Catch of the 2024 Bering Sea Walleye Pollock Trawl Fishery Preliminary Report, Barry et al).

Figure 6. Annual Chum Salmon PSC in the Bering Sea Pollock Fishery



To meet our objectives 1 and 2, we need some observations of chum salmon behavior in the net as well as observing any reaction to the escapement opportunity. If B season 2025 turns out to have closer to average levels of chum bycatch, then EFP fishing outside of the closures will probably be sufficient for our chum-observation objectives. If 2025 mirrors the 2024 B season, where chum encounters were at record lows and occurred mostly in a few patchy areas (therefore triggering rolling hotspot closures), then our requested exemptions from hotspot closures will be critical for meeting objectives to observe chum salmon behavior in net locations for this EFP.

To estimate chum salmon catches in the EFP we relied on the above-referenced Chum Bycatch Report to look at average B season catches over the time series. The figure shows that roughly 200,000 chum is the overall average annual chum salmon bycatch. The average over the last 10 years has, however, been 315,536 chum salmon per year (about 0.5 chums per ton of pollock on average) according to the same document. As Figure 5 shows, however, average rates are skewed by some very high years. Noting this, we decided to estimate chum catches for the additional 3,000 mt requested in the EFP as a range using the average over the last 10 years as the high end (based on 0.5 chums per metric ton of pollock) and using 0.05 chums per metric ton of pollock as the low end (2024 chum bycatch rate). This translates into a range of 150 to 1,500 additional chum catches.

<u>Specific exemptions to regulations requested for this EFP:</u>

1. Allowance to test in <u>all</u> areas suitable for the EFP objectives: While conducting EFP hauls under this permit, we request that the EFP vessels be exempted from any “Rolling Hot Spot” area closures (Amendment 110) that apply to chum salmon bycatch. Further, while fishing for the EFP catch allowances of groundfish, the catcher processor vessel selected for the EFP should be authorized to fish inside the Catcher Vessel Operational Area (CVOA) <u>for the portion of the EFP testing utilizing the groundfish made available through the EFP</u>.
2. While conducting EFP testing under this permit, we request that all groundfish and salmon catches not count against the NMFS specified groundfish TACs or any salmon bycatch caps affecting the directed pollock fishery. This includes not counting the (expected to be minimal) incidental catches of Chinook from the EFP fishing, and waiving requirements of any voluntary agreements that may be in place for chum avoidance in the directed pollock fishery.

<u>EFP catch handling, accounting, fishery observer access to catch, genetic sampling for salmon.</u>

The PI will work with the NMFS Alaska Region and AFSC’s FMA Division during the drafting of the EFP permit to develop catch handling procedures for all EFP vessels. This includes how EFP hauls are identified in electronic reports for the NMFS catch accounting system. At this point, however, we do not anticipate that changes from regular catch handling procedures for the EFP vessels will be necessary. This is because our planned data collections are not expected to negatively affect existing NMFS catch handling procedures, and observer sampling, including salmon genetics sampling. No data gaps should occur in the AFSC's sample population of salmon for genetic information. If a catcher vessel enrolled in the EM program is selected for the EFP our intent is to obtain visual estimates of chum catches on deck on a haul-specific basis. This should be possible without changing normal catch handling and EM procedures because we intend to come up with a way to make visual observations of salmon bycatch on vessels with conveyor belts as catches are moved from the codend to the RSW holding tanks. However, this will need to be confirmed with the FMA Division. Tow-specific estimates of chum salmon are important to help us understand the degree to which our cameras are ablet to identify chum salmon when quick turn-turnaround video reviews are conducted.

<u>Areas where EFP testing is expected to occur during B Season 2025:</u>

Predicting where B season pollock fishing will occur from year to year is inherently difficult due to inter-annual variation in pollock distributions. For this reason, it is impossible to specify exactly where the EFP testing will occur. Below are figures with common pollock fishing areas for B season.

Figure 7. Common fishing areas around the Pribilof Islands

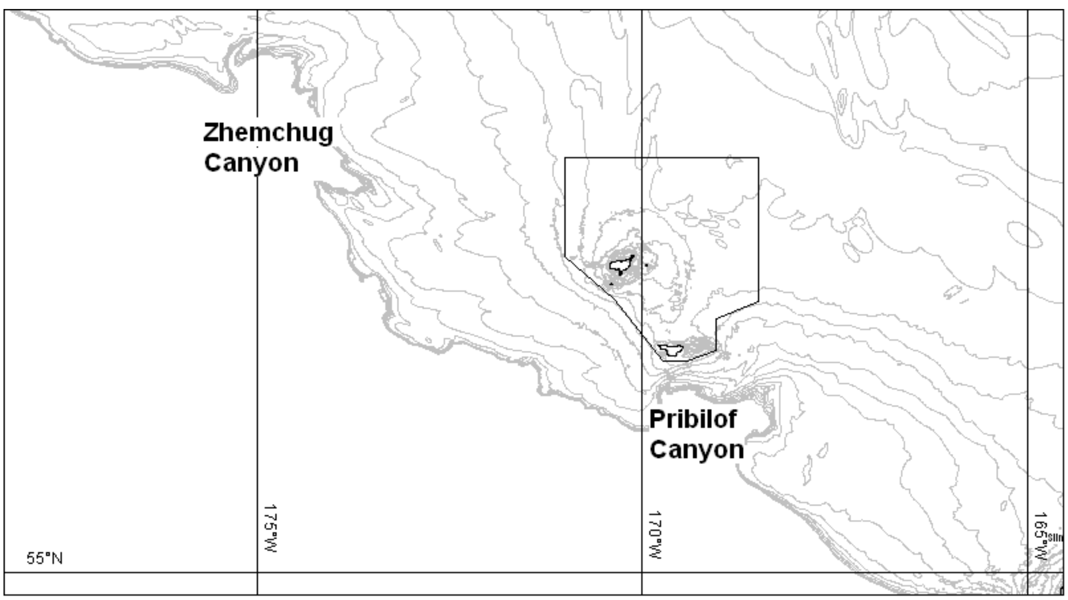
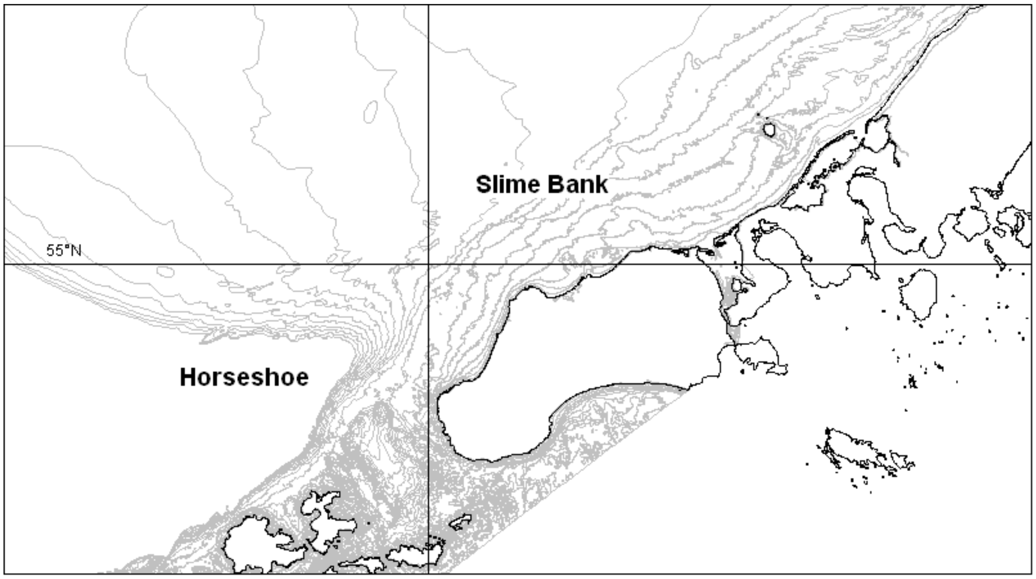


Figure 8. Common fishing areas around Unimak Pass and Bering Canyon (Horseshoe)



<u>Administration of the EFP</u>: The exempted fishing permit's principal investigator (PI), John Gauvin, will be responsible for the overall execution of the EFP, including work with collaborators to organize salmon excluder workshops, carrying out and overseeing all field research, and hiring qualified personnel to manage the field experiments. Likewise, the PI will work with AFSC's RACE Division to draft the RFP and the other explanatory materials needed to solicit applications for qualified EFP vessels. The PI will also be responsible for informing the Alaska Region of NMFS prior to starting at-sea trials and providing EFP vessel information for each vessel participating in the EFP. At the completion of the EFP field testing activities, the PI will be responsible for data analysis and preliminary and final report drafting in consultation with Dr. Lyle Britt, head of AFSC's RACE Division. The PI will notify the NPFMC of the availability of the final report and offer to make a summary presentation of the findings at a meeting convenient to the NPFMC's meeting schedule.