Request for a new exempted fishing permit (EFP) to continue research on salmon bycatch reduction devices

Date of Application: December, 2013

Name, mailing address, and phone number of applicant:

Signature of Applicant:

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Purpose and Objectives of the EFP: This application requests that the Alaska Region of the National Marine Fisheries Service (NMFS) issue another exempted fishing permit (EFP) to assist the Bering Sea pollock industry's continuing efforts to develop salmon excluders. Since 2003, research to develop and test salmon excluders in the Bering Sea has been conducted by the applicant under the direction of the North Pacific Fisheries Research Foundation (NPFRF). Dr. Craig Rose of the Alaska Fishery Science Center and Mr. John Gruver of United Catcher Boats Association have collaborated in this work and will continue to do so under this permit.

The two focus areas for this new EFP come out of the findings from EFP 11-01 (Attachment 1 to this application) which provides a detailed assessment of productive areas of focus for further excluder development. These are: 1) Refinements and tuning to the O/U excluder to increase chum escapement and 2) Improvement of Chinook escapement rates with use of the O/U excluder. These areas for improvement have some overlap for the two salmon species and both objectives were high priorities for Bering Sea pollock fishermen who provided feedback at the conclusion of EFP 12-01.

In summary, considerable headway has been made on excluders for the Bering Sea pollock fishery but additional improvement is extremely desirable. Under the management constraints and incentive programs, fishermen continue to need better tools in their bycatch-management toolbox and further development of salmon excluders is extremely important according to input from fishermen received during NPFRF's outreach efforts.

The stage of excluder development for the Bering Sea is that a workable "flapper-style" excluder for Chinook is in wide use in the pollock fishery. Based on data from several field tests, if rigged according to the specifications described in the EFP final report, this device achieves Chinook escapement rates of 20-40%. At the same time, the pollock escapement rate is well under one percent by weight. These results are based on systematic testing methods employing recapture nets in 2011-2012.

Specific to chum bycatch reduction, the new excluder design which allows escapement at the top and bottom of the net did reduce chum bycatch considerably more than previous devices. This over and under (O/U) excluder tested in the fall of 2012 resulted in chum escapement of approximately 20% along with low pollock escapement rates. This is encouraging but the applicant feels improvement is likely attainable with systematic adjustments to that excluder.

A better salmon excluder is highly desirable at this time because the North Pacific Council is concurrently reviewing existing measures for managing Chinook bycatch and additional steps to reduce chum bycatch.

While progress on excluders is encouraging, not all of the areas slated for improvement in Chinook and chum bycatch reduction set out in the 2011-2012 EFP were successful. Winter 2012 work to further improve Chinook escapement rates with the addition of artificial light encountered problems with controlling effects of lighting. Additionally, chum salmon escapement still lags behind Chinook. After considering what has been done and ideas for further development, the applicant and NPFRF believe there are several potentially productive areas for improvement and have made these the focus here.

Past experience has shown that EFPs for salmon excluder development are an effective way to make progress on excluder development. One aspect of this, in contrast to the typical *ad hoc* gear trails by fishermen, is that our EFPs follow a systematic testing protocol which measures performance as rigorously as possible given the need to test under conditions that are very close to actual fishery. Additionally, a big component of our process is outreach to fishermen. We feel the exchange of ideas is perhaps the most critical component of excluder development.

In workshops prior to and following EFP fieldwork, input from as wide a range of pollock industry participants is encouraged. This is useful to help us focus on the most promising excluder designs. In addition, following EFP field seasons we have conducted numerous workshops to update attendees on performance results and provide information on proper construction and installation/tuning requirements. These approaches have proven to be effective and at this point fishermen and gear manufacturers have come to rely on our EFPs for excluder development. This effort has led to an increasing use of salmon excluders as an integral part of the overall efforts of Bering Sea pollock fishermen to manage their bycatch under the hard caps and industry-managed incentive programs.

In the context of this EFP application, the successful development and adoption of excluders is highly dependent of rigorous field testing and concrete information about tradeoffs in target and salmon catch rates. To date, in the Bering Sea experience with excluders, pollock losses have been very small in comparison to reductions in catches of salmon with excluders. But as work to optimize excluder performance continues, the issue will likely be a more complex balance between reduction in salmon bycatch rates and increasing pollock escapement. As we have seen in our Gulf of Alaska EFP trials of excluder designs to date, pollock escapement rates approaching 5% are possible, particularly on lower horsepower vessels. If the efforts to improve salmon escapement lead to similar pollock escapement levels, it will be critical to have a true understanding of tradeoffs so that fishermen understand the advantages of excluder usage. This will empower fishermen to make informed decisions between excluder usage and/or alternative means of controlling salmon bycatch such as hotspot avoidance.

Specific Areas of Focus for Further Development of Salmon Excluders in this EFP:

To date the only rigorous testing of the O/U excluder occurred in fall of 2012 where chum salmon and pollock escapement rates were the focus. Since then, however, as part of our continuing outreach efforts with the fishery, several pollock fishermen have installed O/U excluders in their nets over the last nine months. Input from these informal trials has helped us better understand practicality aspects of the O/U excluder and fishermen's perceptions of pollock escapement. Loss rate for pollock in our 2012 EFP tests was somewhat uncertain because testing conditions that fall offered only low pollock catch rates which were fairly unrepresentative of the fishery. For this reason, the informal trails by fishermen have been helpful to confirm that pollock escapement was accurately assessed in 2012. Without the same ability to monitor salmon escapement as would occur in an EFP, however, these informal trials have not provided concrete information in that important area.

Plan for the focus areas for this EFP

1) Evaluate O/U excluder modifications to improve chum salmon escapement:

Two field seasons to look at ways to reduce chum salmon bycatch are proposed for this EFP. These would occur in August/October 2014 and August/ October 2015. One or two industry vessels would be used for this work depending on the specifics of what excluder modifications are studied. The testing would make stepwise adjustments to the baseline O/U device tested in September 2012 with the objective of improving chum escapement.

One adjustment we expect to consider is to reduce the degree to which the back edge of the O/U excluder's upper and lower panels provide access to escapement portals. The focus would be on reducing or possibly eliminating overlap in the construction of the O/U excluder. We use the term "overlap" to describe the degree to which the O/U excluder's floated panel (as part of the bottom escapement part of excluder) and the weighted panel (as part of top escapement), extend back behind the entry way to the escapement holes. The basic idea is that reducing overlap decreases the distance that salmon would need to swim forward to escape.

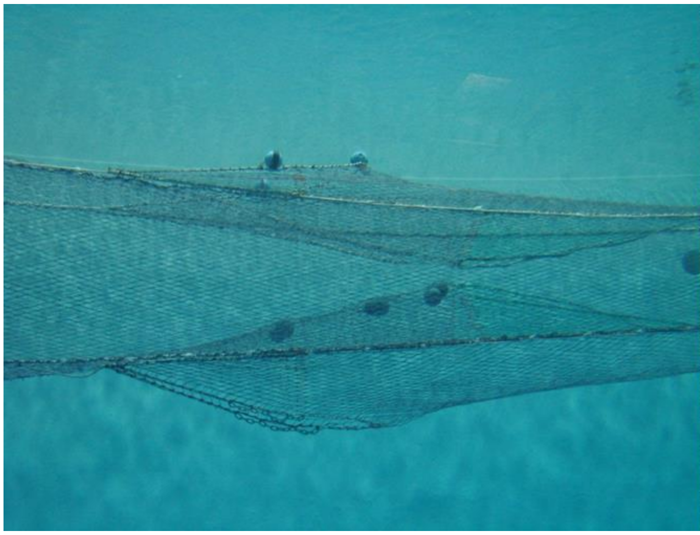
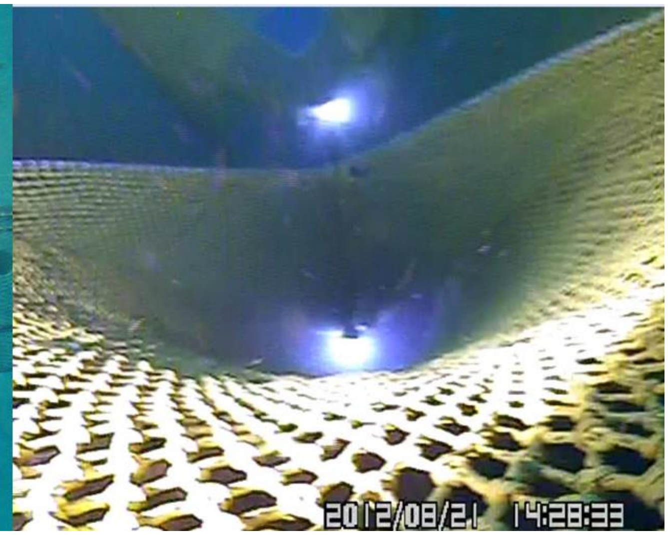
As background, it was widely held by fishermen initially that these panels needed to extend back a considerable distance past the aft edge of excluder's escapement portals in order to avoid high levels of pollock escapement. For this reason, the first O/U excluders, like flapper excluders, extended back typically at least 20% of the panels overall length. The need for this, however, was based on assumptions about differences in swimming ability between pollock and salmon. In the flapper excluder tests in 2012, however, overlap was reduced to evaluate the effects on chum salmon and pollock escapement rates. Although the flapper excluder is a quite different design (e.g. it does not allow escapement on the bottom), we did learn that reducing overlap in flapper exluders did not increase pollock loss rates (see fall 2011section of the EFP 11/01 final report). For the flapper excluder, chum escapement was not improved by reducing overlap but that may not be the case for the O/U excluder.

A key question for this work to look at reduced overlap for the O/U excluder will be whether it will increase chum salmon escapement and the associated tradeoffs in terms of pollock loss. In this regard, many fishermen are concerned that the failure to see increased pollock loss with reduction in overlap with flapper excluders is not necessarily applicable to the O/U. This is, they feel, because the O/U allows escapement from the bottom which they feel is a more natural place for pollock to escape, particularly on lower horsepower vessels.

A second focus of our new EFP will likely be to modify the way the lower and upper components of the O/U excluder come together. The original concept of the O/U excluder was that fish coming down the trawl are guided into the center. This was intended to create ample room aft of where the panels come together in the center to allow salmon can get out of the flow of pollock in the area where they can have access to the escapement portals above and below. Video from our first field trial of the O/U excluder in fall 2012 however, showed that we only achieved some of the shaping objectives for that excluder and that the panels on the top and bottom remained further apart than was intended. This failed to create as much room for salmon to move out of the flow of pollock as was intended.

To address this, there are two steps that make sense at this time. One might be to increase the weight and floatation on the upper and lower panels respectively. Another may be to change the way the tapers of the panels are cut. Using fast tapers for the construction of these panels may allow us to make it easier to pull them together with floatation and weight even where water flow is great. These fast tapers will also help us overcome the natural tendency of the net to achieve a square shape (rather than round) which serves to make the panels stay close to the bottom and top of the net. Resolution of the best way to proceed here will be first looked at in flume tank work during an upcoming trip to a flume tank at Memorial University in November. After evaluating both approaches, it will be critical to do fieldwork to resolve the actual water flow and drag tradeoffs in pre-EFP test tows prior to putting fish through the net to see if the additional room provides advantages for salmon escapement.

To help illustrate how adjustments to the excluder via the two approaches described above, we have included two photos below. The picture on the left side shows the model of an O/U excluder used in our 2011 flume tank work. The right side is a photo from video of the actual O/U used in our fall 2012 field trials on the Pacific Prince. Note the difference in distance between the upper and lower panels in the model and field trial gear. In the flume tank model, anything coming down the net would be ushered into the middle (in a latitudinal sense) whereas in the first real world test of an O/U excluder, fish could move back along the top or bottom with little incentive to come into the middle. The upcoming flume tank work should help resolve which way is the most expeditious to attain the desired shape but pre-EFP tows with full scale materials and water speed will be required to confirm if changes to weighting/floatation or construction are successfully able to achieve the desired shape under with meshes spread under full towing force of pollock fishing.

One additional focus to consider for changes to the O/U excluder comes out of our 2012 field trials where we observed that chum salmon were able to use both the upper and lower escapement portals of the O/U excluder. Previously, escapement of chums in flapper excluders was very low and we believed it to be due to behavioral differences with that species of salmon. This appeared to make sense given that Chinook escapement in the same flapper excluders with top-only escapement was consistently higher than for chums (even when tested simultaneously as occurred in fall 2011). But seeing the much higher chum escapement rates with the O/U excluder increase and noting that most of it occurred out the upper escapement portal has forced us to rethink of the way the O/U excluder works. This has spawned interest in working to optimize the way the O/U affects water flow and currents that occur aft of the excluder panels.

At this point we are unable to know how this work on how the O/U excluder affects water flow will lead to changes in the O/U excluder to make it more effective for chums. The upcoming flume tank trip is expected to help us understand measure the water direction and force aft of the excluder's panels. This should then provide insights for how O/U excluder performance might be optimized for chum escapement.

Fieldwork to investigate any and all of the modifications discussed above will consist of stepwise adjustments to the excluder over two August-October field seasons. These will help us evaluate how changes affect chum salmon escapement while hopefully maintaining negligible pollock escapement from the fall 2012 low baseline escapement rates.

2) Evaluate the baseline O/U excluder for Chinook salmon escapement and made improvements:

The second focus is to evaluate the effectiveness of the baseline O/U excluder for Chinook bycatch reduction and evaluate adjustments to improve performance. This will occur in winter 2015 (pollock A season), likely during the months of February or March when Chinook bycatch rates tend to be highest.

The O/U excluder has never been systematically tested in the Bering Sea to see how Chinook escapement it compares to the flapper excluder. As noted in the final report for EFP 11-01, the O/U excluder appears to work on chums with minimal pollock loss and may have considerable advantages in terms of reducing the need for vessel-specific (horsepower-specific) adjustments. These factors combined make looking at the O/U for Chinook bycatch reduction a logical focus. The primary question will be to see if the O/U actually reduces Chinook catch rates as well as the flapper excluder so that is the starting point for the Chinook-specific part of this EFP.

One intriguing aspect of what we know about excluder performance for Chinook salmon is that they appear to escape at a lower rate on tows with high pollock catch rates. From catch per hour data and from video footage collected during our flapper excluder tests it appears that that when high volumes of pollock pass through the net this affects the Chinook salmon’s access to the excluder’s escapement portal. To address this, the O/U may have advantages because it includes a second escapement path at the bottom which may be accessible when the one at the top is blocked by pollock.

To accomplish our objectives for Chinook, testing in the winter of 2015 will start with a baseline test of the O/U for Chinook escapement. Once we have a solid understanding of escapement rates and we have collected sufficient video to evaluate whether the top or bottom escapement pathway is utilized more frequently by Chinooks, we will be ready to consider adjustments to improve Chinook escapement. Like the ones we will evaluate for increasing chum escapement, adjustments could take the form of adding floatation to the bottom panel and/or weight to the top panel to increase the amount of room created for Chinooks to swim out. Alternatively, changing the tapers of the inserts that comprise the hood and scoop at the top and bottom so as to affect the shaping under water flow may be a more productive approach.

Once the baseline testing is completed, the process of making adjustments for the second stage of testing would be done in the following manner. Adjustments in the weight and floatation on the appropriate panels or changes in the construction of the panels themselves to achieve the desired shape would be done. Next, a set of pre-test video tows in mid-water (not attempting to catch fish) would be done iteratively by the vessel(s) selected for the tests. This would confirm whether the adjustments achieved the desired shape and distance between panels. Once the desired shape is achieved, effects of the change on Chinook and pollock catch rates would be measured systematically by making approximately another set of 12 -15 tows with the device as modified.

Names of participating vessels, copies of vessel Coast Guard documents, names of vessel masters: For each stage of our field testing under the new EFP, the principal investigator will notify the Alaska Regional Administrator of NMFS (or his agent) in writing of the name of the vessel selected including associated document numbers. The principal investigator will also notify all relevant enforcement agencies of the vessel documentation and dates and area of operations for the EFP work. This will include ADF&G, NMFS, and the US Coast Guard.

Exemptions needed to regulations affecting regular pollock fishing during 2014 and 2015

1. While conducting EFP testing under this permit, the EFP vessel must be exempted from the "Rolling Hot Spot" area closures (now promulgated under Amendment 94) so that the EFP field work can be conducted in the salmon bycatch hotspots areas as necessary.
2. Exemption from the regulations applying to the Sea Lion Conservation Area (SCA). This area is normally open to pollock fishing as long as this area remains open for the regular pollock fishery and would like to have access to the area unconditionally.
3. Exemption to the regulations that prohibit catcher processor (CP) vessels from fishing inside the Catcher Vessel Operations Area (CVOA) during B season. Catcher processors are normally excluded from this area in pollock B season, but at times the CVOA has preferable conditions for EFP testing so an exemption to this regulation for our testing on catcher processors is needed.
4. Exemption from regular observer coverage requirements for vessels when participating in our salmon excluder EFP field tests. We need to be able to place up to two sea samplers working directly for the principal investigator and field project manager on vessels participating in this EFP. Additionally, we need to redirect sampling to concentrate on effects of the excluder on salmon and pollock catches. This is the same exemption we have had in the past salmon excluder EFPs.
5. All groundfish and salmon catches during the EFP will not count against the regular groundfish TACs or any salmon bycatch caps affecting the regular pollock fishery or other in-season salmon bycatch control measures in place for the regular pollock fishery (e.g. SIP agreements promulgated under Amendment 94).

Proposed catch limits for the salmon excluder EFP

Field work season	MT of groundfish (in pollock target)	Number of Chinook salmon	Number of non-chinook salmon
Fall 2014	2,500	250	2,500
Winter 2015	2,500	600	250*
Fall 2015	2,500	250	2,500

*small allowance of chum salmon species to avoid premature closure of EFP

The requested amounts of groundfish (in a pollock target fishery) and salmon in the table above are based on previous experience in salmon excluder EFP testing where similar amounts have provided sufficiently powerful tests to produce meaningful results in terms of confidence intervals around estimated mean escapement rates. For each individual test of an excluder design/configuration, 12-15 tows would be made. During these tows no modifications to the device/rigging/net would be made and vessel speed and net rigging would be held constant. As will be explained below, this amount of testing has in the past been sufficient to have the expectation that confidence intervals around the mean escapement rates from the test tows are meaningful for making decisions about the utility of the changes in the excluder configuration. A more detailed explanation of how we arrived at the proposed limits and an explanation for why we feel these quantities are sufficient for rigorous salmon excluder tests is provided in Appendix 2 below.

Groundfish and salmon allowances proposed here are essentially the same as what was granted for our 2011-2012 EFP with one exception and that difference merits explanation here. For our fall 2014 and 2015 tests focusing on chum salmon escapement, we are requesting somewhat higher allowances of Chinook relative to the earlier EFP. This is based on previous experience where we have found conditions with relatively high chum salmon abundance with sufficient Chinook mixed in to make simultaneous testing for the two salmon species possible. In the past, this occurred relatively close to Dutch Harbor on the shelf area east of the Pribilof Islands, an ideal area for excluder testing for logistical reasons. If we can find these conditions once again, it would afford the opportunity for simultaneous assessment of excluder performance for the two species of salmon. This would of course be quite useful for understanding behavioral differences between the two species. This was made possible to a limited extent in 2011 but, with only a small limit for fall Chinook testing (125 at that time), EFP activities had to move to another area before we did sufficient testing to make full use of this opportunity. We feel that a higher limit of Chinooks (250) proposed here would allow sufficient observations to complete a valid test for that species, should such an opportunity recur.

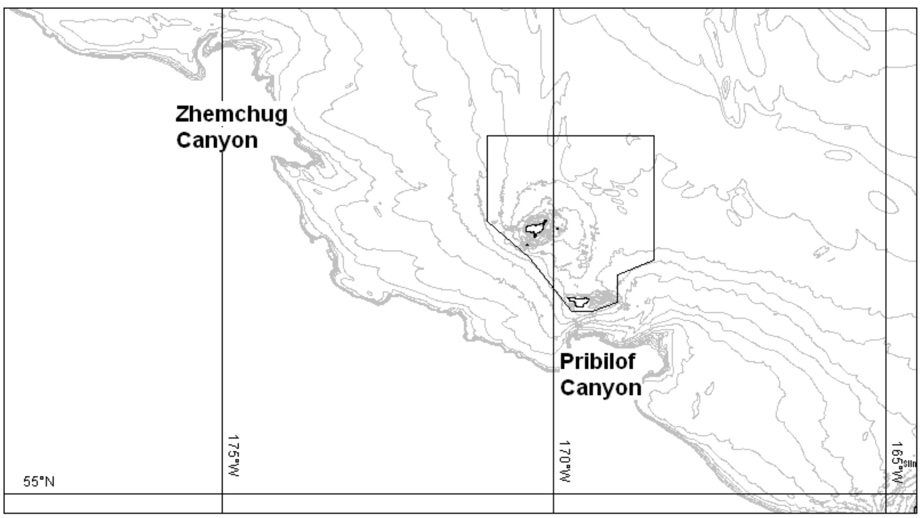
<u>Areas where EFP testing is expected to occur during fall (2014 and 2015) and winter 2015 testing:</u>

For valid tests of salmon excluders, we need to be able to conduct EFP testing in areas with sufficiently high concentrations of salmon as has occurred in the past EFPs. We also need to conduct our testing where pollock catch rates are representative of actual fishing conditions. This is important for evaluating the effects of the excluder on pollock catch rates and salmon escapement rates under realistic conditions.

Predicting where adequate concentrations of salmon and pollock will occur from year to year is inherently difficult. For this reason, it is impossible to specify exactly where the EFP testing will occur for the fall testing in 2014 and 2015. During earlier salmon excluder EFP tests focused on chum salmon escapement, we have found suitable testing conditions in the northern portion of the Catcher Vessel Operations Area (CVOA). Previous EFPs have also successfully found adequate areas for testing for chum salmon escapement in the Horseshoe (Bering canyon) during late September and October. This could be ideal because it is relatively close to Dutch Harbor in case there are equipment failures or a need to obtain materials to repair our excluder.

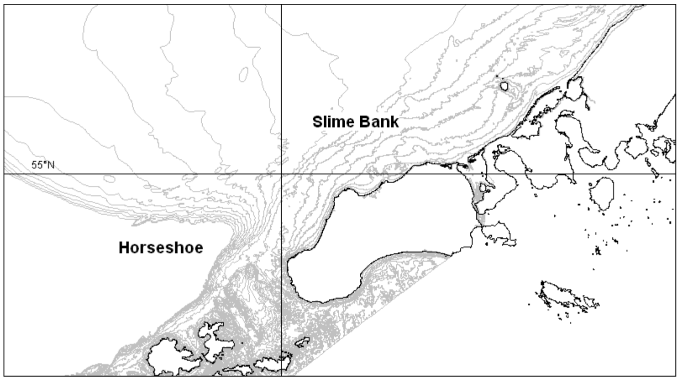
If suitable pollock and salmon conditions cannot be found in the CVOA or Horseshoe, then we may have to conduct testing on the shelf area adjacent the Pribilof no trawl zone or in the headlands of Pribilof or Zemschug Canyons. These areas are identified in Figure 2 below. In most cases, areas of the shelf between 80-200 fathom outside of the Pribilof Islands no trawl zone or at the headlands of the Bering Sea canyons would be where we would expect to find adequate concentrations of chum salmon and pollock. In years when the Bering Sea “cold pool” water temperature feature extends onto the shelf, pollock tend to school in the canyons themselves and in that case we might need to conduct testing in those canyons.

Figure 2: Common fishing areas around the Pribilof Islands



To address our objective of testing the O/U excluder design for Chinook salmon escapement, our best guess is that Winter (A Season) in February or March 2015 would occur somewhere in the areas known as the “Horseshoe” or the Slime Bank (see Figure 3 below). If these areas do not offer suitable conditions for the test, then winter testing could be conducted in the “Mushroom” area northwest of Unimak Pass or in the areas around the Pribilof Islands that are commonly used by the pollock fishery during the Winter A Season.

Figure 3: Common Winter A Season pollock fishing areas adjacent to Unimak Pass



Administration of the EFP: The administration of the EFP will follow the same procedures used for the previous salmon excluder EFPs by the same EFP researchers. The exempted fishing permit holder (EFP applicant) will be responsible for the overall responsibilities of the EFP including carrying out and overseeing all the field research and associated responsibilities of the EFP. This includes hiring qualified personnel to manage the field experiments to ensure objectives of the EFP are accomplished. The permit holder will also be responsible for working with the NMFS-certified observer provider companies to ensure the experiments utilize qualified sea samplers. The permit holder will ensure that sea samplers are provided with instruction and briefing materials to understand their sampling duties for the EFP. Likewise, the permit holder will prepare materials for and conduct periodic meetings to get feedback from pollock captains and gear manufacturers on excluder designs that will be tested during the EFP. As with the earlier EFPs, decisions on gear modifications to be tested and field testing protocols will be the shared responsibility of the PI and co-investigators.

Prior to starting any field testing, the permit holder will draft request for proposals (RFPs) and the other explanatory materials needed to solicit applications for qualified EFP vessels. Personnel in the RACE Division with experience in contracting for vessels charters will review applications for vessels to participate in the EFP testing and advise the EFP holder on vessel/crew qualifications to conduct the EFP testing.

The permit holder will be responsible for informing the Alaska Region of National Marine Fisheries Service of field testing dates and required EFP vessel information prior to each field test.

At the completion of the EFP field testing activities, the permit holder will be responsible for data analysis and preliminary and final report drafting in consultation with Dr. Craig Rose of the Alaska Fishery Science Center or other RACE scientists that RACE may assign to this project. The permit holder will present results from the different field work seasons to the pollock industry, North Pacific Fishery Management Council (Council) and its advisory panels according to the direction of the Council.

Attachment 1. EFP 11-01 Final Report (electronic attachment to EFP application email)

Attachment 2. Supplemental Section Detailing Methods and the Rationale for Proposed EFP Catch Allowances

Our first three salmon excluder EFP applications (2003, 2005, 2008) based the requested catch allowances on power analyses fashioned from catch data and expectations for how much the excluder would affect the catch rate for salmon. Statistical power relationships included a desired level of power to detect an expected proportional effect of the excluder (on salmon catches) assuming a simple binary relationship with two possible outcomes (capture or escapement). In the format of the field testing, the two possible outcomes were that salmon would 1) end up in the vessel's codend if they failed to make use the escapement opportunity provided by the excluder or 2) be accounted for in a secondary net used to collect escaping fish (called are recapture net). Additionally, without data or an *a priori* expectation for proportional effect of the excluder, the most conservative proportion, the one that would be most difficult to detect (namely 50%) was used for the power equations. This was done to help ensure sample size would be sufficient. Finally, we selected the standard 95% level of statistical confidence as the desired level of certainty for the power analyses.

EFP field testing methods were well suited to the proportional effect approach because the excluder's effect would be accounted for in terms of the fraction of salmon (or pollock) that "escaped" (were recovered in the recapture net) relative to the total number (counted in the vessel's codend plus the number in the recapture net). This would be tracked on a tow by tow basis and the data could also be pooled if differences in testing conditions were significant over the course of test fishing.

To arrive at catch allowances, early estimates of sufficient sampling started with the target sample size for salmon species of interest from the power analyses then based catch allowances on how much fishing in a pollock target mode would be needed to ensure the desired sample size for the species of interest would be caught. Salmon catch rates from observer data in years prior to each EFP application were used for this purpose although from the outset it was understood that this was not an optimal data source. This is because the plan was for the EFP was to conduct the testing inside salmon bycatch "hotspot" which would be expected to have higher salmon abundance than areas where the regular fishery occurred.

Observer data were used because data to systematically characterize salmon catch rates inside hotspot areas were not available. These areas were typically closed as soon a single vessel had a "lightning strike" catch rates of salmon. Once triggered, in most cases no additional data were available because the areas typically remained closed for the remainder of the season. Recognizing that average salmon catch rates in areas open to pollock fishing was not necessarily representative of catch rates inside the hotspots, upper quartile salmon bycatch rates in the observer data were used in the development of catch allowances for the EFP as a proxy of expected salmon catch rates in the hotspot areas.

To explain our use of proxy information for salmon bycatch rates and our "hardest to detect" expected proportional effect of the excluder in the power analysis, the EFP applications argued that our approach was sufficient because it tended to err on the side of caution in terms of ensuring target sample size was obtained. Looking back, however, it is clear that in reality our attempt to apply a rigorous methodology for estimating sample size involved a string of assumptions and proxies for missing information.

The upside, however, was that these methods did provide a starting point for field testing and this led to experience and data for assessing methods. The experience with field testing has provided much more relevant data and experience, providing more reliable estimates of the amount of fishing needed to provide meaningful results. From this we can now base the catch allocation on this real-world experience which is simpler and more workable and realistic. In describing this improved approach and how we intend to continue its use in this EFP, we examine below how well it has performed in the various field seasons since it was adopted.

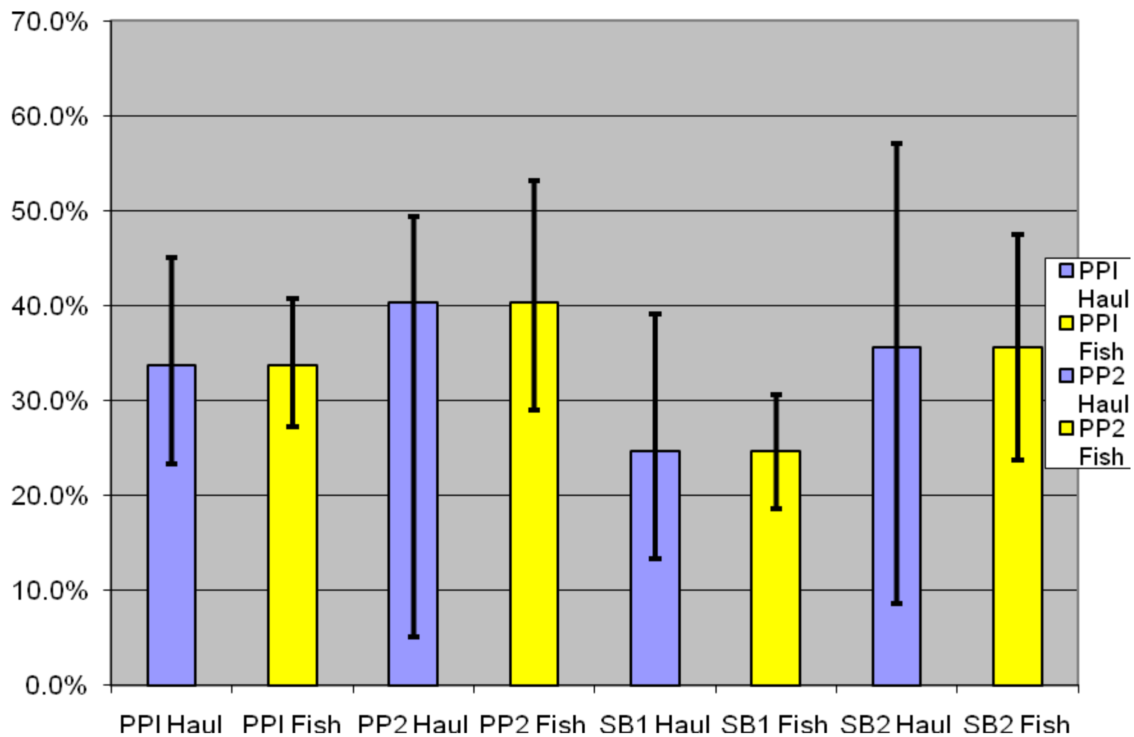
The alternative approach was first proposed for the EFP application prior to this one (EFP 11-01) where we planned to do a prescribed number of tows with pollock catch amounts that are representative of the fishery. The set of tows would follow a testing protocol that holds constant many testing parameters (e.g. excluder design/rigging as well as some of the key vessel fishing parameters such as towing speed, net). Others factors, that are part of the normal variation in pollock fishing conditions, are recognized as likely to affect excluder performance, and variation in these is explicitly sought during the testing. To do this, testing is deliberately spread out over time to ensure we get a mix of conditions such as day and night fishing and differences in pollock catch rates. Testing was spread over these conditions by working with the test vessel to limit groundfish catches per tow to a target amount. This helped ensure the groundfish available for the test is not taken in a few very large catch quantity tows, which would actually be unrepresentative of today's pollock fishery where product quality is a big concern.

The work to spread the EFP catches out over different fishing conditions effectively means that the groundfish available for an excluder test on a CP vessel will typically be harvested over a period of approximately 7-10 days. For CV vessels where multiple trips are needed to catch the groundfish, we typically get 4-5 tows per trip and two and one-half to three trips per vessel per test. This means that testing of each configuration takes about two weeks.

Adopting an approach based on a prescribed amount of fishing was initially motivated by a retrospective look at results at the conclusion of EFP 08-01. In particular, results from the final stage of testing under that EFP in winter 2010 season showed relatively large reductions in Chinook catches with relatively tight confidence intervals around mean escapement rates. These results occurred from testing on two separate test vessels and the pattern held during two separate tests conducted on each vessel over that testing period.

In looking retrospectively, we asked ourselves what factors likely contributed most to the soundness of the results. One factor we agreed on was that the effect of the excluder on Chinook catches was relatively large (20-40% range) and effects of that magnitude, we reasoned, are probably easier to detect. Another aspect of the winter 2010 results, that indicated the stability of the escapement rates, was that confidence intervals around mean escapement rates were tight whether the data were pooled or whether variation between tows was accounted for. The testing had taken place inside the salmon hotspot areas, which we thought probably helped the stability of the results from the perspective of having consistency in catch rates of salmon over the EFP testing. Testing in the hotspot areas was also important in having demonstrable results because testing with very low numbers of salmon seemed to be unlikely to achieve much statistical significance regardless of the magnitude of the effect of the excluder.

To help illustrate the reasoning for our decision to adopt a "keep going with what has worked" approach, the figure below shows the 2010 results for mean salmon escapement. The 95% confidence intervals (alpha of 0.05) are shown by the vertical lines for each colored bar in the figure indicating mean escapement rate for the different excluder design/configurations tested that winter. In examining these results in the context of the number of tows done in each test, our thinking was as follows. The "PP1 and SB1", or phase one, results in the figure were for tests that included 12-15 EFP tows per test vessel (12 for one vessel, 15 for the other). The confidence intervals around the P1 results were still rather narrow , even when variability between tows was accounted for in estimating the intervals. This can be seen in the figure where results labeled "haul" in the figure and "fish" indicates confidence intervals where all salmon are treated as if coming from a single tow.



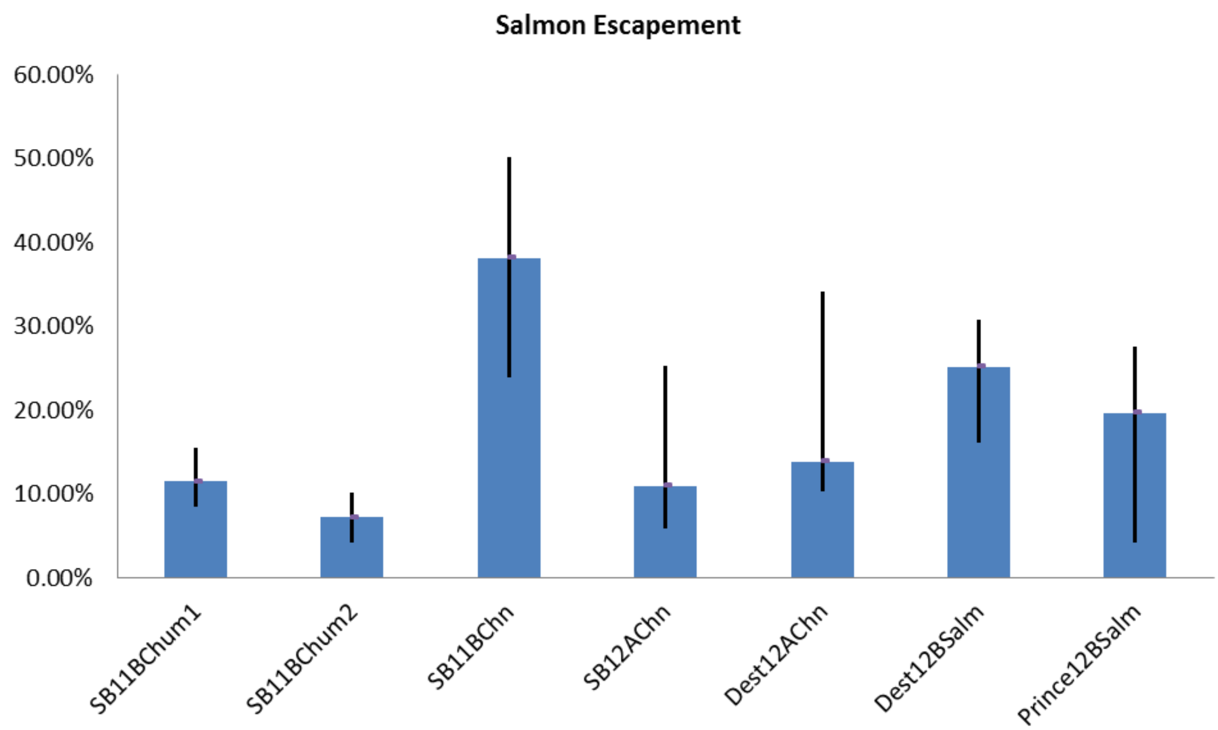
Characterizing the importance of this in terms of progress on the excluder, we noted that even the low end of the range for the results were good excluder performance in terms of escapement. Given that pollock escapement was very low and the test vessels encountered little to no problems for using the excluder, this was a sign that this excluder was a valuable tool for fishermen to manage their salmon bycatch.

On the other hand, the results from a second set of tests involving a modification to the device tested in the first test showed wider confidence intervals. This can be seen for the "PP2 and SB2" or phase two results. Due to an insufficient amount of groundfish available for the second phase of testing, only eight EFP tows were completed for these tests. The wider range of confidence around mean escapement, we surmised, was likely due to the smaller number of EFP tows.

Reviewing the thinking behind the adoption of the change from simple power analysis, based on general data, to a more targeted amount of testing used during EFP 11-01, and proposed to be used again here, begs the question of how well the approach worked for that EFP (11-01). That is the last Bering Sea salmon excluder EFP and it is where we first employed the approach of a prescribed number of tows during its three field seasons (fall 2011, winter 2012, fall 2012). The focus of that EFP was to examine whether the flapper excluder would be effective for chums (with adjustments), whether adding light would improve Chinook escapement, and of course the first test of the O/U excluder see if it improved chum salmon escapement over flapper excluders.

The specific objectives and progress made towards them are detailed in the final report included as Appendix 1 here. Of interest in this discussion of methods is whether what the 12-15 tow standard, based on the EFP 08-01 analysis, allowed us to adequately determine the effectiveness of the different excluders during EFP11-01(while also employing all the other aspects of our testing protocol described above). The figure below, pulled from EFP 11-01's final report, provides a way to evaluate this question. In the figure, mean escapement rates and associated confidence intervals are shown. In all cases, confidence intervals in this figure include haul-to-haul variability.

EFP 11-01. Percent salmon escapement with 95% CI's by EFP segment and salmon species where appropriate



Looking at the figure, a few interesting differences from expectations emerge. First is that confidence for estimates of mean escapement was greater (intervals narrower) in the 2011 tests on chum where escapement rates are low. Based on our thinking in the adoption of these tow numbers targets one would expect that small effects of the excluder would be harder to detect. As discussed in the final report for this work, however, these low escapement rates were fairly consistent between tows and catch rates for chums were also quite consistent over the course of this stage of the EFP testing. Variability between tows in both escape rates and number of salmon have added considerable uncertainty to salmon escape estimates from most of the excluder tests to date and this test was a welcome exception.

The Chinook escapement rate result for 2011 was actually an unanticipated bonus to the work where chum salmon escapement was the focus. The area selected by the test vessel for the EFP, it turned out, had relatively high chum abundance and considerable numbers of Chinook as well. Unfortunately, the testing had to be moved to a different area after eight tows, however, because the EFP (permit) had a low limit of Chinook available to it that fall. The larger intervals around what is a bigger magnitude effect (38% Chinook escapement) are therefore probably attributable to the small number of test tows.

The remaining tests focusing on the different excluder configurations generally followed our expectations in terms of 12-15 tows being sufficient for useful confidence intervals around estimated escapement rates. The test of the O/U excluder on the F/V Pacific

Prince in fall 2012 is probably the least useful result in terms of confidence in the outcome and the reason for this is not obvious. The number of tows and consistency in total salmon catch per tow were nearly the same as for the two test vessels (F/V Destination being the other), the testing occurred in the same areas for the most part and the excluder configurations are fairly close in design. This leaves us unable to come up with any good explanation for why these two results are so different in terms of confidence intervals.

It is worth mentioning that pollock escapement rates have been so consistent and low that any number of tows providing a useful measure of salmon escape rate also provides very strong confirmation that pollock escape is highly unlikely to be high enough to affect excluder use.

<u>Notes on video cameras to track escapement for tests of the O/U excluder.</u>
Given that we know of no viable recapture net that would work to capture escapement on the bottom portion of the O/U excluder and based on the success we obtained using video to rigorously track escapement in our first trials of the O/U excluder in fall of 2012, we intend to continue with this approach for some or all of the work under this new EFP. Our decision to go this route is based on the following evolution in our thinking regarding the utility of cameras for excluder testing under conditions we face.

For all trials in the last two EFPs except the fall 2012 work, recapture nets were used exclusively. The fall 2012 work required us to move away from using a recapture net in favor of using video to track escapement. In the past, we have had concerns that video would not be adequate for accurately determining the proportion of escapement in as rigorous a manner as is accomplished with recapture nets. The impetus for revisiting this issue came from the recognition that escapement from the bottom portion of the O/U excluder would require “flying” an additional recapture net on the bottom of the trawl. Our efforts to evaluate how this might be done in flume tank trials in 2011 did not provide any solutions to the problems that arose when we attempted to use water kites in an “upside down” fashion in the field in the past. So faced with the challenge of how to monitor escapement on the bottom part of the excluder, we decided to revisit video given the progress that NOAA technicians at the AKFC have made on their “trawl vision” camera.

NOAA’s new “tube” cameras are integrated video systems entirely enclosed in a plexiglass tube. These systems include camera, battery, recorder, and lighting which are housed in a three inch diameter tube that is approximately two feet long. The camera lens collects images right through the clear tube that houses the system which avoids exposed cable and connections entirely. The rechargeable batteries allow for approximately eight to ten hours of continuous recording (depending on whether the light is powered on and water temperature where the camera is deployed. In contrast, the cameras we have used in the past had operational limits of approximately two to three hours. In fact, this extended operation capacity exceeds average tow time by a large margin. If needed, we could place a six or eight our limit on EFP tow duration without creating a burden on EFP vessels.

In learning about the greatly improved features/capacities of NOAA's new system and hearing the reports from "Beta testing" under fishing conditions/depths more adverse than pollock fishing, this spurred our interest in deploying these cameras in lieu of a recapture net for tests with the O/U excluder. The approach we opted for was to install four separate cameras at a time, two on each escapement portal of the O/U excluder. This was done to always have a backup camera in case a camera failed as well as providing two different video angles on the top and bottom to help us see salmon escapes even if the volume of pollock escapement was high periodically. With earlier cameras, mounting for separate cameras would have been a huge burden to the ease of attaching these small, lightweight cameras resolved this problem.

In arriving at this decision to use video to track escapement, it is important to point out that we were aware that getting the video reviewed independently would add to the cost and timing for completing our data analyses. With recapture nets, data collections on the boat provide solid preliminary results and the cost of at-sea personnel pretty much covers all the data collections costs. This is not so for independent review of video footage which can take several weeks and cost thousands of dollars. But, we reasoned, our at sea personnel would be able to do significant spot checking and fast review of video to get an idea of escapement rates sufficient for knowing gross escapement results so that decisions affecting what changes to make for the next phase of testing would be based on a solid notion of escapement performance.

Based on what we learned from our first O/U excluder trials, we feel that we can once again utilize cameras to track escapement for some or all of the O/U trials described above. As a cost saving measure, we expect to track escapement from the top escapement portal of the O/U with a recapture net while relying on video for the bottom portion of the excluder. This would result in reduced video review costs as well as allowing us some instantaneous information about escapement rates during fieldwork. Using two different methods to track escapement rates does potentially introduce complications in terms of using multiple methods but we feel the current video systems are capable of comprehensively tracking escapement and both are able to fully account for escapement so combining them should not be problematic.