Request for a new exempted fishing permit (EFP) to continue research on salmon bycatch reduction devices with a focus on chum salmon bycatch reduction and one field season to improve to Chinook salmon escapement rates

Date of Application: November, 2010

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Purpose and Objectives of the EFP: This application requests the Alaska Region of the National Marine Fisheries Service (NMFS) issue an exempted fishing permit for our continuing research on salmon excluders for the Bering Sea pollock fishery. The primary objective of this research will be the development and testing of an excluder that reduces chum salmon bycatch rates without significant negative effects on pollock fishing. While we have achieved some success on Chinook salmon bycatch through our previous EFP work on salmon excluders, to date none of our excluder designs have shown much promise for reducing chum salmon bycatch. Additionally, a secondary objective under this EFP is to examine two promising ideas to improve the Chinook salmon bycatch reduction performance of the final version of the Chinook salmon excluder developed under EFP 08-02.

Figure 1 below summarizes the salmon bycatch reduction rates achieved in our most recent tests under EFP 08-02. Field testing under EFP 08-02 was completed in February of 2010. Most notably, our final excluder design in the last field season (winter 2010) was able to reduce Chinook salmon catch rates on the two test vessels by approximately 25% and 35% (winter 2010 results for Phase 1 (P1) tests) with no negative effects on pollock fishing. In the past, problems such as bulging of the trawl intermediate and loss of trawl door spread in areas with high pollock catch rates were experienced.

As we noted in our final EFP report for EFP 08-02, confidence intervals around estimated escapement rates for the P1 tests on *F/V Pacific Prince* and *F/T Starbound* allowed us to conclude that significant gains in Chinook salmon selectivity were achieved from the final version of an excluder developed under that EFP. That excluder is a flapper-style excluder designed to stay open and therefore allow escapement during normal towing operations. A secondary test done during that same field work season (Phase 2 (P2) results in Figure 1 below) on one of the EFP vessels (*F/V Pacific Prince)* suggested that the addition of artificial light placed just above the excluder's escapement portal may increase Chinook escapement rates. However, due to the limited amount of groundfish available to that EFP test in winter 2010, we were not able to confirm that potential result with sufficient statistical confidence. As part of our continuing work under this EFP, we are therefore planning to do one field season on Chinook salmon to evaluate how to improve Chinook salmon escapement. One part of that work will involve a dedicated test of whether artificial light increases Chinook escapement rates. The other potential focus is to examine how reducing the degree to which the flapper panel extends aft of the escapement hole (overhang) affects Chinook (and pollock) escapement.

Figure 1: Overall salmon escapement results from EFP 08-02

Test /date	Vessel	Codend salmon #	Recap salmon #	Salmon escape %
Winter 2009 P1	Pac Prince	726	91	11.1%
Winter 2009 P2	Pac Prince	1079	209	16.2%
Winter 2009	Starbound	720	70	8.9%
Fall 2009 P1 (chum)	Starbound	196	5	2.5%
Fall 2009 P2 (chum)	Starbound	643	34	5.0%
Winter 2010 P1	Pac Prince	122	62	33.7%
Winter 2010 P2	Pac Prince	37	25	40.3%
Winter 2010 P1	Starbound	150	49	24.6%
Winter 2010 P2	Starbound	38	21	35.6%

Although improvement in Chinook escapement is a component of this EFP application, chum salmon bycatch reduction will be the primary focus. Two stages of field research on chum salmon are planned in this EFP, the first in fall of 2011 and the second in fall of 2012. The reason for focusing on chum is that like Chinook bycatch, reducing chum salmon bycatch is a priority for the Bering Sea pollock industry.

To date, excluders that have shown useful selectivity advantages for Chinook salmon do not appear to work for chum salmon. For example, in the fall of 2009 testing under EFP 08-02, an early version of a flapper excluder was tested to evaluate its selectivity for chum salmon bycatch reduction. Just as with funnel and tunnel excluders, testing showed that version of a flapper excluder was not effective for chum bycatch reduction.

What we were unable to do under EFP 08-02 was to evaluate the device tested in the final stage of work on EFP 08-02 in terms of its selectivity for chum salmon bycatch reduction. The final version of the flapper excluder differs from the earlier flapper excluders because it is installed further back in the trawl, a location where the flow of water down the trawl is slower because the excluder is located in the straight section of the trawl instead of a tapered section. Because the lower escapement rates for chums seen in our excluder research to date may be explained by differences in swimming behavior or ability, the final version excluder from EFP 08-02 may hold promise for reducing chum bycatch. Likewise, it will be worthwhile to evaluate how a reduction in the overhang of the flapper panel might increase chum escapement as well.

Finally, a long-suspected reason for the performance differences comparing Chinook and chum salmon is that chum may avoid swimming out the top portion of the trawl where escapement holes have been placed for all past excluder designs. The notion that chum are unlikely to swim out of top of the net comes from numerous comments from salmon fishermen who report that chum tend to dive to avoid their gill and seine nets. Should the first field season of tests involving the latest version of the flapper excluder show that the design is not very effective for chum (including with the reduction in overhang), a potential focus for the second field season might be to modify the current flapper excluder in conjunction with side escapement holes.

The re-design aspects to allow side escapement holes with a flapper excluder would not be trivial, however, and would likely require work in a flume tank prior to field testing. This is why work using side escapement holes would logically be best done during the second field season on chum in 2012. This would allow the first priority to be on the simpler, more easily modified aspects of the current excluder while at the same time setting the stage for more challenging work if it is needed in 2012.

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 2011 and 2012

1. While conducting EFP testing under this permit, the EFP vessel(s) must be exempted from the Non-Chinook Salmon ICA regulations (671.21g) and Chum Salmon Savings Area (CSSA) regulations. These exemptions are needed to allow the EFP field work to be conducted in areas where high salmon bycatch can be expected, as necessary.
2. Ability to do up to 100% of testing in the portion of the Sea Lion Conservation Area (SCA) normally open to pollock fishing as long as this area remains open for the regular pollock fishery.
3. Ability to conduct EFP testing with a catcher processor 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 Chinook salmon bycatch caps per regulations at (679.21f) affecting the regular pollock fishery or other in-season salmon bycatch control measures in place for the regular pollock fishery (e.g. Chinook salmon IPA agreements promulgated under Amendment 94). Additionally, EFP chum salmon catches need to be exempted from the accounting for triggers to Chum Salmon Savings Area trigger amounts.

<u>Proposed catch limits for the salmon excluder EFP</u>

Field work season	MT of groundfish (in pollock target)	Number of Chinook salmon	Number of non-chinook salmon
Fall 2011	2,500	125*	2,500
Winter 2012	2,500	600	125*
Fall 2012	2,500	125*	2,500

*allowance of salmon species not normally taken as bycatch seasonally to avoid premature closure of EFP

In the past we have based the requested EFP catch allowances on a statistical power analysis fashioned from available catch data from the regular pollock fishery and limited by the lack of a concrete expectation for the proportional effect of the excluder. Accordingly, our EFP applications in 2005 and 2007 requested catch allowances that were designed around the objective of having a sufficiently high probability of detecting a 10% difference in proportion of effect (bycatch reduction via excluder) at the 95% level of statistical confidence. While impressive sounding, in fact our expectations for the number of chum or Chinook salmon captured per tow and the variability associated with that catch were based on rates from the regular pollock fishery even if our study was allowed to access bycatch hotspot areas closed to normal fishing operations. This was necessary because we lacked data that better represented our proposed testing inside salmon bycatch hotspots, where salmon catch rates were expected to be higher. Likewise, as no data or *a priori* expectation for proportional effect of any particular excluder design were available, our power calculations used a simple binary escape process with the most conservative escape proportion (0.5)[1]. So our early power analysis suffered from significant limitations.

Over time and with the experience of multiple field-testing seasons using recapture nets, we have established testing protocols that have effectively used the resources provided under the previous EFPs. For this reason, we feel that the power analyses used in previous EFP applications are somewhat obsolete but that relying on the same baseline catch amounts from recent EFPs is a better and more realistic basis for further work. With this in mind, our request for what we feel are sufficient pollock and salmon allowances for this EFP application is designed to assure a valid test for at least one configuration even under the worst case scenario of salmon availability and catch variability or gear problems. We feel this is achievable because we have been able to do this in the past. Additionally, in our field work experimental success indicators (i.e., variance around estimate, number of salmon observed) have been monitored until study managers are confident that a valid and useful performance evaluation has been achieved. The remaining catch allowances for the EFP have then been expended testing a secondary configuration whenever possible. Therefore our expectation for this EFP is that a minimum of one statistically precise test and possibly two can be achieved in one field season. Failing full completion of a second test, the partial second test generally would at least provide an indicator of whether the new modification pursues a useful direction.

This practical approach is particularly appropriate because the main focus on our new EFP shifts from Chinook to chum salmon. Applying recent results in a formal power analysis would only roughly approximate the new experimental parameters. In fact, we do know that excluders that have created useful selectivity results for Chinook salmon have not achieved similar results for chum salmon. This means that expectations for statistical power would only be as good as the degree of relevance between chum and Chinook bycatch and excluder performance.

Our experience with field testing of salmon excluders has shown that tests to evaluate Chinook salmon excluders comprising 12-15 tows under the EFP protocol have been successful in providing useful confidence intervals around estimates of mean escapement. This was the range of sampled tows originally estimated to be needed to attain the 200 observed salmon guideline[2] indicated by our earlier power analysis. Equally important,

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[1] Variance of proportion p [= p*(1-p)] is highest at 0.5 (=0.25). For comparison, Var (0.1) = 0.09 and Var (0.25) = 0.1875.

[2]Minimum number of salmon in a test from previous power analysis for 2003 EFP application, based on having a sufficient power to an 80% percent probability of detecting a 10% difference in proportion of effect from the underlying proportion of 0.5 with 95% statistical confidence (alpha =0.05), as described in Application (EFP 2003-01) Technical Support Document" as part of our 2005 EFP application.

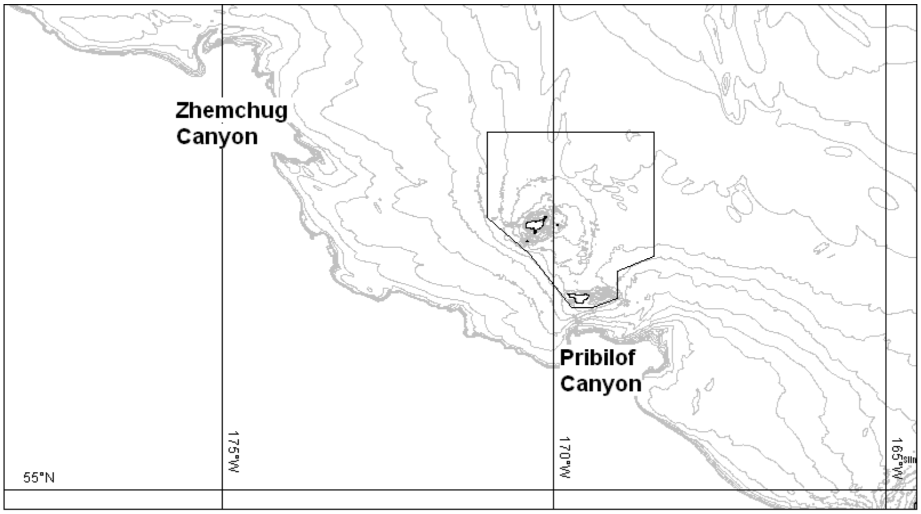
these 12-15 tows tended to provide a sufficiently wide range of fishing conditions (e.g., day/night, tow direction relative to weather and current, etc.) to represent the variability inherent in commercial fishing operations. Our protocols were designed to be representative of fishing in the regular pollock fishery in terms of the catch amounts (e.g. 80 to 100 mt of catch per tow) and fishing locations were selected to provide representative pollock catch rates and relatively high salmon bycatch rates. This is another reason why we have opted to continue our research using previous EFP catch limits and the amount of research obtained from them as guidelines for what can be accomplished during each field season under this new EFP.

Areas where EFP testing is expected to occur during fall (2011 and 2012) and winter 2012 testing: For valid tests of salmon excluders, we need to be able to conduct EFP testing in areas with sufficiently high concentrations of salmon to achieve our sample size objectives. 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 2011 and 2012 directed at our primary objective of chum salmon selectivity. During earlier salmon excluder EFP tests, we have found suitable testing conditions in the northern portion of the Catcher Vessel Operations Area (CVOA) within and adjacent to areas that formerly were closed by regulation in the Pollock B Season. Previous EFPs have also successfully found adequate areas for testing for chum salmon escapement in the Horseshoe 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 or the recapture net.

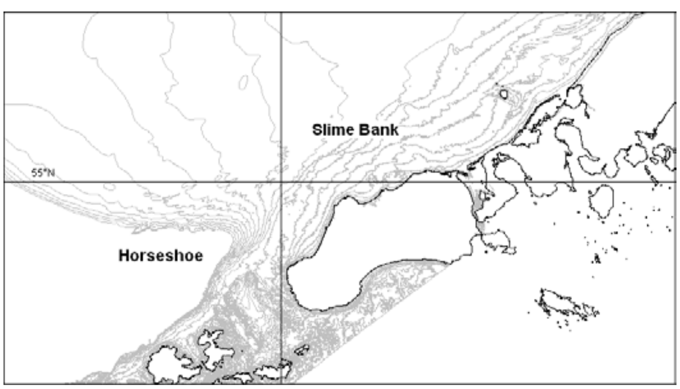
If suitable pollock and salmon conditions cannot be found in the CVOA or Horseshoe, then we may have to conduct testing on the shelf area adjacent the Pribilof no trawl zone or in the headlands of Pribilof or Zemschug Canyons. These areas are identified in Figure 2 below. In most cases, areas of the 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 salmon and pollock. In years when the Bering Sea “cold pool” 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 secondary objective of potentially improving the effectiveness of the current excluder for Chinook salmon, our best guess is that Winter A Season in January 2012 EF P testing will 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 EFP applicant (permit holder) 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 managing the field experiments to make sure that objectives of the EFP are accomplished and staffing field experiments with a qualified field project manager. The EFP applicant will also be responsible for working with the NMFS-certified observer provider companies to ensure the experiments utilize qualified sea samplers. The EFP applicant will ensure that sea samplers are provided with instruction and briefing materials to understand their sampling duties for the EFP. The EFP applicant will also 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. The permit holder will present results from the different field work seasons to the pollock industry, North Pacific Fishery Management Council, and other venues to obtain feedback needed for development of the excluder designs. 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. 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. Co-investigators on the overall project to develop a workable salmon excluder are Dr. Craig Rose of the Alaska Fishery Science Center and Mr. John Gruver of the United Catcher Boats Association. Input from the pollock industry will help inform the decision process in terms of prioritizing designs to be tested and making adjustments as data from tests and video and sonar information become available. 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. Additionally, the permit holder will be responsible for drafting "request for proposals" and other explanatory materials to solicit applications for qualified EFP vessels. The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center will review those applications and advise the EFP holder on which vessel(s) are best qualified to conduct the EFP testing.

Supplemental information for our EFP field testing plan: The most pressing area to address in continued work on salmon excluders is coming up with a workable excluder for chum salmon escapement. All excluder designs tested prior to EFP 08-02 have shown much lower chum escapement rates than for Chinook with the highest escapement of chum being about 12% from a tunnel and funnel-style excluder testing in 2003 and 2004. Those same excluders achieved between 25% to 43% Chinook escapement, albeit with routine problems from fish and jellyfish becoming pinned ahead of the square mesh excluder panel as explained in our EFP final reports. The difference in performance with chum and Chinook escapement from the same excluder design has never been understood. More recently with EFP 08-02, fieldwork in fall of 2009 also showed little or no useful selectivity for reducing chum salmon bycatch rates with a flapper excluder. That version of the flapper, however, was different from the final version with one of the most important differences being that it was located in the tapered section of the trawl intermediate and the final version was moved back into un-tapered section where water flow is lower.

Potential explanations for the excluder performance differences between chum and Chinook are that Chinook are stronger swimmers or that chum salmon behavior in response to the excluder is somehow different from Chinook. For the latter idea, several salmon fishermen contacted us to point out that chum salmon tend to dive in seine and gill nets. Their speculation is that chums would be reluctant to swim up and out of an escapement hole located in the top of the trawl. Most of our escapement holes have been in the top section although earlier excluders had escapement portals located in the upper portion of the sides and top of the trawl. We did in fact see higher escapement rates for chums in the earlier tests with escapement holes extending to the sides of the upper panels of the intermediate. Excluder designs have evolved so much since the earlier tests that it is hard to even speculate whether this suggestive difference is even meaningful at this point.

For our focus on chum salmon, the first logical step will be to see whether the final version of the excluder as tested in January/February 2010 provides useful selectivity for reducing chum salmon bycatch. The reason this is warranted is that the final excluder from EFP 08-02 is located in a part of the net with slower water flow than all other excluders tested in EFPs to date. Based on what is learned from that initial test and video observations accompanying that work, a modification to the current excluder might be to cut back the overhang (distance aft of the escapement hole that the flapper panel extends) to reduce the distance chum would need to swim forward to escape. Alternatively, the current escapement hole at the top of the trawl might be revised such that it extends to the sides to some degree. This matter is, however, not as simple as cutting a different type of escapement hole. The shape of the flapper excluder and how it is built into the trawl would mean that some design changes are needed to accommodate room at the sides for escapement. This is particularly true if the initial work suggests that side escapement holes would have to extend down very far towards the top riblines.

As a practical matter, the most efficient way to proceed would be to start with reducing the overhang to see if that creates useful results. If escapement at the sides is still an area of focus following the first tests, work in a flume tank to redesign the current flapper excluder to accommodate escapement at the sides would likely be needed. So that focus would logically be done as a second step and a trip to the flume tank would be probably be done to help inform that work because attempting to do that kind of shaping work in the field would likely be inefficient.

For our secondary objective of additional Chinook salmon bycatch reduction testing, fishermen remain interested in knowing whether the addition of artificial light above the escapement hole in the current flapper excluder would help improve escapement. The impetus for looking at how light affects escapement rates came about during the winter 2010 testing where daytime escapement rates per tow were nominally higher than nighttime rates. To examine this possibility, we attempted to evaluate how the addition of artificial light above the excluder escape portal increased escapement rates. This was done in the second EFP test on the Pacific Prince last winter. Interestingly, the average escapement rate did increase nominally to approximately 40% in that test but confidence intervals around that average escapement rate were not sufficient for us to conclude that a lighted escapement pathway actually increases Chinook escapement. So a clear priority is to do another test with a lighted pathway to see if that results in higher Chinook escapement.

Another logical place to focus for increasing Chinook escapement is to decrease the "overhang" of the flapper sheet relative to the back edge of the escapement hole. This would reduce the distance salmon need to swim forward to reach the escapement hole. A potential downside to this would be that pollock, which thus far have shown only limited ability to swim forward against the flow to reach the escapement portal may have a better opportunity to do so. The question is how much of an increase in pollock and salmon escapement would result and would the increase in salmon escapement justify additional pollock escapement?

A recapture net experiment is particularly well suited for addressing tradeoff regarding the reduction in salmon escapement and related increase in pollock escapement. As long as the change in the amount of overhang is made in a relatively small increment, the recapture net should be able to accommodate the increase in pollock escapement. In our experience, this is the best way to evaluate this kind of selectivity tradeoff; video alone or paired comparisons are unlikely to be able to efficiently measure the effect of these tradeoffs from small adjustments.

Field testing methods to address the above objectives for this EFP will be the same as those used in previous EFPs where recapture nets were used. Given our past experiences, we are now confident that use of the recapture net in conjunction with opportunistic video and sonar observations and data is the best overall method for gauging the performance of salmon excluders for the pollock fishery.

The detailed draft testing plan for this EFP is as follows:

<u>Fall 2011:</u>
Test with the current excluder to measure chum escapement and follow-up test with some amount of reduction in the flapper panel overhang as a second test if sufficient groundfish and salmon allowance remain after the first test. This test would likely involve use of a single testing vessel to avoid vessel-effects so that the results from the first and second tests are as comparable as possible.

<u>Winter 2012:</u>
The focus would be to evaluate whether adding artificial light or reducing overhang augments Chinook escapement rates. This test would logically involve two different testing vessels assuming that the 2010 results are the starting point for Chinook escapement and modifications to the device would reflect the difference in escapement rates for Chinook. So using the baseline from the Pacific Prince from 2010 testing (35% escapement in the first test without artificial light), we might test the escapement rate with artificial light set up to illuminate above the escapement hole. On the second vessel, we might conduct a test with the flapper panel that extends back less that the current excluder based on what was tested in winter 2010.

<u>Fall 2012:</u>
Depending on what was learned from the first test on chum in 2011, the fall 2012 work would evaluate additional cut back in flapper panel's overhang or escapement portals cut

into the sides of the intermediate. Either one or two test vessels may be needed for the fall 2012 tests. If the focus was on whether the excluder design was workable for vessels with different towing power or other differences in fishing characteristics of nets used by different types of pollock vessels, then two different vessels would be used for the test. If the test was focused on a large change to the excluder, such as escapement portals in the sides of the trawl, then the preference may be for one test vessel and two different sets of side escapement portals to evaluate the differences in chum and pollock escapement.