-Draft-
2016 Annual Deployment Plan for Observers in the Groundfish and Halibut Fisheries off Alaska

September 2015

Fisheries Monitoring and Analysis Division, Alaska Fisheries Science Center
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115

National Marine Fisheries Service, Alaska Regional Office
P.O. Box 21668
709 W. 9th Street
Juneau, Alaska 99802

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Contents

1 Executive Summary

This draft 2016 Annual Deployment Plan (ADP) documents how the National Marine Fisheries Service (NMFS) intends to assign fishery observers to vessels fishing in the North Pacific during the calendar year 2016.

- NMFS recommends using the trip-selection method (i.e., the trip-selection pool) to assign observers to vessels in 2016.

- In June, NMFS recommended and the Council supported changing the definitions of the deployment strata and considering designs based on gear and Fishery Management Plan (FMP) area. Appendix B in this draft ADP provides an evaluation of alternative sampling designs. The sampling design for observer deployment involves two elements: 1) how the population of partial coverage trips is subdivided (stratification); and 2) what proportion of the total observer deployments are to occur within these subdivisions (allocation). Six stratification schemes, including several based on gear and FMP areas, and two allocation methods (proportional allocation and optimal allocation) were evaluated. The evaluation generated 12 alternative sampling designs (6 stratification schemes * 2 allocation strategies).

  The alternative designs were compared by simulating observer deployments and estimating the relative precision of total retained and discarded groundfish. We note that the measures of precision used in the Appendix B analysis are not equivalent to the estimates of variance that will arise from the estimation processes that incorporate the hierarchical sampling design of the observer program and the Catch Accounting System. The 12 alternative designs were then evaluated using gap analysis (i.e., exploring situations where no observer data would be available). The gap analysis was used to determine which sampling designs would have a 50% probability of having at least 3 observed trips. The designs that met this criteria were ranked based on results from the simulations to provide a relative comparison among all the sampling designs.

  The analysis found that a stratification scheme based on gear with an optimal allocation strategy had the highest overall ranking. This sampling design was a large improvement over the small and large-vessel trip sampling designs used in previous ADPs. Additionally, the gear-only stratification outperformed stratification schemes that were defined by both gear and FMP area (e.g., trawl in the GOA; trawl in the BSAI).

- NMFS proposes three trip-selection strata for 2016:
    - ***Trawl trip-selection pool*:** This pool is comprised of all catcher vessels fishing trawl gear on a trip.
    - ***Hook-and-line trip-selection pool***: This pool is comprised of catcher vessels that are greater than or equal to 40 ft, LOA that are fishing hook and line gear.
    - ***Pot trip-selection pool***: This pool is comprised of catcher vessels that are greater than or equal to 40 ft, LOA that are fishing pot gear.

- NMFS uses estimates of anticipated fishing effort and available sea-day budgets to determine selection rates for each stratum. Once a stratification design for the final ADP is established,

simulation models will be used to refine expected coverage rates and will be provided in the final 2016 ADP. Preliminary selection rates, using optimal allocation, for the 3 trip-selection strata in 2016 are:
    - Trawl – 29%
    - Hook and Line – 14%
    - Pot – 14%

- NMFS recommends that "No selection pool," which is the pool of vessels that will have no probability of carrying an observer on any trips for the 2016 fishing season, be composed of two categories:
    - Catcher vessels less than 40 ft LOA, or vessels fishing with jig gear.
    - *EM Selection pool*: Fixed gear vessels that elected to opt-in and participate in Electronic Monitoring (EM) cooperative research. NMFS sent letters to all small hook and line vessels (40-57.5 ft LOA) requesting them to opt-in to the EM selection pool. Vessels that have opted-in and will participate in the 2016 EM cooperative research and carry EM as described in the EM Pre-Implementation plan.

- NMFS recommends not granting any conditional releases or temporary exemptions to any vessels subject to observer coverage and is instead proposing to mitigate the impact of human observation on vessels through the EM Pre-implementation Plan and placing vessels into the EM selection pool with no requirement to carry an observer. Vessels that had received a conditional release in previous year (2013, 2014, and 2015) had an opportunity to opt-in to the EM selection pool and would be given priority to participate in the EM research.

- NMFS will continue to collect genetic samples from salmon caught as bycatch in groundfish fisheries to support efforts to identify stock of origin. The same sampling protocol established in the 2014 ADP will be used in 2016.

- Trawl vessels that fish for Pacific cod in the BSAI will be given the opportunity to opt-in to full observer coverage and carry an observer at all times when fishing in the BSAI using the same approach as 2015.

- NMFS will continue to communicate the details of the ADP to affected participants though letter, public meetings, and posting information on the internet. Outreach activities during 2015/2016 fall and winter will focus on changes to observer deployment in the 2016 ADP and the ongoing work to integrate EM into the observer program.

2 Introduction

1.1 Purpose and authority

This draft 2016 Annual Deployment Plan (ADP) documents how the National Marine Fisheries Service (NMFS or Agency) intends to assign at-sea and shoreside observers to vessels and processing plants engaged in fishing operations in the North Pacific under the authority of the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP), the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA FMP), and the Northern Pacific Halibut Act of 1982. Data collection by observers is currently the only reliable and verifiable method available for NMFS to gain fishery discard and biological information on fish, and data concerning seabird and marine mammal interactions with fisheries. Onboard observers also perform the critically important task of collecting biological data such as species composition, weights, and tissue samples that are important for stock assessment scientists and researchers. Much of this information is expeditiously available (e.g., daily or at the end of a trip, depending on the type of vessel) to ensure effective management.

Details on the legal authority and purpose of the ADP are found in the Final Rule for Amendment 86 to the BSAI FMP and Amendment 76 to the GOA FMP (77 FR 70062, November 21, 2012). This ADP follows section 313 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA, 16 U.S.C 1862), which authorizes the North Pacific Fishery Management Council (Council) to prepare a fisheries research plan that requires the deployment of observers into the North Pacific fisheries and establishes a system of fees. The ADP describes the science-driven method for observer deployment that enables observers to perform their duties, including species identification, quantification and disposition of catch, documenting interactions with marine mammals and seabirds, and collection of biological specimens to support research and assessment of biological resources in the North Pacific. This ADP specifically describes observer deployment for the partial coverage category (50 CFR 679.51(a)) in the halibut and groundfish fisheries in 2016.

1.2 Process and Schedule

NMFS and the Council created the ADP process to provide flexibility in the deployment of observers to gather reliable data for estimation of catch in the groundfish and halibut fisheries off Alaska. NMFS and the Council recognized that the amount of observer coverage available for any given year would be dependent on available revenue generated from fees on groundfish and halibut landings. The ADP process allows NMFS to adjust deployment in each year so that sampling can be achieved within financial constraints. Some aspects of observer deployment can be adjusted through the ADP, including the rates of coverage, the assignment of vessels to a specific partial coverage selection pool, or the allocation strategy used to deploy observers in the partial coverage category.

The ADP process ensures that the best available information is used to evaluate deployment, including scientific review and Council input, to annually determine deployment methods. On an annual basis, NMFS develops an ADP to describe how observers will be deployed for the upcoming calendar year and prepares an annual report that evaluates the performance of the prior year's ADP implementation. The schedule for the 2016 ADP is as follows:

- June 2015: NMFS presented the 2014 Annual Report to the Council and the public. The 2014 Annual Report provided a comprehensive evaluation of observer program performance including, costs, sampling levels, issues and potential changes for the 2016 ADP. The 2014 Annual Report identified areas where improvements are needed to (1) collect the data necessary to manage the groundfish and halibut fisheries, (2) maintain the scientific goal of unbiased data collection, and (3) accomplish the most effective and efficient use of the funds collected through the observer fees. This review informed the Council and the public about how well various aspects of the program are working.

- September 2015: Based on information and analyses from the 2014 Annual Report and Council recommendations, NMFS prepared and released this draft 2016 ADP containing recommendations for deployment methods in the partial coverage category.

- September – October 2015: The Council and its SSC will review this draft 2016 ADP and any associated Plan Team and Observer Advisory Committee (OAC) recommendations. Based on input from its advisory bodies and the public, the Council may choose to clarify objectives and provide recommendations for the final 2016 ADP. NMFS will review and consider these recommendations; however, extensive analysis and large-scale revisions to the draft 2016 ADP are not feasible. This constraint is due to the short time available to finalize the 2016 ADP prior to the December 2016 Council meeting, and practical limitations on planning for deployment (including contracting with an observer provider) and associated processes that need to be in place by January 1, 2016.

- December 2015: NMFS will finalize the 2016 ADP and release it to the public prior to the December 2015 Council meeting.

The analysis and evaluation of the data collected by observers and the ADP development is an on-going process; in June 2016, NMFS will present the 2015 Annual Report that will form the basis for the 2017 ADP.

3 Annual Report Summary

As described in section 2.2, NMFS releases an Annual Report in June of each year that provides an evaluation of observer deployment under the ADP and includes an overview of the fees and budget associated with deployment, enforcement of the observer program regulations, a summary of public outreach events, and a scientific evaluation of observer deployment conducted by the Observer Science Committee (OSC). NMFS has released two Annual Reports: the 2013 Annual Report (NMFS 2014a) that was presented to the Council in June 2014; and the 2014 Annual Report (NMFS 2015) that was presented to the Council in June 2015. This draft 2016 ADP builds upon NMFS recommendations in the Annual Reports and reviews and provides recommendations based on the 2014 report presented to the Council (Appendix A).

In both the 2013 and 2014 Annual Reports, NMFS evaluated the deployment method and concluded that trip selection was working well whereas the vessel selection process had several problems. Based on these evaluations, NMFS recommended that participants in the vessel selection category be placed in the trip selection category and this recommendation was implemented under the 2015 ADP. NMFS continues to recommend trip-selection method for all vessels in 2016.

The Annual Reports have evaluated observer deployment in each of the sampling strata for each year. The strata definitions from 2013-2014 have been based on gear and vessel size where all trawl vessels and fixed gear vessels >57.5 ft length over all (LOA) were placed in one strata, and all fixed gear vessels from 40-57.5ft LOA were placed in a separate strata. In the 2014 Annual Report, the Observer Science Committee recommended exploring new strata definitions based on gear and FMP area (NMFS 2015). They also noted that it would be important that definitions of the sampling strata be based on characteristics that are known before the trip begins and that each trip can be assigned to a single stratum at the time the trip is logged. Based on these recommendations, NMFS and the Council supported changing the definitions of the deployment strata (Appendix A). In this draft ADP, NMFS provides an evaluation of alternative sampling designs (Appendix B). Based on these analyses, a sampling strata definition based on gear is recommended (section 4.1).

Recognizing the challenging logistics of putting observers on small vessels and low levels of catch by these vessels, NMFS has placed vessels less than 40ft LOA and jig vessels in the no-selection pool for observer coverage since 2013. However, the Annual Report (NMFS 2015) and Observer Program Supplement Environmental Assessment have highlighted the data gaps caused by not having any observer information on vessels less than 40 ft LOA. NMFS proposes to continue placing vessels less than 40ft LOA in the no selection pool in 2016 (section 4.1) and recommends that vessels less than 40ft LOA be considered for testing of electronic monitoring in the future.

In both the 2013 and 2014 Annual Reports, NMFS found that biased observer data resulted from the policy of issuing conditional releases and temporary exemptions. Under the 2015 ADP, NMFS granted temporary exemptions only to vessels in the small vessel category with insufficient life-raft capacity to accommodate an observer, or if their two previous trips were observed trips (i.e., two trips in a row were observed, the third trip will be released from coverage). For 2016, the EM workgroup has developed a Draft EM Pre-implementation Plan for small hook-and-line vessels that will be presented to the Council at its October, 2015, meeting. NMFS proposes to no longer issue conditional releases (see Section 4.3), and is instead proposing to mitigate the impact of human observation on vessels through the EM Pre-implementation Plan and placing vessels into the EM selection pool with no requirement to carry an observer. As part the EM selection process, the EM workgroup recommended that NMFS send a letter to the small-vessel fixed-gear fleet requesting owners to indicate if they are interested in participating in the EM cooperative research being implemented through the Draft EM Pre-implementation Plan (Appendix C). NMFS sent a letter to all 40-57.5 ft fixed gear vessels requesting that anyone interested in participating should respond and that priority would be given to vessels that had been granted temporary exemptions and conditional releases for insufficient life raft capacity or bunk space. The EM workgroup has proposed a maximum of 60 vessels be allowed in the EM selection pool. As of August 2015, 56 fixed gear vessels responded to the letter and would be included in the EM selection pool.

The Observer Declare and Deploy System (ODDS) facilitates random selection of trips for fishery operations that are in partial coverage and within one of the trip selection pools. Users are given flexibility to accommodate their fishing operations; up to three trips may be logged in advance of fishing and trips can be cancelled to accommodate changing plans. If a trip that was selected for observer coverage is then cancelled by the user, then the vessel's next logged trip is automatically selected for coverage. The "inherited" selection of this next logged trip preserves the number of selected trips in the year, but cannot prevent the delay of selected trips during the year. The 2014 Annual Report provided an evaluation of ODDS performance and found that ODDS users cancelled trips that had been selected for coverage at nearly four (3.7) times the rate of unselected trips (NMFS 2015). Temporal bias was evident in the 2013 and 2014 Annual Reports (NMFS 2014a). Based on these finding, NMFS has proposed two alternatives as potential modifications to ODDS to address temporal bias (see section 4.4).

Both the 2013 and 2014 Annual Reports noted that data analysis issues were created by the lack of a shared trip identifier between ODDS and eLandings. The eLandings system enables the Alaska fishing industry to report landings and production of commercial fish and shellfish to the three management agencies in Alaska (NMFS, Alaska Department of Fish and Game, and the International Pacific Halibut Commission) through a single application. In the context of the Observer Program, eLandings provides a record of all trips that were taken during the year, which can be compared to the number of trips that were logged in ODDS. NMFS is proposing changes to eLandings system in 2016, to provide better linkage between ODDS and eLandings and improve data analysis (see section 4.5).

4 2015 Deployment Methods

The North Pacific Observer Program uses a stratified hierarchical sample design where strata are defined through a combination of regulations and the annual deployment process. A multi-stage sampling design is used to sample the species composition of catch along with other catch components, such as biological information that is important for stock assessments. Both shoreside sampling methods (for salmon) and at-sea sample collections are nested within a trip. At-sea sampling methods follow a nested structure where samples are nested within hauls, and hauls are nested within trips.

A random selection of trip will be the sole method of assigning observers to at-sea fishing events in 2016. Trip-selection refers to the selection of the fishing trip as the sampling unit. Trip-selection is facilitated through the Observer Declare and Deploy System (ODDS).

1.3 At-Sea Selection Pools (strata)

The 2014 Annual Report recommended, and the Council reiterated (Appendix A), that NMFS evaluate different sampling strata definitions for the 2016 ADP; Appendix B contains details on this analysis. The analysis found that sampling strata defined by gear type was a large improvement over the small and large-vessel trip sampling designs used in previous ADPs.

Additionally, a gear-only stratification outperformed stratification schemes that were defined by both gear and FMP area (e.g., trawl in the GOA; trawl in the BSAI). Based on these results, NMFS proposes to implement gear-specific sampling strata for 2016. Separate sampling strata would be defined for trawl, hook-and-line, and pot gear. The small- and large-vessel trip strata used in the 2014 and 2015 ADPs would not be used in 2016. Instead, vessels 40 ft length overall (LOA) and larger would be part of the same gear-specific sampling strata. For example, all hook-and-line vessels > 40ft LOA in partial coverage would have the same sampling rate.

NMFS recommends that following observer deployment strata for vessels in the partial observer coverage category (50 CFR 679.51(a)):

- ***No selection Pool*:** The "no selection" pool is comprised of vessels that will have no probability of carrying an observer on any trips for the 2016 fishing season. These vessels are broken into two categories:
    - Catcher vessels less than 40 ft LOA, or vessels fishing with jig gear, which includes handline, jig, troll, and dinglebar troll gear.
    - *EM Selection pool*: Fixed gear vessels that have opted-in and will participate in the 2016 EM cooperative research described in the EM Pre-Implementation plan (see Appendix C).
- ***Trawl trip-selection pool*:** This pool is comprised of all catcher vessels fishing trawl gear on a trip.
- ***Hook-and-line trip-selection pool***: This pool is comprised of catcher vessels that are greater than or equal to 40 ft, LOA that are fishing hook and line gear.
- ***Pot trip-selection pool***: This pool is comprised of catcher vessels that are greater than or equal to 40 ft, LOA that are fishing pot gear.

1.4 Projected At-Sea Deployment (sample size)

For this draft ADP, a preliminary at-sea budget for the deployment of observers in 2016 was set at 5,130 days. NMFS anticipates the budget for 2016 deployment to be approximately $5.5M, of which $4.2M is projected revenue from the fee for the 2015 calendar year. The remaining funding includes fees carried over from 2015 and federal funds from NMFS.

NMFS uses available sea-day budgets and estimates of anticipated fishing effort to determine selection rates. NMFS recommends the gear stratification scheme with optimized allocations (OPT) described in Appendix B. However, the preliminary deployment rates provided in Appendix B do not incorporate uncertainty in budget projections for 2015, uncertainty in the timing when the observe fees will be available[1], and potential differences in fishing effort

[1] As in previous years, funding the partial coverage contract is contingent upon the Office of Management and Budget releasing observer fee collections in time to fund the next option period. The partial coverage observer contract awarded to AIS in April 15, 2015 was for a base period and four option years. The observer fees became available the end of May and the first option year was funded on June 17, 2015 to cover the period running from June 17, 2015 to June 16, 2016. The four option periods must be awarded by June 17 of each year to fund the following year's observer sea days. Since the contract spans calendar years,

between the year used for effort projection (2014) and realized effort in 2016. To accommodate this uncertainty, a buffer of approximately 10% was applied to the rates in Appendix B (Rates * 0.9) to calculate the following preliminary selection rates for the proposed strata:

- No selection – 0%
- Trawl – 29%
- Hook and Line – 14%
- Pot – 14%

Once a stratification design for the final ADP is established, simulation models (following methods outlined in NMFS 2014b) will be used to estimate expected coverage rates and will be provided in the final 2016 ADP.

1.5 Conditional Release Policy

For 2016 NMFS recommends not granting any conditional releases or temporary exemptions to any vessels subject to observer coverage.

As described in section 3, the 2013 and 2014 Annual Reports (NMFS 2014a, NMFS 2015) raised a number of concerns with conditional releases in the vessel selection stratum (i.e., the small vessel trip-selection stratum in the 2015 ADP). In light of the issues associated with conditional releases, NMFS modified the conditional release policy in 2015 to only grant temporary exemptions to vessels with insufficient life raft capacity. In 2015, NMFS granted conditional releases to vessels in the small-vessel trip selection pool to vessels with insufficient life raft capacity to accommodate an observer, and to vessels if their two previous trips were observed (i.e., two trips in a row were observed, the third trip was released from coverage). With the new life raft release policy in place, NMFS issued only 5 conditional releases through September 2015 (the most recent data available at the time this Draft ADP was released).

In 2016, the expansion of the EM selection pool is an additional mitigating factor in NMFS recommendation to not grant any temporary exemptions. In May 2015, NMFS sent letters to all small hook and line vessels (40-57.5 ft LOA) requesting them to opt-in to the EM selection pool if they were interesting in carrying EM (Appendix C). All vessels that had received a conditional release in any previous year (2013, 2014, and 2015) received a letter from NMFS and had an opportunity to opt-in to the EM selection pool. Vessels in the EM selection pool will carry EM equipment as described in EM Pre-Implementation Plan, but will not be subject to human observer coverage. The pool currently stands at 56 vessels, although the EM workgroup has discussed allowing up to 60 vessels into the pool.

1.6 Changes to the Observer Declare and Deploy System (ODDS)

Based on information in the 2014 Annual Report, the current method of logging up to three trips in ODDS with the ability to cancel a trip has resulted in a temporal bias for observed trips. Observed trips are about four times (3.7) more likely to be canceled than unobserved trips with a total of 18% of all observed trips canceled in 2014. Although observed trips that are canceled

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funding for sea days from January- June 2016 is included on the current year's contract for which funds have already been obligated, and sea days from June 17- December 31, 2016 will be purchased under a new option period on the contract on June 17, 2016.

result in the next logged trip being subject to observer coverage, there is a potential for temporal bias in observer coverage, because previously logged trips not subject to coverage still exist in the system.

For 2016, NMFS proposes to address concerns with to temporal bias resulting by allowing only two trips to be logged in ODDS. This option would provide flexibility for logging and canceling up to two trips. Any observed trip that is canceled would automatically be inherited on the next logged trip. NMFS believes that this change may not eliminate the temporal bias in trip selection, will reduce the problem.

1.7 Changes to the eLandings electronic reporting system

Based on information in the 2013 and 2014 Annual Report, NMFS plans to make modifications to the eLandings system in 2016 to enable the ODDS trip number to be entered on a groundfish landing reports in eLandings. When vessels log trips in ODDS they are given an ODDS trip receipt with a unique trip number. When landing reports are entered in eLandings at the end of the trip, the vessel operators will provide their ODDS trip number so that it can be entered on the landing report. Having ODDS trip numbers entered on groundfish landing reports will facilitate data analysis and provide better linkage between ODDS and eLandings.

1.8 Chinook Salmon Sampling in the Gulf of Alaska

Genetic sampling of Chinook salmon in the GOA remains a priority for NMFS in 2015. This priority follows the implementation of Amendment 93 to the GOA FMP (77 FR 42629, July 20, 2012), which required all vessels fishing for pollock in the central and western GOA to retain salmon until delivery to a processing facility. There have been several iterations of the sampling design used to obtain genetic samples from salmon bycatch for the purposes of stock of origin (Faunce 2015). The sampling protocol for Chinook salmon that was established in the 2014 ADP (NMFS 2013b) and continued under the 2015 ADP (NMFS 2014b) will remain in effect for 2016. Trips that are randomly selected for observer coverage that occur in the GOA pollock fishery will be completely monitored for Chinook salmon bycatch by the vessel observer during offload of the catch at the shoreside processing facility. Outside of the pollock fisheries, tissues will be obtained from all salmon found within observer at-sea samples of the total catch. These genetic samples are important for the management of Chinook PSC and are used by the Alaska Fishery Science Center (AFSC) to identify the stock of origin of Chinook salmon caught as bycatch in groundfish fisheries (e.g. Guyon et al 2015).

1.9 BSAI Voluntary Full Coverage Compliance Agreement

Since 2013, NMFS has provided trawl vessels fishing for Pacific cod an option to carry an observer at all times when fishing in the BSAI. The additional coverage benefits the management of that fishery and reduces the population of trips in the partial coverage category, thus increasing the coverage rates for the trips remaining in partial coverage.

NMFS is extending the voluntary full coverage option through 2016. However, NMFS and the Council have recognized that this would be best addressed in the long-term through a regulatory amendment. A separate action is being considered by the Council to move BSAI trawl vessels into the full coverage category. Since the regulatory change will not be in place in 2016, entities participating in the BSAI Pacific cod trawl fishery that want full coverage in 2016 must submit a signed compliance agreement to NMFS on or before **December 1, 2015** (Appendix D). Vessels operating under a full coverage compliance agreement would pay partial coverage observer fees as required in regulation, but would also need to contract directly with observer providers and also directly pay for those observer costs. In addition, vessels operating under the full coverage compliance agreement must comply with the partial coverage regulations, including logging trips into ODDS.

5 Communication and Outreach

NMFS will continue to communicate the details of the ADP to affected participants through letters, public meetings, and posting information on the internet. Information about the Observer Program is available at:
http://www.alaskafisheries.noaa.gov/sustainablefisheries/observers/default.htm
and Frequently Asked Questions are available at:
http://alaskafisheries.noaa.gov/sustainablefisheries/observers/faq.pdf
For Frequently Asked Questions regarding ODDS go to: http://odds.afsc.noaa.gov and click the "ODDS FAQ" button.

Outreach activities listed below are tentatively planned for the fall of 2015 and winter of 2016 to inform industry participants affected by changes to observer deployment in the 2016 ADP and ongoing work on the EM cooperative research plan to integrate EM into the existing research plan. Table 5-1 includes a list of suggested meeting locations and dates.

Observer Program staff are available for additional meetings upon request by teleconference and/or WebEx pending staff availability and local interest. A community partner would be needed to organize a location and any necessary equipment to facilitate additional meetings. To request a meeting or suggest a topic for discussion, please contact Chris Rilling at (206) 526-4194

Table 5-1 Proposed public outreach meeting locations and schedule.

Location	Date
Seattle, Fish Expo	Nov 18-20, 2015
Homer	November 2, 9, 16 or 23, 2015
Anchorage, NPFMC Meeting (Evening Session)	December, 2015
Petersburg	1st week of March, 2016
Sitka	1st week of March, 2016
Kodiak, ComFish	April, 2016

6 References

NMFS. 2013a. 2013 Annual Deployment Plan for Observers in the Groundfish and Halibut Fisheries off Alaska. 39 pp plus appendices. Available at: http://alaskafisheries.noaa.gov/sustainablefisheries/observers/ADP_Final_2013.pdf.

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7 List of Preparers and Contributors

Craig Faunce, Alaska Fisheries Science Center (AFSC)
Jason Gasper, Alaska Regional Office (AKRO)
Jennifer Mondragon, AKRO
Alicia Miller, AKRO
Chris Rilling, AFSC

With contributions from:

Glenn Merrill, AKRO
Sally Bibb, AKRO
Elizabeth Chilton, AFSC

Appendix A. Council motion on the Annual Report and ADP

C-4 Observer Annual Report
Council motion June 8, 2015

The Council approves the following recommendations in the development of the draft 2016 Annual Deployment Plan and future annual reports, including consideration of SSC comments:

- Provide additional information on observer rates and percent coverage by gear type, in addition to numbers of trips and deployment. Report the percentage and metric tons of total catch observed (Table 4-2 and subsequent). Track these key metrics over time in each annual report. (OAC)

- Identify the best approach to a trip identifier tied to landings data to provide a linkage between ODDS and eLandings and improve data analysis, including those trips delivered to a tender. (OAC/SSC)

- Evaluate and suggest modifications to ODDS to reduce temporal bias associated with the policy of allowing trip cancelation and logging multiple trips prior to departure. (OAC and SSC)

- The Council appreciates the development of performance metrics and encourages NMFS to continue to develop tools to evaluate both the reliability of the data and deployment performance.
    - Include information on observer sampling such as percent of hauls observed vs total hauls/trip, and number of hauls with complete observer data vs partial data by vessel size and gear. (OAC)

    - Continue to develop ways to evaluate observer effects, including possible examination of potential associations of PSC with trip attributes on observed vessels. If associations are found, PSC rates in shoreside offloads from unobserved vessels could be compared for evidence of bias. (SSC)

    - Continue evaluation of and improvements in catch and bycatch estimation, including the necessary procedures for calculating the variances associated with point estimates. Consider SSC suggestions on a starting point for assessing variance. (OAC and SSC)

- Assess inefficiencies in the program and evaluate ways to achieve cost efficiencies in the partial coverage category within the existing 5-year contract. (OAC)

- Include information about the availability of fixed gear lead level 2 observers. (OAC)

- Incorporate some additional quantitative measures in the enforcement section of the report, especially in relation to trends by incident type. (OAC)

- The 2016 ADP should explore defining strata to deploy observers by gear (longline, pot, and trawl gear) and FMP area and, if necessary, consider operational sector (CV vs CP).

In addition, the Council supports continued outreach by enforcement personnel regarding observer issues, especially to vessels where captains are under increasing pressure to monitor PSC. (OAC)

<u>SSC comments on variance</u>: *While we agree with the analysts that it is not the sole determinant of quality of the sampling program, there is a critical need to calculate the variances associated with the point estimates (e.g. target catch, by-catch) to aid with optimization of the observer deployment sampling design and to assess uncertainty in estimates of catch. For example, the observer effect detected in landed catch in the HAL and TRW gears could have been better assessed for significance if there had been variances of these landed catches. In this way the potential for bias detected by the observed versus unobserved trips could be weighed against measurement error in the estimates of landed catch for these two gears. Variances would also aid assessment authors in their understanding of the uncertainty associated with estimates of catch. Consider, as a first-step, the calculation of variance using standard multi-stage cluster sampling (Thompson 2012), wherein the stage-specific variance is calculated along with the mean.*

<u>Talking point on ADP</u>: *Given the comment that deploying into smaller boxes requires higher rates of selection, the OAC emphasized that it will be important to retain the ability in October to evaluate trade offs between the proposed strata and alternative designs, and the information provided should support an understanding of the size of the strata in terms of both trips and catch or discards and trade offs with deployment rates. If necessary to retain larger boxes for deployment, it seems that defining strata by gear type might be more important than FMP area, within the partial coverage category (e.g., all longline in BSAI and GOA in same strata with same deployment rate).*

Appendix B. An Initial analysis of alternative sample designs for the deployment of observers in Alaska

Introduction

The North Pacific Groundifsh and Halibut Observer Program (observer program) uses a hierarchical sampling design with randomization at all levels to achieve unbiased data from fishing operations in the region. The fishing trip represents the primary sampling unit of this design. Since 2013 fleet operations in Alaska have been divided into two portions; vessels and shore-based industry operations that are subject to complete observation at the level of the trip or delivery are termed "full-coverage" while the remainder are termed "partial-coverage." Definitions of full- and partial coverage are set in Federal Regulations.

Observer deployment hereafter refers to how trips and deliveries are selected for observer coverage in the partial-coverage category of the Alaska fishing industry. All fishing trips subject to partial observer coverage constitute the target population for observer deployment. A sampling frame for the deployment of observers is constructed though the use of a mandatory log-in system known as the Observer Declare and Deploy System (ODDS)[2].

Since 2013, the observer program has presented an Annual Report and an Annual Deployment Plan (ADP) to the North Pacific Fisheries Management Council (Council). The Annual Report is presented in June, contains information on how well various aspects of the observer program are performing in addition to recommendations for future ADPs. The draft and final ADP are presented in September and December respectively and describe the observer deployment for the coming year. Three separate advisory bodies provide their comments and perspectives to the Council at each meeting. These include the Observer Advisory Committee, the Advisory Panel, and the Science and Statistical Committee (SSC). Members on the Observer Advisory Committee and the Advisory Panel represent major segments of the fishing industry as well as observers, consumers, environmental/conservation, and sport fishermen. Science and Statistical Committee members are scientists with expertise in biology, economics, statistics, and social science.

Partial coverage observers are trained prior, and debriefed after their respective deployments by the observer program. Observers are employees of an observer provider company who is responsible for the logistical aspects of deployment. Funds to deploy observers in partial coverage are obtained by NMFS through a landings fee, and these funds are contracted to the observer provider company. The Council has the authority to change the fee up to a maximum of 3% of landed value. The fee currently stands at 1.25% and is scheduled to be re-assessed in 2018.

The ADP process provides a mechanism for NMFS and the Council to re-evaluate deployment and improve efficiency in the sampling design. There are several ways in which a sampling design can be made more efficient. These include how the target population is defined as well as how available samples (observer deployments) are allocated. In the most recent Annual Report (NMFS, 2015), the NMFS recommended that future ADPs explore alternative ways to subdivide

[2] http://odds.afsc.noaa.gov

the population of partial coverage trips. The corresponding SSC report added that such an endeavor will require estimates of uncertainty and likely involve tradeoffs in quality among the multiple measures produced by the observer program (NPFMC, 2015).

What follows is a comparison of alternative stratum definitions and sample allocations for the deployment of observers into the fleet of vessels in partial coverage. These analyses are performed in support of the 2016 ADP following the findings and recommendations contained in the 2014 Annual Report and the SSC response to those findings.

Methods

The sampling design for observer deployment involves two elements; how the population of partial coverage trips is subdivided, and what proportion of the total observer deployments are to occur within these subdivisions. The first of these is termed *stratification*, while the second is termed *allocation*.

Stratification schemes

Stratification is the division of sample units in the population into subpopulations. The subpopulations are individually called stratum (strata if plural). Stratified random sampling is the act of obtaining independently random samples from within each stratum in the population. For this reason, strata need to be defined based on criteria known prior to the draw of the sample. The elements of fishing trips known prior to departure are valuable in defining deployment strata, whereas the amount of catch or the specific target category to which the catch is assigned are not are not known prior to departure and thus result in poorly defined strata boundaries.

There are numerous reasons for creating strata. These include: when a separate estimate for a subpopulation is desired, when administrative convenience (field logistics) permits it, and to increase the precision of sample-based estimates of the total. Increased precision is accomplished through the division of a heterogeneous population into homogenous subpopulations since the variance in the population total is dependent on the variances of the individual stratum means (Cochran, 1977).

The collection of strata that together subdivide the population of trips in partial coverage constitutes a *stratification scheme*. In this study six stratification schemes were considered. These stratification schemes (with numbered lists of the individual strata) are:

1. 2010 stratification scheme (STRATA 2010)

The classification and regression tree (CART) model included in the Analysis prepared for the restructured observer program (NPFMC et al., 2011) influenced this stratification scheme. Strata are:

1) Trawl gear
2) Fixed gear (Hook and Line and Pot) ≥ 57.5’ LOA
3) Fixed gear < 57.5’ LOA.

2. 2013-2015 stratification scheme (STRATA 1315)
The observer program employed this stratification scheme 2013-2015. Strata are:

1) Fixed and trawl gear ≥ 57.5’ LOA (a.k.a. the “T” stratum of 2015)
2) fixed and trawl gear < 57.5’ LOA (a.k.a the “t” stratum of 2015)

3. 2016 stratification scheme (STRATA 16)
This stratification is a modified version of the 2013-2015 scheme (STRATA 1315) that incorporates changes to the full and partial coverage category of the fleet following Council recommendations. These proposed changes include: 1) some small catcher processors (CPs) that were in full coverage be placed into the partial coverage category, 2) some “AFA” trawl catcher vessels when fishing in the Bering Sea and Aleutian Islands voluntarily choose to belong to the full coverage category, and 3) vessels that opt-in to the EM cooperative research for 2016 are removed from the partial coverage category. How data were prepared to accommodate these changes are provided later in the subheading “data preparation.”

4. Gear stratification scheme (STRATA Gear)
This stratification uses the partial coverage definitions in the 2016 Scheme (STRATA 16), but divides the trips into three gear strata that apply in both the BSAI and GOA combined:

1) Hook and Line
2) Pot
3) Trawl

5. Gear and FMP stratification scheme (STRATA GFMP2)
This stratification uses the partial coverage definitions in 2016 Scheme (STRATA 16) and builds on the stratifications in Gear Scheme. Gear-based stratifications are additionally divided by whether they occur in the Fishery Management Plan (FMP) of the Gulf of Alaska (GOA) or the Bering Sea and Aleutian Islands (BSAI). Strata are:

1) Hook and Line in the BSAI
2) Hook and Line in the GOA
3) Pot in the BSAI
4) Pot in the GOA
5) Trawl in the BSAI
6) Trawl in the GOA

An alternative to this stratification that further subdivided the BSAI into separate Bering Sea and Aleutian Islands portions was also investigated. However, this nine strata scheme was abandoned since two strata had less than 20 trips, resulting in very little chance of obtaining even a single observed trip through random sampling.

6. Half-year stratification scheme (STRATA HALFYR)
This stratification uses the partial coverage definitions in the 2016 Scheme (STRATA 16). The strata definition is structured to provide the observer program with mid-year flexibility in setting coverage rates:

1) Hook and Line in the first half of the year (First)
2) Hook and Line in the second half of the year (Second)
3) Pot in the first half of the year (First)
4) Pot in the second half of the year (Second)
5) Trawl gear for the entire year

These stratification schemes are a continuum. Comparisons between the second and the third schemes should represent the relative impact of anticipated changes to the partial coverage and full coverage categories proposed for the 2016 ADP (e.g. moving some CPs into partial coverage, and moving 56 vessels into the EM selection pool). Comparison between the third scheme and each of the third, fourth, and fifth schemes illustrate the relative impact of each of the alternative definitions of the partial coverage category for 2016.

Sample allocation
Sample allocation is the term for how observer deployments are apportioned to strata. Previously, the SSC requested that NMFS examine methods to optimize observer coverage. In mathematic terms, an optimal allocation will be designed to provide the most precision for the least cost (c), for each measure considered (e.g., retained or discarded groundfish). The procedure for calculating the optimized sample size follows equation 1, where n is the number of observed trips for which funding is available, N denotes all partial coverage fishing trips, h denotes a stratum defined by the sample design and within set H strata (partial coverage), S^2 is the variance of the metric of interest (e.g., weight of discarded or retained catch), and n_h is the optimum sample size within stratum h.

$$n_h = n * \frac{N_h S_h / \sqrt{c_h}}{\sum_{i=1}^{H} \left(N_h S_h / \sqrt{c_h} \right)} \text{ (Cochran, 1977)} \qquad (1)$$

The cost for observer coverage under partial coverage is governed by two variables: the fixed costs for each deployment day (e.g., labor), and variable costs in terms of transportation and lodging associated with a given deployment. While the fixed cost component of observer days are known and equal for each deployment of an observer, the variable costs associated with a specific deployment are not known ahead of time. Because the transportation costs for a specific deployment cannot be reliably predicted, NMFS assumes that the cost for each day of deployment is based on the fixed cost per day, and the average travel cost per day used by the Observer Program. This results in an estimated "fully loaded rate." This rate (cost per day) is equal for each deployment, and the cost per day is assumed equal among all potential strata considered in this ADP.

Neyman (1934), proposed a special case of optimum allocation that is arguably the most widely used and known concept of stratification and optimal allocation of the sample. Under the constraint that costs of obtaining each sample unit in a stratum is equal across strata, the optimal allocation of samples within each stratum is proportional to its relative weighting of the total number of units in the stratum (*N*) and the square root of the variance (equation 2).

$n_h = \frac{N_h S_h}{\sum_{i=1}^{H} N_i S_i}$	(2)

"Neyman allocation" has important implications on how strata are defined in a sampling program. If strata are defined such that they comprise groups of similar values of the target metric, then overall variance will be reduced through stratification. If, however, strata poorly discriminate between similar sample units according to the target metric, overall variance will not be substantially reduced. In the special case where variance is unknown or considered equal among strata, then n_h is set equal to the weight of the strata, where the weight of the strata is defined as the number of trips in the stratum (N_h) divided by the total number of trips in the population *N*. This weighing of the stratum is denoted as W_h, and the resulting allocation is known as *proportional allocation*.

There are three problems that arise with Neyman allocation. First, it is possible that formulae may result in $n_h > N_h$. In this case Cochran (1977) recommends setting the n_h with the largest n_h : N_h ratio equal to N_h (100% coverage) and then re-calculating Neyman allocation with the remaining strata. The second problem is that resulting n_h are not integers. Rounding offers a simple solution, however it is possible to end up with the situation where the sum of $n_h > n$. The third challenge is how to allocate when there is more than one target metric. In these cases, Cochran (1977) shows that the *compromised optimal allocation* (m_h; OPT) is derived from the average number of optimal sample sizes measured across all metrics (equation 3).

$m_h = n * \frac{(\frac{1}{n_L}\sum_{i=1}^{L} n_h)}{\sum_{i=1}^{H}(\frac{1}{n_L}\sum_{i=1}^{L} n_h)}$	(3)

It is worth noting that unless n_h among all metrics are positively correlated, the resulting compromise allocations may be substantially different from n_h for any individual target metric.

Data preparation

The staff of the Sustainable Fisheries Division of the Alaska Regional Office and the Fisheries Monitoring Division (FMA) of the Alaska Fisheries Science Center have worked collaboratively to generate a shared database to support observer program annual reports. This database contains species-specific catch amounts, dates, locations, and disposition, observation status, and associated ADP strata for 2013 and 2014. These source data were enhanced with additional information from the Alaska Regional Office and FMA to assign past fishing trips to stratification schemes 3-6. First, in anticipation of new regulations that will enable small CPs to choose to be in partial coverage, past fishing activity by nine CPs in the second half of the year were relabeled as belonging to the partial coverage category and not the full coverage category. Second, AFA catcher vessels that are currently assigned to partial coverage but that volunteered to be in full coverage for their fishing activity in the BSAI during 2014 were relabeled as belonging to the full coverage category. This decision was a compromise between the larger list of vessels that volunteered in 2013 and the corresponding smaller list from 2015. Third, past partial coverage fishing activities by 56 vessels identified by the Council's Electronic Monitoring workgroup[3] as the "2016 EM Selection Pool" (Appendix C) were removed from the stratification schemes.

Evaluation of alternative designs

The evaluation of alternative designs involves three steps: simulation of observer deployments under each of the six possible deployment schemes, gap analysis, and distance rankings. The following sections describe these steps in greater detail.

Simulation of observer deployments

Two trip metrics were used in this analysis: total retained groundfish and total discarded groundfish. This first metric is identical to that used in NPFMC *et al*. (2011) to generate the 2010 stratification scheme. The second metric is the product of observer discard rates applied to total retained groundfish on each catcher vessel trip combined with the "prohibited species catch" algorithms of the Catch Accounting System (Cahalan *et al*., 2014). Total groundfish discarded in this study includes Pacific halibut (*Hippoglossus stenolepis*), but not crab or salmon species.

The population of partial coverage trips from 2013 and 2014 corresponding to each stratification scheme was used to generate Neyman optimal allocation for each metric (equation 2) that were adjusted following Cochran (1977) and rounded if necessary. If the sum of $n_h \neq n$, the stratum with the greatest n_h value was reduced or increased by the difference. These values were then subsequently used to generate weighted optimized allocations (OPT) for each stratification scheme (equation 3) using a sample size of 2000. This initial value for n was chosen as a rough approximation of the combined number of trips sampled in 2013 and 2014 and is of relatively minor consequence since it is used only to convert weighted allocations into actual sample sizes for simulations which will be described in the following paragraph. Proportional allocations (PRS) were also generated for each stratification scheme.

Each of the six stratification schemes described previously were combined with PRS and OPT to generate twelve alternative sampling designs (6 stratification schemes * 2 allocation strategies). For each design, stratified random sampling without replacement was performed on the population of partial coverage trips for 10,000 iterations. In each iteration Horvitz-Thompson estimates (Horvitz and Thompson, 1952) with corresponding standard errors (SE = the square root of the variance of the estimate) of each metric were obtained and compared with the known true value to generate relative percent errors. For comparison, these values were plotted with ellipses corresponding to the 95% region assuming a multivariate normal distribution. Although the independent values from each iteration provide meaningful ways to explore the data from each simulation, their means provide a much easier way to compare sampling designs. Therefore the mean percent error and SE from each sampling plan were divided by their minimum and multiplied by 100 to create a relative index to compare among sampling designs.

[3] Preliminary fleet demographics of these vessels can be found online at: http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/EM%20Selection%20Pool%20Opt-In%20Characteristics.pdf.

Gap analysis

Previous evaluations of observer deployments by the observer program have placed a high value on the results of gap analysis (Faunce *et al*., 2014; 2015). This is because of the importance of observer information in the generation of total catch estimates; the absence of observer data in a given domain of interest results in data being used from similar or adjacent sampling units, which may have implications for the in-season management of quota.

Unlike the observer deployment simulations, the goal of the gap analysis is to predict the performance of each sampling plan using the most recent data. For this reason, gap analyses and all subsequent analyses were performed on the 2014 subset of the original data. The number of partial coverage trips corresponding to each stratification scheme was summed into domains defined by Gear, NMFS Area, and Target combinations that are roughly equal to those used by the Catch Accounting System for catcher vessels delivering shoreside (Cahalan *et al*., 2014). Gear was defined as three types following the gear stratification scheme and the Bering Sea and Aleutian Islands FMP areas were combined into one area (BSAI).

The number of budgeted observer days was converted into budgeted observer deployments (i.e. observed trips) by dividing it by the average trip duration during 2013 and 2014 within the partial coverage category of the 2016 stratification scheme. Using the previously identified weighted sample allocations, this revised value for *n* was then used to calculate PRS and OPT sample sizes for each strata in each stratification scheme.

The hypergeometric distribution was used to calculate the probability of observing at least three trips within a domain for each sampling design. These probabilities were made Boolean based on whether or not they exceeded 50%. This value was chosen as the minimum acceptable value since it represents equal chance of meeting the needs of variance calculation within a domain. The proportion of domains that passed this criteria was divided by its minimum among sampling designs and multiplied by 100 to provide a relative metric for the gap analysis.

Distance rankings

The relative mean percent error in the sample-based estimate, the relative mean SE, and the relative proportion of passing domains in gap analyses were used to generate a single Euclidean distance to compare each sampling design. The choice to use relative metrics provides equal weighting of the input values on the resulting distance metric. Euclidean distances are widely used in multivariate statistics such Principal Components Analysis (PCA) and have been used in fisheries to provide a single metric in Productivity and Susceptibility Analyses (PSA; Patrick et al., 2010; Ormseth and Spencer, 2011). The relative distance was calculated by dividing the distance for each sampling design by the minimum among designs. This relative distance for each sampling design was plotted for visual comparison.

Calculation of preliminary coverage rates

The calculation of observer coverage rates is desired by the public, Council, and required by ODDS for 2016. Potential coverage rates were calculated only for the sampling plans with above average gap analyses and above average distance metrics (hence gap analyses results have been used twice in the final evaluation). Similar to the gap analyses, the most recent available data (2014) were used in determining preliminary coverage rates under the necessary assumption that these best represent future fishing effort. The number of expected observed trips in each stratum from gap analyses divided by the number of trips in the stratum yielded the expected coverage rate. These calculations were repeated for the Neyman optimal allocations for both catch metrics for comparison with the compromised optimal allocation. The coverage rates should be considered preliminary estimates and are likely high relative to those that will be provided in the final ADP. Once a stratification design for the final ADP is established, simulations will be used to estimate expected coverage rates following the final 2015 ADP (NMFS, 2014).

Results and Discussion

The PRS designs outperformed all but one OPT design in gap analyses (Figure 1). This is because PRS allocates observer deployments proportional to fishing effort and thereby ensures that observer coverage is allocated at the same rate to all fishing activities (akin to Gear:Area:Target used in gap analyses), whereas OPT strategies instead allocate proportional to the product of effort and variance in the target metric(s). For example, if many vessels fishing with the same gear have highly varying catches of retained and or discarded groundfish of the same principal species, then OPT strategies will tend to allocate many observed trips to that area whereas PRS would not. In contrast, if a few vessels fished in many different areas with similar catch characteristics, then PRS would (with sufficient sample size) ensure that at least some of those trips were observed, whereas OPT allocation would not suggest allocating observer deployments to those trips and they would be missed.

Several trends are evident from plots of catch estimates and associated precision (Figure 2). Regardless of the sampling design, the mean estimate always reflected the true value. This is because of the “law of large numbers”, which states that as sample size grows, the mean of the sample will get closer and closer to the population mean. This applies only if a random and unbiased sample is achieved, which is achieved in the perfectly executed deployments as simulated here. As designed, the OPT allocations resulted in greater precision in groundfish retained estimates than PRS allocations. The current stratification (STRATA 1315) had the least precision whereas the Gear and FMP stratification (STRATA GFMP2) had the greatest precision among stratification schemes (Figure 2). However, OPT allocation did not always result in greater precision in the total discards of groundfish. The total discard estimates from the STRATA 2010, STRATA 1315, and STRATA 16 stratification schemes were nearly identical when OPT and PRS allocations were compared (Figure 2). However, the remaining three stratification schemes did exhibit a lower *range* of SE values for discarded catch for OPT allocation than for PRS allocation. This is largely due to how a few trips with extremely high total discards were handled in each allocation. The PRS allocation of all stratification schemes in some iterations captured these high discard trips in their estimates and sometimes did not. Consequently on some iterations the resulting total discard estimate had low precision, whereas sometimes it had rather high precision. The PRS “clouds” of all stratification schemes in Figure 2 contain a distinct patch of estimates for total discards that is different from the remaining points. These are the estimates resulting from the inclusion of those high discard trips. In contrast, OPT allocation puts more observer samples in the strata with the greater variability in the total discards. The stratification schemes that separate Gear by itself (STRATA Gear) or as a function of something other than vessel length (FMP in the case of STRATA GFMP2 and Half

Year in the case of STRATA HALFYR) were able to adequately reduce the “impact” of high discard trips on the overall estimates of total discards of groundfish.

When total groundfish and discard estimate precision and accuracy are averaged across all iterations for each sampling design the improved performance of OPT allocation over PRS allocation is readily apparent (Figure 3). However, it should be noted that the best performing designs in terms of catch estimates performed here are not those that performed well in gap analyses. The STRATA GEAR stratification scheme with was the only one examined with OPT allocation that also had above average gap analysis scores. The STRATA GEAR.OPT sampling design had the greatest overall distance score among all of the sampling designs considered, and this stratification scheme with PRS allocation was among the four designs with above average distance scores (Figure 4).

It is proposed here that the four sampling designs with above average distance scores be considered as possible candidates for consideration in the 2016 ADP. Details on the relative allocations for these designs and how the expected number of budgeted trips translates into coverage rates is provided in Table 1. Again, these rates should only be considered preliminary estimates that are likely high relative to those that will be provided in the final ADP. This is because of the necessary simplification of trip duration used in simulations. Once a stratification design for the final ADP is established, more robust procedures will be used to estimate expected coverage rates following the final 2015 ADP (NMFS, 2014).

It is important to recognize that the result of the simulations performed here change as a function of the target metrics chosen, how gap analyses are performed, the choice of evaluation metrics and how they are weighted for final comparisons. Table 2 is provided as an example of how allocations differ depending on the target metrics chosen for the gear stratification scheme (STRATA GEAR).

Caveats and potential improvements

There are a number of assumptions that were made that affect the utility of the results of this effort and need to be discussed. First, the simple rounding methods used here to adjust Neyman allocations can be improved upon by using the methods proposed by Wright (2012; 2014). Second, the decision to conduct simulated samples from the population of partial coverage trips from both 2013 and 2014 combined was to incorporate between year variance in the data. Consequently, the results of these simulations should represent the “optimal of the average”. This is a desirable feature since the results can be interpreted as general predictions about how a given sampling design will perform on a new population of trip data (2016 partial coverage fishing), compared to the alternative of being an excellent design for prior trip data and a poor performer on new data. Third, simulations were performed under the simple assumption that deployment is executed perfectly (e.g. there are no “deployment effects” or “observer effects”, *sensu* Benôit and Allard; 2009). This is likely to be untrue in reality, since observer effects have been demonstrated in the observer program over multiple years (e.g. Faunce and Barbeaux, 2011; Faunce et al., 2015). However, it is beyond the scope of this analysis to incorporate potential observer effects into simulated deployments. Finally, the catch on each sampled trip was assumed to be known without variance. Obviously this was an oversimplification. The simulations and catch estimates produced in this effort are single-stage and should not be confused with the estimates and associated variance that will arise from the five stage sampling design of the observer program (Cahalan *et al*., 2014). Previous studies have demonstrated that although the vessel was a significant factor in estimating total discards, the first stage of nested sampling designs (vessel or trip) is often, but not always, the stage with the *least* amount of variance (Allen *et al*., 2002; Borges *et al*., 2004). An examination of the variance components of the hierarchical design of the observer program is warranted. The choice of target and evaluation metrics as well as their equal weighting lies with the analysis in this study. Different choices will yield different results. It is possible that future iterations of this work can be interactive and facilitate custom user inputs[4].

Summary and Conclusions

The analyses performed here, while far from perfect, represent a necessary and important first step towards providing data-based comparisons of observer deployment sampling designs for NMFS, the Council and the public. The results presented here demonstrate that: 1) Neyman allocations derived from multiple target metrics can be compared to a compromised allocation, 2) compromised allocation largely (but not always) results in greater precision in resulting single-stage estimates than are obtained from proportional allocation, and 3) proportional allocation outperformed compromised allocations in gap analyses. Consequently, this endeavor supports the 2016 ADP following the findings and recommendations contained in the 2014 Annual Report and the SSC response to those findings. All but one of the sampling plans with above average gap analyses scores and above average total distance scores included proportional allocation, which may be more robust than compromised optimal allocation to new data. It is cautioned here that what is "optimal" in the past may not be so in the future. The gear stratification scheme (STRATA GEAR), which stratifies partial coverage by three gear types was included as two of the four best performing sampling plans in this study.

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[4]Quantitative staff of the AFSC and AKRO use the R programming language. For examples of how R can be used interactively, see http://shiny.rstudio.com/.

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Figures

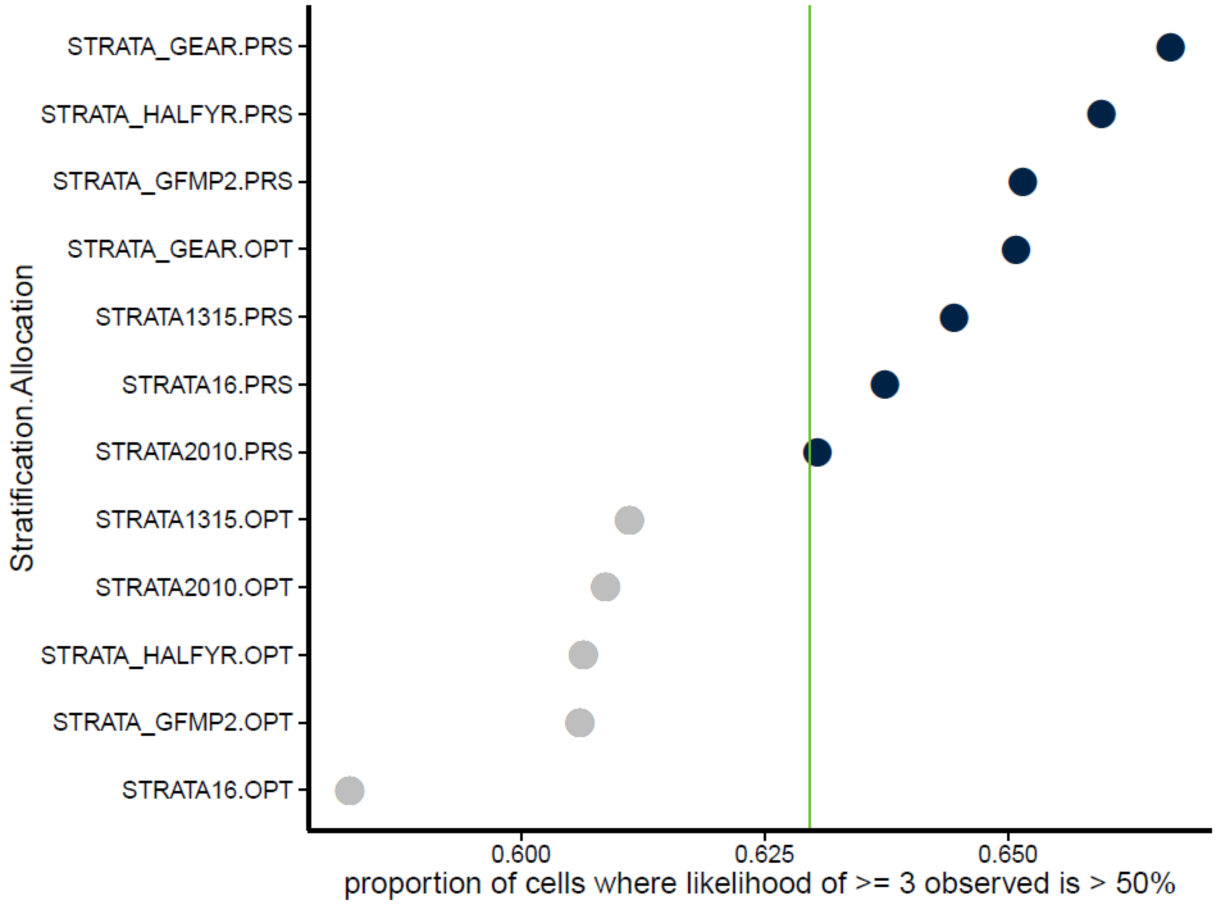

Figure 1. Comparison of gap analysis results for the twelve sampling designs under consideration for the 2016 ADP. See text for details on strata definitions and allocation strategy definitions. Green vertical line denotes mean among sampling designs.

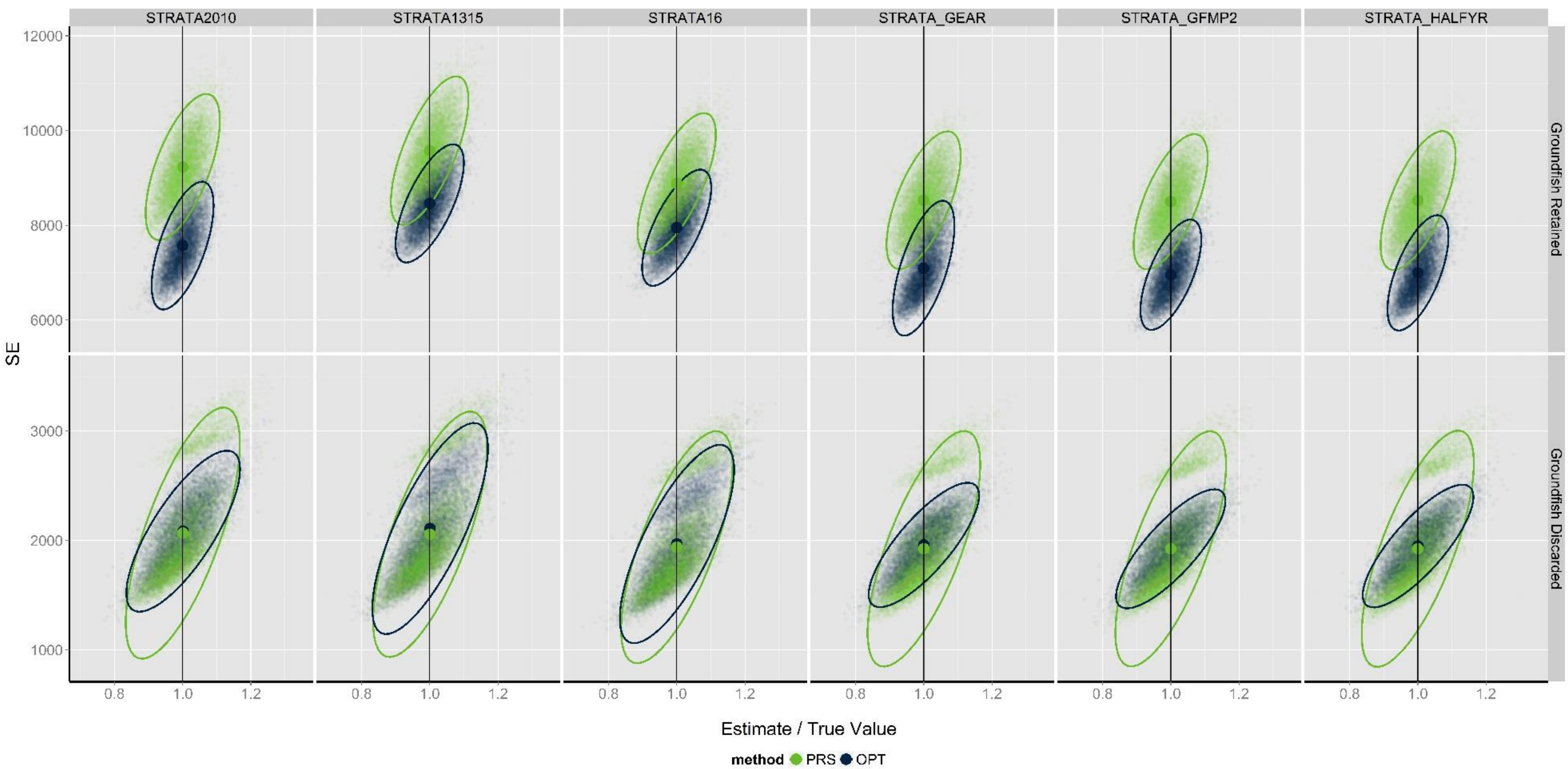

Figure 2. Comparison of the relative accuracy (horizontal-axis) and relative precision (vertical-axis) in the single-stage catch estimates for total retained groundfish (top panels) and total discarded groundfish (bottom panels) estimated from stratified random sampling according to six stratification schemes (columns) and two allocation strategies (colors; PRS = proportional, OPT = compromised optimal). The vertical line at 1.0 denotes the true value. As expected from the law of large numbers, distribution means from each design approximates the true value.

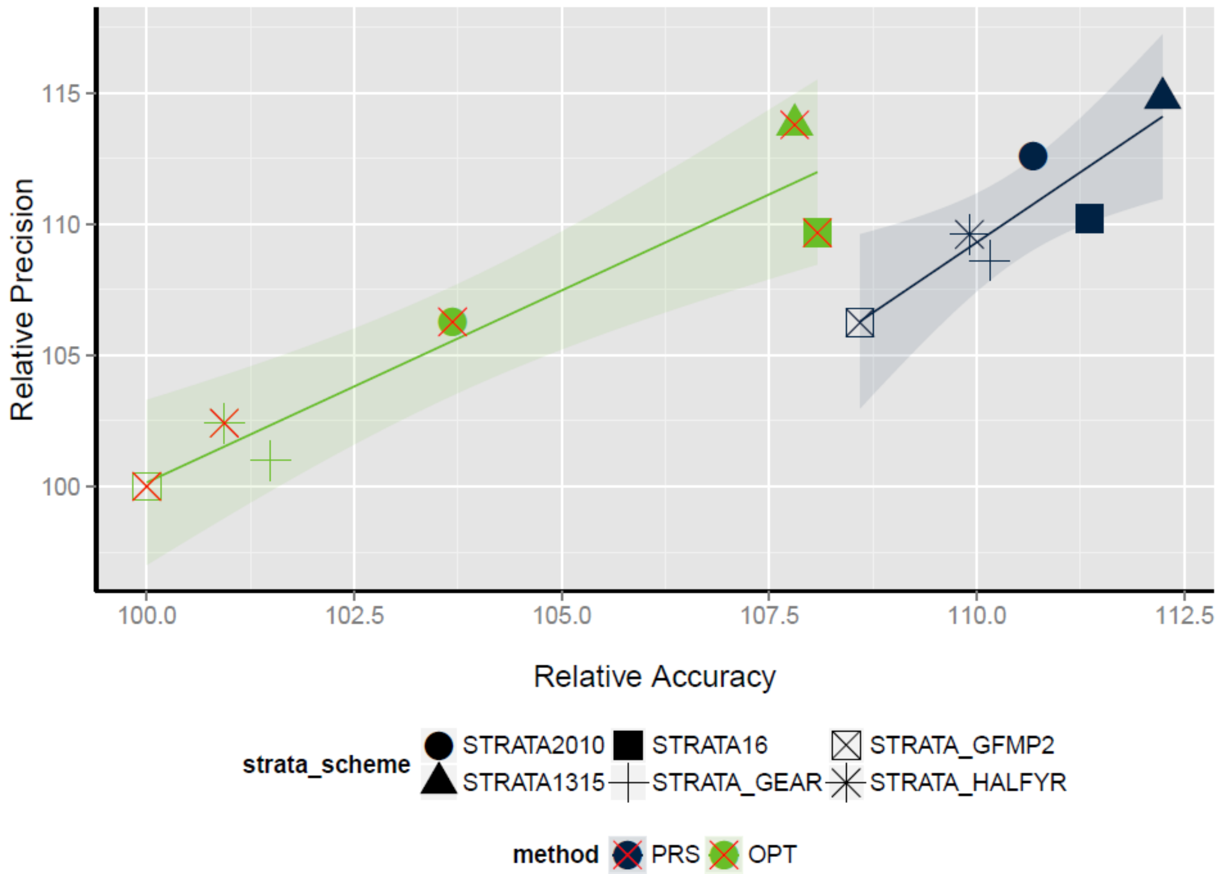

Figure 3. Relative accuracy and precision of total groundfish retained and discarded as measured by the comparison of means from each sampling design (strata_scheme = stratification scheme, PRS = proportional allocation, OPT = compromised optimal allocation). Sampling designs with below average coverage in gap analyses are denoted with a red "x".

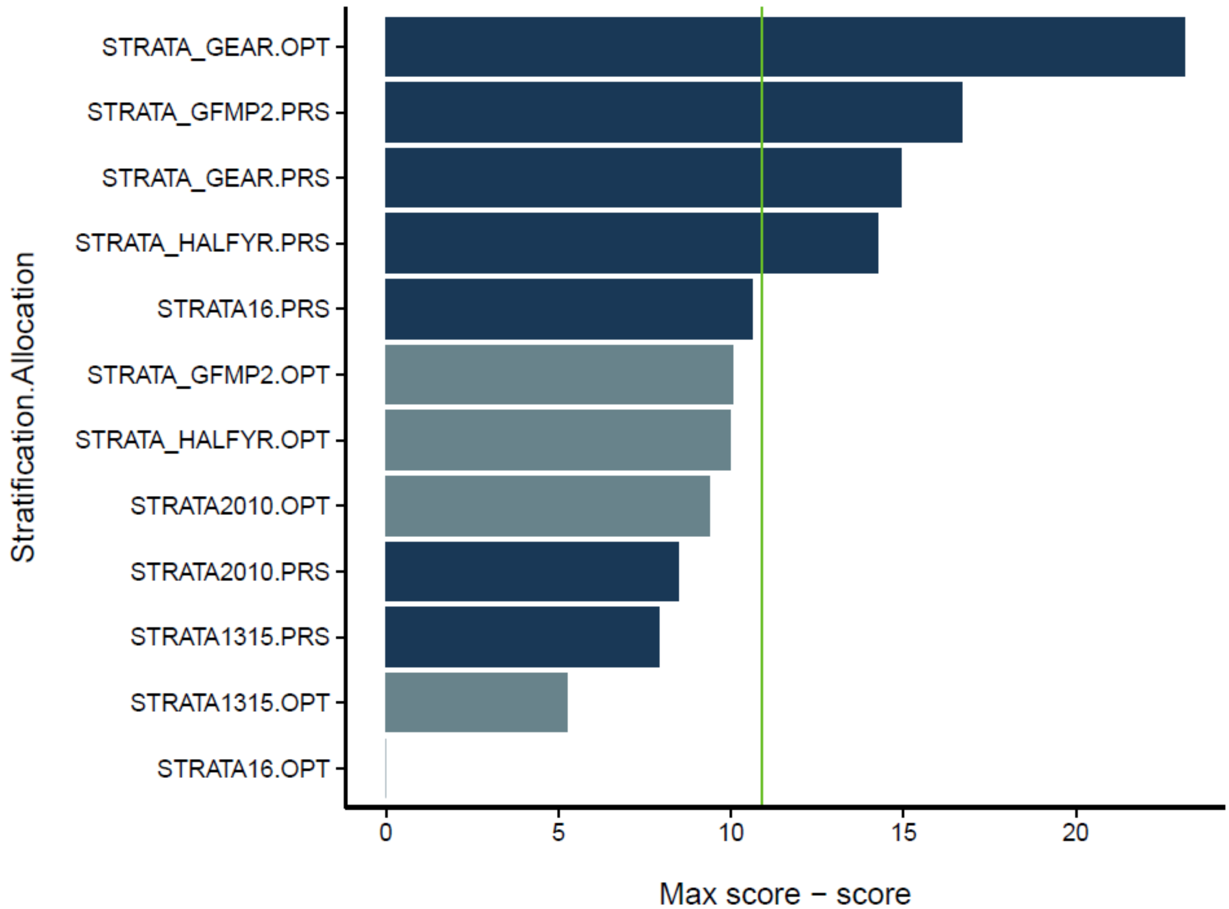

Figure 4. Relative distance scores of the twelve sampling designs examined in this study. Vertical line denotes mean across all designs. Those designs with below average scores in gap analyses are colored light grey. Only those four designs with above average gap analyses scores and above average distance scores are examined for preliminary coverage rates.

Tables

Table 1. Sampling designs with above average gap analysis results and above average distance values recommended for consideration in the 2016 ADP. Sampling designs are defined by their stratification schemes and sampling allocations (OPT = optimal, PRS = proportional). Gear stratum abbreviations are HAL = Hook and Line, POT = Pot, and TRW = Trawl. FMP stratum abbreviations are: BSAI = Bering Sea and Aleutian Islands, GOA = Gulf of Alaska. The total number of trips in each stratum, their relative proportion (Proportion N), and relative allocation under compromised optimal allocation (Relative m_h) are also provided for comparison. The number of samples afforded in each stratum (n_h) is the product of the number of samples afforded total (*n*) and either the PRS weighted allocation (W_h) for proportional allocation or the OPT weighted allocation (m_h) for compromised optimal allocation. The weighted allocation used in each rate calculation is depicted in bold. The anticipated preliminary coverage rate (Rate) is n_h divided by N_h.

Sampling Design (Strata Scheme. Allocation)	Stratum (h)	Trips (N_h)	PRS weighted allocation (W_h)	OPT weighted allocation (m_h)	n_h	Rate*
GEAR.OPT	HAL	2775	0.522	**0.339**	419	0.151
GEAR.OPT	POT	1253	0.190	**0.152**	187	0.149
GEAR.OPT	TRW	1992	0.288	**0.510**	630	0.316
GEAR.PRS	HAL	2775	**0.522**	0.339	646	0.233
GEAR.PRS	POT	1253	**0.190**	0.152	235	0.188
GEAR.PRS	TRW	1992	**0.288**	0.510	357	0.179
FMP.PRS	HAL_BSAI	323	**0.067**	0.032	83	0.257
FMP.PRS	HAL_GOA	2452	**0.454**	0.311	562	0.229
FMP.PRS	POT_BSAI	546	**0.082**	0.089	101	0.185
FMP.PRS	POT_GOA	707	**0.108**	0.052	134	0.190
FMP.PRS	TRW_BSAI	119	**0.021**	0.025	26	0.218
FMP.PRS	TRW_GOA	1873	**0.267**	0.491	331	0.177
HALFYR.PRS	HAL_First	1665	**0.302**	0.183	373	0.224
HALFYR.PRS	HAL_Second	1110	**0.220**	0.154	272	0.245
HALFYR.PRS	POT_First	650	**0.106**	0.099	131	0.202
HALFYR.PRS	POT_Second	603	**0.084**	0.049	104	0.172
HALFYR.PRS	TRW	1992	**0.288**	0.515	357	0.179

*NOTE: RATES PROVIDED HERE ARE FOR COMPARISON PURPOSES ONLY AND ARE MADE UNDER THE ASSUMPTION THAT EACH TRIP IS IDENTICAL IN LENGTH, THAT OBSERVER DEPLOYMENTS ARE PERFECTLY EXECUTED, AND FISHING EFFORT IN 2014 IS EQUIVALENT TO FISHING EFFORT IN 2016.

Table 2. Comparison of observer coverage rates* for the STRATA GEAR stratification scheme that result from proportional allocation and compromised optimal allocation (Relative m_h; OPT). Also depicted is how the OPT coverage rates differ from those that would have resulted from either the Neyman allocation based on total groundfish discarded (Discarded) or total groundfish retained (Retained). The sampling design GEAR.OPT was the only design with OPT allocation with above average gap analysis scores and above average distance scores.

Stratification Scheme	Stratum (h)	Proportional (PRS)	Relative m_h (OPT)	Neyman allocation (Discarded)	Neyman allocation (Retained)
GEAR	HAL	0.233	0.151	0.231	0.071
GEAR	POT	0.188	0.149	0.049	0.251
GEAR	TRW	0.179	0.316	0.269	0.363

*NOTE: RATES PROVIDED HERE ARE FOR COMPARISON PURPOSES ONLY AND ARE MADE UNDER THE ASSUMPTION THAT EACH TRIP IS IDENTICAL IN LENGTH, THAT OBSERVER DEPLOYMENTS ARE PERFECTLY EXECUTED, AND FISHING EFFORT IN 2014 IS EQUIVALENT TO FISHING EFFORT IN 2016.

Appendix C. Electronic Monitoring (EM) Pre-Implementation Plan Opt-In Letter

In 2014, the Council established an Electronic Monitoring (EM) Workgroup as a Council committee, to allow industry, agency, and EM service providers a forum to cooperatively and collaboratively design, test, and develop EM systems that are consistent with Council goals and objectives to integrate EM into the Observer Program[5]. Multiple research tracks are being undertaken under the EM cooperative research plan in order to collect information that will help inform future Council alternatives for EM to enable catch estimation.

For 2016, the EM workgroup has developed a Draft EM Pre-implementation Plan for small hook-and-line vessels. As part this process, the workgroup recommended that NMFS send a letter to the 40-57.5 ft fixed gear vessels, requesting owners to indicate if they are interested in participating in the 2016 EM pre-implementation program. The following "opt-in" letter was sent to all 40-57.5 ft fixed gear vessels indicating that priority would be given to vessels that had been granted temporary exemptions and conditional releases for insufficient life raft capacity or bunk space.

As of August, 2015, 56 vessels fixed gear vessels 40-57.5 ft LOA had responded to the letter. Descriptive information about these vessels is available on the Council's website at: http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/EM%20Selection%20Pool%20Opt-In%20Characteristics.pdf .

-------------------EM Pre-implementation Plan Opt-In Letter-----------------

May 18, 2015

Dear Vessel Owner,

The North Pacific Groundfish and Halibut Observer Program is seeking vessels to participate in the 2016 electronic monitoring (EM) Cooperative Research Project to collect data on board commercial fishing vessels. The goal of the research is to determine whether data collected using EM technologies can be used to estimate catch and whether this can be achieved in a cost-effective and sustainable manner. We request that you let us know of your interest to "opt-in" to the 2016 EM selection pool by July 27, 2015. Since vessels will be given a choice to opt-in for the EM pool or remain part of observer selection pool the Council may reconsider if any of the current observer exemption rules remain such as life raft capacity. Any vessel that does not opt-in by July 27 will likely not be eligible for the EM pool in 2016 and will be required to participate in the partial observer coverage pool per Federal regulations.

The National Marine Fisheries Service (NMFS) and the North Pacific Fishery Management Council (Council) have yet to determine the number of vessels that will be eligible to be in the EM selection pool. NMFS and the industry continue to seek additional funds to support the EM program and the number of vessels that will be selected to participate will depend on the amount of funding received. However, any owner that is interested in participating should let us know their preference to participate.

Priority will be given to vessels that meet the following criteria:

[5] More information about the EM Workgroup is available on the Council's website: http://www.npfmc.org/observer-program/

A. Hook and line vessels 40 to 57.5 feet in length;
B. Vessels granted a conditional release for insufficient life raft capacity or limited bunk space in 2013 or 2014;
C. Vessels granted temporary exemptions for limited life raft capacity in 2015, or that might be eligible for a life raft exemption in 2015. Eligibility is based on consistent fishing history with a crew of 4 including the vessel master, and a 4-person life raft;

NMFS will select vessels that meet these criteria and have contacted FMA to opt-in to create the EM selection pool. All vessels that are participating in the 2016 EM selection pool will not be required to carry a human observer for the entire 2016 fishing year.

A 2016 EM Pre-Implementation Plan will provide comprehensive details on the EM cooperative research program for 2016. The EM Pre-Implementation Plan is expected to be completed during the summer of 2015 and presented to the Council at the October 2015 meeting. The plan will include specific criteria for vessel participation and other operational details to ensure effective deployment of EM systems in 2016. Once the EM Pre-Implementation Plan is approved by the Council, NMFS will notify owners of vessels that are selected for the EM pool with more details about the 2016 EM cooperative research in November 2015. Vessels will be given an opportunity to opt-out of the EM cooperative research prior to the start of the fishing year, but any vessels that opt-out will be subject to human observer coverage, with the exception of those granted temporary exemptions for life raft capacity, if exemptions continue to apply in 2016.

All EM equipment will be provided through the EM cooperative research program. If selected, vessels will be expected to carry and maintain EM systems on all halibut IFQ trips and all groundfish trips in Alaskan federal fisheries in 2016. Vessels will also be required to use either an electronic or a paper logbook to record basic information such as fishing location, fishing effort (i.e. hook count) and fishing duration.

EM systems will be installed in a limited number of ports - likely Homer, Kodiak, Sand Point, and Sitka, AK. The final list of ports will be included in the 2016 EM Pre-Implementation Plan. Once a vessel's participation has ended, the EM system will be removed at one of these ports. Vessels will not be required to make all their landings in these ports while participating in this cooperative research project.

If you would like to opt-in to this EM cooperative research in Alaska, please contact Elizabeth Chilton at 206 526-4197 or via e-mail at elizabeth.chilton@noaa.gov by **July 27, 2015**. We look forward to working with you in this EM cooperative research effort.

Chris Rilling
Director
Fisheries Monitoring and Analysis Division
Alaska Fisheries Science Center
7600 Sand Point Way NE
Seattle, WA 98115

Appendix D. Full Coverage Compliance Agreement Letter for the BSAI Pacific Cod Fleet

----------------Example Letter Requesting Full Coverage in the BSAI------------------------

(Include your return mailing address)

(Date your letter)

James W. Balsiger
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99801

Dear Dr. Balsiger:

We are writing to request that the National Marine Fisheries Service assign the attached list of vessels with 100% observer coverage for 2016 any time these boats are fishing in the Bearing Sea Aleutian Islands (BSAI) in 2016. This will enable trawl catcher vessels in the BSAI Pacific cod fishery to take observer coverage in addition to that required for the partial observer coverage category.

We understand that we will be required to comply with all applicable regulations, including logging all fishing trips that are not AFA pollock prior to the start of a trip. Trips will be logged in the Observer Declare and Deploy System (ODDS).

Once the trips are logged, we understand that we will procure an observer through one of the five certified observer providers and pay for this observer coverage directly to the observer providers. In addition, we understand that the observer fee liability under §679.55 would continue to apply.

We agree to, and understand, the following:

1. individuals taken over and above existing observer coverage requirements are observers as defined at §679.2;
2. vessel owners and operators will comply with the prohibitions protecting observers that are at §679.7(g) and will meet the vessel responsibilities described at §679.51(e);
3. vessel owners and operators are subject to general requirements applicable to observers described at §600.746;
4. vessel owners or operators must log all fishing trips and follow applicable regulations when they are in the partial coverage category; and
5. landings will be subject to the observer fee under §679.55.

Sincerely,

Vessel Name: ____

Federal Fisheries Permit Number:__________________________________

ADF&G Vessel Number:____

Printed Name of the vessel owner: ________________________________

Signature of the vessel owner: ___________________________________

Vessel Name: ____

Federal Fisheries Permit Number:__________________________________

ADF&G Vessel Number:____

Printed Name of the vessel owner: ________________________________

Signature of the vessel owner: ___________________________________

Vessel Name: ____

Federal Fisheries Permit Number:__________________________________

ADF&G Vessel Number:____

Printed Name of the vessel owner: ________________________________

Signature of the vessel owner: ___________________________________

Vessel Name: ____

Federal Fisheries Permit Number:__________________________________

ADF&G Vessel Number:____

Printed Name of the vessel owner: ________________________________

Signature of the vessel owner: ___________________________________