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U.S. DEPARTMENT OF COMMERCE
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Deployment Performance Review of the 2017 North Pacific Observer Program

by
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ABSTRACT

This report contains the analyses and findings of the Alaska Fisheries Science Center's Fisheries Monitoring and Analysis Division's Observer Science Committee (OSC) on the efficiency and effectiveness of observer deployment following the 2017 Annual Deployment Plan. Responses to comments by the North Pacific Fishery Management Council's Science and Statistical Committee from the 2016 version of this report, and recommendations to improve data quality and guide the 2019 Annual Deployment Plan are also included. In 2017, there were 10 strata to evaluate: one full-coverage stratum, six partial-coverage observer strata defined by gear and tender designation, one partial-coverage Electronic Monitoring (EM) stratum in pre-implementation, one zero coverage EM research stratum, and one zero-coverage stratum. Observers were deployed under trip-selection on 164 full coverage vessels that fished for 3,422 trips and 541 partial coverage vessels that fished 5,468 trips total. Pre-implementation EM systems were successfully deployed onto 80 vessels that fished for 683 trips. Research EM systems were deployed onto three vessels that fished for 36 trips. A total of 396 vessels fished 1,986 trips with no chance of being observed or monitored (zero-selection stratum). Coverage rates in full- and zero-coverage met their expectations for the year. Coverage rates in partial-coverage met their expectations in four out of six gear- and tender-based strata, with coverage rates for strata that did not meet expectations being higher than expected. Coverage rates in pre-implementation EM were lower than expected, however, it is important to note that the NMFS directed EM providers not to review some trips, so that resources could be allocated to other tasks. There was evidence of temporal bias in observer deployments: three of six gear- and tender-based partial-coverage strata were outside of their expected coverage rates for the majority of the year, with *POT – No Tender* being outside of its expected range for 100% of the year. There was also some evidence of spatial bias among the gear- and tender-based partial-coverage strata, with clustering of trips occurring to a similar extent as in 2016, but in different NMFS areas. There was evidence of an observer affect in three gear- and tender-based partial-coverage strata.

However, the OSC recommends that the metrics used to test for observer effects be re-evaluated. The OSC also recommends that the linkages between the planned and realized trip databases be strengthened, that strata be kept the same between the 2018 and 2019 ADPs, that sampling rates in future ADPs be high enough in each stratum to maximize the probability of achieving three observed trips in each of the NMFS areas, and that future ADPs include, as one option, a sample design in which strata are selected at the same rate.

CONTENTS

INTRODUCTION

Background of the North Pacific Groundfish and Halibut Observer Program

Fisheries observers collect independent information that is used to determine the effects of fishing on natural resources. The National Marine Fisheries Service (NMFS) uses its observer program in Alaska to enable the use of tools such as catch quotas to manage against the over- or under-harvest of fishes. The data collection by observers is currently the only reliable and verifiable method for collecting fishery discard information used to estimate total catch, as well as seabird and marine mammal interactions with fisheries. In addition, observers also collect biological information such as length, sex, weight, ageing structures (e.g., otoliths, spines, scales, and vertebrae), and stomachs to support ecosystem studies and stock assessments.

The observer program in the North Pacific has a long history. Observers were first deployed onto fishing vessels in the Bering Sea in 1973 and into the remainder of the North Pacific in 1975 (Nelson et al. 1981, Wall et al. 1981). Fisheries in the North Pacific were initially prosecuted exclusively by foreign and later by "joint venture" operations where a developing domestic fleet of catcher vessels delivered to foreign-owned processing vessels. During the foreign and joint venture operations, foreign vessels carried fisheries observers at their expense, while domestic vessels were exempted from this observer coverage. As foreign vessels' rights to fish in the U.S. Exclusive Economic Zone (EEZ) were reduced over time and the domestic fishery grew, it became obvious to managers that observer coverage would be necessary for the emerging domestic fleet. At the onset of fully domestic fishery operations in 1990, the North Pacific Groundfish Observer Program was established as an interim observer program with rules governing observer coverage codified in regulations. This interim program would be extended four times over the next 20 years by the North Pacific Fishery Management Council (Council) - the last without a sunset date.

The regulations established in 1990 required vessels 60-125 feet in length (overall) and all vessels fishing pot gear to carry observers at their own cost for 30% of their fishing days in a calendar quarter plus at least one trip in each fishery they participate in (termed the “30% fleet”), and vessels greater than 125 feet in length to carry an observer for 100% of their fishing days at their expense. Some vessels were not required to carry observers. These included vessels less than 60 feet, vessels fishing jig gear or vessels fishing with trawl gear that deliver unsorted codends to processing vessels (termed “catcher processors” or CPs if the vessel also has catching ability and “mothership” or M if the vessel does not) and vessels that fished for Pacific halibut (*Hippoglossus stenolepis*). For shoreside processors, the rules governing observer coverage were based on the estimated tonnage processed in a calendar month: plants that processed less than 500 metric tons (t) a month were exempted from coverage, those that processed between 500 t and 1,000 t a month were required to be observed for 30% of the calendar days, and those that processed more than 1,000 t a month were required to be observed for each day in the month.

Soon after the establishment of the domestic observer program, concerns over the ability and incentive for fishers to manipulate observer coverage in a way that might bias catch estimates and other analytic products prompted efforts by NMFS and the Council to provide a mechanism for NMFS to gain control over where and when observers were deployed (Faunce and Barbeaux 2011). From 1992 to 2008, several attempts to “restructure” the program were made. In 2010, the Council unanimously decided to move forward with the restructured observer program. In 2012, the Final Rule 77 FR 70062 was published to implement Amendment 86 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area and Amendment 76 to the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA). Amendments 86/76 added a funding and deployment system for observer coverage to the existing North Pacific Groundfish Observer Program and amended existing observer coverage requirements for vessels and processing plants. The “restructured” North Pacific Groundfish and Halibut Observer Program (hereafter termed “Observer Program”) began in 2013 with the randomization of deployments among trips and vessels. Since 2013, the Observer Program has employed a hierarchical sampling design with randomization at all levels (trips > haul > species composition > length, age, sex, maturity and tissues for genetic analysis). In 2018, the use of electronic monitoring (EM) was added as an additional catch monitoring tool, with the understanding that some data elements collected by observers would not be collected using EM systems.

THE ANNUAL DEPLOYMENT PLAN AND REVIEW

Analysis and evaluation of the data collected by observers is an ongoing process. The NMFS considers Council input in making decisions as to the amount of coverage (i.e., selection probabilities that are assigned to each partial-coverage category). These decisions are based on available funding, the cost of observer coverage, and anticipated effort. The restructure of the Observer Program established new annual reporting processes. Each June, the NMFS provides the Council with a comprehensive evaluation of past years' observer deployments, costs, sampling levels, and implementation issues as well as recommended changes for the coming year. The June deployment performance review aims to identify areas where improvements are needed to 1) collect the data necessary to manage the groundfish and halibut fisheries; 2) maintain the scientific goals of unbiased data collection; and 3) accomplish the most effective and efficient use of the funds collected through the observer fee. The annual deployment performance review is an opportunity to inform the Council and the public of how well various aspects of the program are working, and consequently lead to recommendations for improvement as appropriate. The NMFS also prepares the Observer Program Annual Deployment Plan (ADP) each fall. The ADP defines deployment strata and establishes selection rates given available budgets and anticipated fishing effort. A draft ADP is released by 1 September of each year to allow review by the Council's Groundfish Plan Teams, as well as the Council and its Scientific and Statistical Committee (SSC). Based on input from its advisory bodies and the public, the Council may choose to clarify objectives and provide recommendations to NMFS for the ADP. Upon analysis of the Council recommendations, NMFS will make any necessary adjustments to finalize the ADP and release it to the public. The ADP is released to the public prior to the December Council meeting.

Observer Science Committee

Each year the Alaska Fisheries Science Center's (AFSC) Fisheries Monitoring and Analysis (FMA) Division establishes an *ad hoc* Observer Science Committee (OSC) for the North Pacific Observer Program. The OSC provides scientific advice in the areas of regulatory management, natural science, mathematics, and statistics as they relate to observer deployment and sampling in the groundfish and halibut fisheries of the Bering Sea and Aleutian Islands (BSAI) and the Gulf of Alaska (GOA). OSC members have analytical and scientific expertise relating to observer sampling of groundfish and halibut fisheries of the BSAI and GOA and the use of the resulting data. If possible, the OSC is represented by at least one member of the AFSC/FMA (Observer Program) Division, one member of the AFSC/Stock Assessment and Multispecies Assessments Program, one member of the Alaska Regional Office, Sustainable Fisheries Division (SF), and one member of the International Pacific Halibut Commission (IPHC).

The Sampling Design of the Observer Program

Since 2013, the Observer Program has used a stratified hierarchical sampling design with randomization at all levels. Stratification is used to increase the efficiency of sampling by observers and to address logistical issues associated with deployment. By grouping similar fishing activities into strata and sampling appropriately to those groupings, logistics of sampling is increased and variance of resulting estimates may be decreased. Sampling strata are defined in the ADP and are designed such that a unit of deployment (trip) is generally unique to a stratum.

Within a stratum, observers are deployed randomly to either vessels for a predetermined period of time (termed vessel-selection), or to individual fishing trips (termed trip-selection). In both cases, this initial deployment to the fishery is the first level of the sampling hierarchy and defines the primary sampling unit (PSU; either vessel-periods or individual trips). The list of all PSUs in a stratum defines the sampling frame and should equate to the population of interest for that sampling stratum (e.g., all trips taken by trawl vessels fishing in the Alaska EEZ). In cases where the sampling frame (list of PSUs) for a stratum does not include all the elements of the stratum (i.e., where some fishing occurs in the stratum but is not captured by the sample frame), the resulting information from sampling may not represent the population of trips. The magnitude and direction of the bias will depend on how different the fishing activities in the sample frame are from actual fishing activity.

For each observed trip, if all hauls cannot be sampled for logistical reasons, hauls are randomly selected to be sampled. This is the next level in the hierarchy; the secondary sampling units are defined as hauls within a trip. Randomization of haul selection is designed to allow observers to record and transmit data, attend to other non-sampling responsibilities, and to allow observers time to sleep and eat. Haul selection is determined using the random sampling tables and random break tables provided by NMFS. For each haul, fishing location and effort (e.g., number of hooks) are recorded, while marine mammal and seabird interactions are primarily recorded on randomly selected hauls.

For the randomly selected hauls for each trip, a random sample of the catch is collected and data from those samples are used to determine the species composition and amount of discarded catch. These samples of catch within each haul are the tertiary sampling units, the third level of the sampling hierarchy. While observers are trained to collect multiple large samples of catch, the number and size of samples taken from each haul will depend on the vessel configuration, fishing operations, and diversity of catch.

At the fourth level of the sampling hierarchy, a predetermined number of individual fish of predetermined species is randomly selected from the species composition sample and measured. Lastly, at the fifth sampling level, a random selection of fish is used to collect otoliths, reproductive maturity assessments, stomach contents, genetic tissues, and other biological specimens. The number and species of fish selected for measurement and biological specimen collection is specified each year by the AFSC's stock assessment scientists. Sampling rates for genetic tissue collection by observers (e.g., 1 of 10 Chinook salmon caught as bycatch) are set each year by the AFSC's Auke Bay Laboratories.

In summary, the overall sample design used by the Observer Program is a stratified design where within each stratum, NMFS randomly selects primary units (vessels or trips) to be monitored. Within each selected trip, hauls are randomly selected to be further sampled, and marine mammal and seabird interaction data are collected. From each selected haul, a random sample of the catch is collected to obtain species composition and disposition data. From within each species composition sample, individual fish are randomly selected and measured. Finally, from these measured fish, additional fish are randomly selected for the collection of biological specimens. More information on the sampling design used by observers and the relationship between the sample design and catch estimation can be found in Cahalan et al. (2014) and the 2017 Observer Sampling Manual (AFSC 2016). The focus of this report is deployment related and the resulting evaluation is at the trip level of the sampling hierarchy.

THE 2017 ANNUAL DEPLOYMENT PLAN

The following briefly summarizes the final 2017 ADP (NMFS 2016b). In general, all vessels that participate in cooperatives or act as catcher-processors or motherships are fully observed at the trip-level and constitute the full-coverage category of the fleet. In 2016, NMFS published new regulations to allow the owner of a trawl catcher vessel to annually request that NMFS place requesting vessels in the full coverage category for all directed fishing for groundfish using trawl gear in the Bering Sea and Aleutian Islands management area (BSAI) in the following calendar year. This regulated process has replaced an interim policy. For the 2017 calendar year, NMFS received and approved requests and has placed 31 catcher vessels in the full coverage category for all directed fishing for groundfish using trawl gear in the BSAI management area. The NMFS used only the trip-selection method (i.e., no vessel-selection) to assign observers to vessels in the partial-coverage category for 2017. The partial-coverage category includes vessels greater than or equal to 40 feet (ft) length overall (LOA) and not in the full coverage category. There are six sampling strata in the partial coverage category:

1. Hook-and-line vessels not delivering to tenders (*HAL - No Tender* stratum).
2. Hook-and-line vessels delivering to tenders (*HAL - Tender* stratum).

3. Pot vessels not delivering to tenders (*POT - No Tender* stratum).
4. Pot vessels delivering to tenders (*POT - Tender* stratum).
5. Trawl vessels not delivering to tenders (*TRW - No Tender* stratum).
6. Trawl vessels delivering to tenders (*TRW - Tender* stratum).

Pre-implementation testing of EM deployment and data collection was conducted in 2017, hence EM was offered to partial coverage vessels fishing longline or pot gear as a monitoring option. Vessels had to volunteer to participate in the EM Program by 1 November. The NMFS then selected vessels to be included in the EM Program following an evaluation of available funding (NMFS 2016b). NMFS also sought vessels to participate in EM research and development activities. Vessels that volunteered for the EM Program or EM research activities and were selected by the NMFS were not required to carry observers but were required to continue to log their fishing trips into the Observer Declare and Deploy System (ODDS). Since this placed them within the zero-selection pool of the 2017 ADP, the non-research EM trips are not evaluated in this report to the same degree as trips in the observer sampling strata, but are instead evaluated to answer more basic questions about the success of pre-implementation deployments of EM systems. EM pre-implementation has been ongoing since 2015. EM was implemented in the 2018 ADP and will therefore be evaluated as an implemented program in future annual reports.

PERFORMANCE REVIEW OBJECTIVES

The following sections contain the OSC review of the deployment of observers in 2017 relative to the intended sampling plan and goals of the 2017 ADP (NMFS 2016b). This report identifies where potential mechanisms for biases exist and provides recommendations for further evaluation, including potential improvements to the observer deployment process that should be considered during the development of the 2019 ADP.

The goal of the Observer Program is to monitor commercial fishing activities in the Alaska EEZ. It accomplishes this goal through the random deployment of observers and EM systems into fisheries to collect representative data used to estimate catch and bycatch, assess stock status, collect fishery-dependent biological information used in population and ecosystem modeling efforts. Therefore, this evaluation focuses on the randomization of observer deployments and how departures from a random sample affect data quality. Although this report includes evaluations of EM deployment, current evaluation of this tool is limited in scope due to its pre-implementation status.

The following items from the 2017 ADP have been identified as objectives for evaluation in this report:

1. Deploy for the planned number of sea-days. This objective will be considered to be met if the actual number of sea-days expended falls within the range of values from simulated sampling provided in the 2017 ADP. The Observer Program's budget was expected to cover 3,121 days in 2017.
2. Deploy at the coverage rates specified in the 2017 ADP. Following the 2017 ADP, the ODDS was programmed to randomly select logged trips at a rate of 17.57% in the *TRW - No Tender* stratum, 11.09% in the *HAL - No Tender* stratum, 3.88% in the *POT - No Tender* stratum, 14.29% in the *TRW - Tender* stratum, 25% in the *HAL - Tender* stratum, 3.92% in the *POT - Tender* stratum, and 30% in the EM stratum. Partial coverage rates are expected to fall between upper and lower bounds of the expected value from the 0.025 and 0.975 quantiles of a binomial distribution (i.e., a 95% confidence interval), under a randomized deployment scheme.
3. Collect tissue samples from Chinook and chum salmon as specified in the 2017 Observer Sampling Manual to support the goal of collecting genetic samples from salmon caught as bycatch in groundfish fisheries to identify stock of origin. The sampling protocol established in the 2014 ADP (NMFS 2013) was used in 2017. Under this protocol, observers on vessels delivering to shoreside processors in the GOA trawl pollock fishery monitor the offload to enumerate salmon bycatch and obtain tissues for genetic analysis from the salmon bycatch. For

trips that are delivered to tender vessels and trips outside of the pollock fishery, observers obtain salmon counts and tissue samples from all salmon found within at-sea samples of the total catch.

4. Minimize the number of conditional releases from observer coverage issued. The NMFS aimed to not grant conditional releases or temporary exemptions to vessels subject to observer coverage. It was expected that no conditional releases would be granted in 2017.
5. Randomize deployment of observers into the partial coverage category of fishing activities. This randomization is used to collect observer and EM samples that are representative of the entire fishing fleet (observed and monitored trips are equivalent to unobserved and unmonitored trips within a stratum). Evaluation of this objective is focused on the randomization of observer and EM deployments into primary sampling units, and how departures from a random sample affect data quality.

Observer Deployment Performance Metrics

Performance metrics have been developed to assess whether the trip-selection process (through the implementation of the 2017 ADP) provides a representative sample of fishing trips in the North Pacific in 2017. These metrics reflect four mechanisms that can impact the quality of the data: sample frame discrepancies, non-response, differences in trip characteristics, and sample size.

The performance metrics used in this evaluation are as follows:

1. Deployment rates for each stratum: This is the basic level of evaluation for comparing targeted and achieved sampling rates, where sampling strata are partitions of the entire population about which we want to make inferences (e.g., generate estimates of catch). Implementation challenges can be identified in this step, such as: sample frame inadequacy, selection biases, and issues with sample unit definitions. Specifically, this section assesses the following:
    a. Sample rates and number of samples relative to intended values.

b. Quantification of under- and over-coverage rates (sample frame discrepancies). Over-coverage of a population occurs when the sample frame includes elements that are not part of the target population. When these elements are included in the random sample, effort (time, cost) is expended needlessly. Under-coverage results from having a sample frame that does not include a portion of the target population which can lead to biased data if that portion of the population differs from the population included in the sample frame.

c. Non-response rates. Non-response occurs when randomly selected elements (trips or vessels) are not actually sampled. If these trips or vessels have different fishing behavior (e.g., catch, areas fished) than the rest of the population, the data collected will not represent the entire fleet (non-response bias).

2. Representativeness of the sample: Randomized sampling is a method used to ensure that the results of sampling reflect the underlying population. Departures from randomization can lead to non-representative data and hence potential bias in estimates of the parameters of interest. A randomized sample design is expected to achieve a rate of observed events that is similar across both space and time. Representativeness of the sample was divided into three separate components:

    a. Temporal representativeness

        i. Effort plots: plots of expected and actual observed effort over time. Areas where these two lines deviate from each other are indicative of periods with differential realized sample rates (and potential temporal bias).

    b. Spatial representativeness

        i. Maps: Maps provide a visual depiction of the spatial distribution of observer coverage relative to effort in each partial coverage stratum, as well as where low or high coverage rates occurred.

ii. Probability of selecting a sample and observing a fewer or greater number of trips within an area than would be expected given the implemented sample rates. These data are used to identify departures from anticipated sampling rates.

c. Representativeness of trip characteristics

i. Consistency of trip characteristics for observed and unobserved portions of the stratum. These metrics are based, in part, on the availability of data for both observed and unobserved fishing activities, for example, data that are reported for all trips on landing reports. Attributes tested in this report include the following:

- Trip duration (days).
- Vessel length (feet).
- The number of NMFS Areas visited during the trip.
- The amount of landed catch (metric tons).
- The number of species in the landed catch (also known as species richness).
- The proportion of the total landed catch that was due to the most prevalent species (pMax, an inverse a measure of species diversity where an increase in pMax indicates a decline in diversity).

3. Adequacy of sample size: A well-designed sampling program will have a sample large enough to reasonably ensure that the characteristics of interest in the entire target population are represented in the data. Whether the sample size collected was adequate was determined through an examination of the probability of deploying observers at the implemented rate and having no observer coverage in one or more cells (e.g., defined by NMFS Reporting Area and strata).

Although these metrics can identify places where observed results differ from expectations, it is ultimately a subjective decision as to whether or not these differences are substantial enough to have management implications. This holds true even for tests that have associated p-values. Additionally, our focus on landed catch is due to the fact that total catch is comprised of retained and discarded portions, and since discarded catch is not available from unobserved trips, landed catch represents the only portion of the catch that is available from all trips.

CHANGES TO THIS REPORT FROM LAST YEAR

Strata Definitions and Deployment Methods

In 2016, observers were deployed through trip-selection into three gear-based strata with separate selection rates: trawl gear (*TRW*; 28.31%), hook-and-line gear (*HAL*; 15.41%), and pot gear (*POT*; 15.24%; NMFS 2015a). In 2017, these gear-based strata were divided on the basis of whether the vessel was delivering to a tender, resulting in the six partial coverage strata mentioned previously in this report. The decision to stratify by tendering status was made in an attempt to address differences in operation characteristics (e.g., trip length) and logistics, after the results of permutation tests suggested that tender trips differ from non-tender trips (NMFS 2017a, Faunce et al. 2017).

Vessel-selection was not used as a selection method for either observers or EM systems in 2017. In 2016, vessel-selection was used only to select vessels for EM coverage, and the year was divided into four separate selection time periods (NPFMC 2016a). In 2017, trip-selection was used to select EM trips, and the year was not divided into separate time periods (NPFMC 2017).

The year 2017 was the third year of the NMFS Pre-Implementation of Electronic Monitoring (EM) Cooperative Research (NPFMC 2017). In 2016, EM pre-implementation was limited to hook-and-line vessels, and 58 vessels opted into the program. The Final 2017 Electronic Monitoring Pre-Implementation Plan developed by the EM Working Group (EMWG) (hereafter EMWG Plan) allowed for up to 90 hook-and-line vessels and 30 pot vessels to participate in EM pre-implementation in 2017

(NPFMC 2017). The 2017 Annual Deployment Plan included 96 vessels that opted into EM: 73 fishing predominantly with hook-and-line gear, and 18 fishing predominantly with pot gear (NMFS 2016b).

Methodological Changes

The results in this report are presented in largely the same way as in previous years. One difference is that coverage maps for the *HAL - No Tender*, *POT - No Tender*, and *TRW - No Tender* strata of 2017 are presented next to coverage maps for the *HAL*, *POT*, and *TRW* strata of 2016 to allow a comparison of coverage patterns between years. In contrast to previous years' reports, coverage maps that show the proportion of trips covered in each NMFS area have been excluded in favor of coverage maps that use the hypergeometric distribution to show whether the coverage rate observed in each NMFS area was within expected levels. This was done for clarity since presenting coverage in this way incorporates both the observed and expected coverage rates.

Evaluation of Deployment in 2017

The deployment of observers into the 2017 Federal fisheries in Alaska is evaluated at the level of the deployment stratum because each stratum is defined by a different sampling rate or by a different monitoring method (e.g., observers and EM). In this document, trips in the EM stratum are considered successfully monitored if at least some video was reviewed from a trip. The rationale for defining monitored trips this way is that it is most similar to the way in which trips in other strata are considered observed (i.e., irrespective of whether or not haul information or usable species composition data were collected).

Evaluating Effort Predictions

Each year the NMFS sets an annual budget in terms of observer days. Therefore how close anticipated observed effort is to actual invoiced effort in each ADP is a function of how well the NMFS predicts effort and how well the NMFS achieves its sampling rate. The observer day budget for 2017 was set at 3,121 days in the 2017 ADP (NMFS 2016b). Based on simulations using 2016 fishing data conducted a year in advance of deployment for the 2017 ADP, the FMA predicted it would observe 3,127 fishing days at the end of 2017. In 2017, the FMA paid for 2,591 observer days, which was 17% lower than predicted (Fig. 1). This can partially be explained by the fact that the stratum-specific effort predicted in the 2017 ADP (NMFS 2016b) was higher than actual effort by 40.1% in the *TRW - No Tender* stratum and 24.4% in the *TRW - Tender* stratum, and lower than actual effort by 34.7% in the *POT - No Tender* stratum and 7.6% in the *POT - Tender* stratum (Table 1). The *TRW - No Tender* and *TRW - Tender* strata had the highest programmed selection rates at 17.57% and 14.29%, respectively, compared to 3.88% and 3.92% in the *POT - No Tender* and *POT - Tender* strata, respectively. Therefore, there was less effort than expected in strata with relatively high selection rates and more effort than expected in strata with relatively low selection rates.

PERFORMANCE OF THE OBSERVER DECLARE AND DEPLOY SYSTEM IN TRIP-SELECTION

The random selection of trips is made by the ODDS. The ODDS generates a random number according to the pre-determined rates and assigns each logged trip to either “selected to be observed” (selected) or “not selected to be observed” (not selected) categories. The NMFS observer provider has access to all selected trip information necessary to schedule observer logistics. Up to three trips may be logged in advance of fishing to provide industry users with flexibility to accommodate their fishing operations.

Logged trips have different dispositions. When initially logged, they are considered pending and can be either closed or cancelled. Whether these changes can be made by the user (person logging the trip) or must be made by the observer provider (or the NMFS) depends on whether or not the trip is selected to be observed, the stratum the trip belongs to, and the timing of the activity. Trips can be closed (marked as complete) by the ODDS user after the planned trip departure date by either entering the dates of the trip and the port processor of the landing, or by selecting from a list of pre-populated landing reports. For partial coverage strata subject to observation, the observer provider is given 72 hours for an observer to board the vessel prior to the trip start. While a trip may be entered into ODDS that is scheduled to start earlier than 72 hours from the time of entry, if selected for observer coverage, the observer provider can opt to delay the start of the trip up to, but not exceeding 72 hours from the time of trip entry. This helps protect the observer provider from the high cost of deploying an observer with short notice. The vessel operator is protected as well by guaranteeing the assigned observer to the vessel up to 48 hours past the planned start of the fishing trip. This rule helps ensure that an observer is available to the boat in case of unforeseen events such as weather. If, however, the trip start date and time has passed by more than 48 hours, then the observer provider can cancel the trip and release the observer from the vessel and trip, and the vessel would need to log a new trip with a new 72-hour notice in place prior to fishing. These ‘forced cancellations’ are not present in trips that are not selected for observation since the logging, closing, or cancellation of the trip is entirely under vessel control. The vessel operator may change the dates of a logged trip regardless of selection status prior to, or in lieu of cancellation. However, trips that have not been closed at the end of the calendar year are automatically cancelled by the ODDS to prevent 2017 ODDS trips from affecting the deployment rates set for the 2018 ADP.

The number of trips logged in the ODDS in 2017 and their dispositions is summarized in Tables 2-4. The forced cancellation rate by users and by the ODDS is summarized for selected trips in each stratum (Table 2). Of the 5,879 total trips logged, 767 were selected, and 136 were cancelled: 0 by ODDS (0%) and 136 by users (2.3%). The user cancellation rate for selected trips ranged from 0.0% for *POT - Tender* to 40.0% for *HAL - Tender* and *TRW - Tender*.

The flexibility offered by the ODDS means that the outcome of random selection is known to the vessel operator for up to three logged trips in advance of fishing. In the case where ODDS users disproportionately cancel selected trips, one would expect observed coverage to be lower than the programmed selection rates. To reduce this potential bias, ODDS is programmed to automatically select the vessel's next logged trip if a previously selected trip was cancelled by the user. Although these "inherited" trips preserve the *number* of selected trips in the year, they cannot prevent the *delay* of selected trips during the year. Therefore, the potential for temporal bias is still present. The percentages of selected trips from either inherits or waivers are found in Table 3. The relative percentage of selected trips that inherited their final selected-status due to a previous cancelation ranged from 0.0% for *HAL - Tender* to 66.7% for *POT - Tender* (Table 3). It should be noted that no trips (inherited or otherwise) were selected in the *HAL- Tender* stratum. The stratum with the next-lowest rate of inherited selections was the *TRW - No Tender* stratum at 12.3%. The number of waived trips (i.e., trips given a "pass" on their required observer coverage by the NMFS) was low, with the highest level occurring in the *HAL - No Tender* stratum at 1.8% (Table 3).

The extent to which trip-selections are changed from the time they are entered can be determined by comparing the rate of trip observation expected from 1) random selection of all logged trips (initial random selection) and 2) random selection of remaining trips after cancellations, waivers, and inherited trips (Table 4). In any case, the proportion of trips selected to be observed should fall within what would be expected given the binomial distribution (since each trip is either selected or not selected). The rates obtained (%, with associated p-value based on the binomial distribution) in the initial selection process were 11.18% (p-value = 0.897) for the *HAL - No Tender* stratum, 31.25% (p-value = 0.567) for the *HAL - Tender* stratum, , 4.63% (p-value = 0.233) for the *POT - No Tender* stratum, 2.27% (p-value = 0.497) for the *POT - Tender* stratum, 18.73% (p-value = 0.154) for the *TRW - No Tender* stratum, and 18.87% (p-value = 0.112) for the *TRW - Tender* stratum (Table 4). This means that there is no evidence that the ODDS was not selecting trips according to the programmed rate. The final selection rate after trips were closed, cancelled, or waived was 14.07% (p-value < 0.001) for the *HAL - No Tender* stratum, 25.00% (p-value = 1.000) for the *HAL - Tender* stratum, 7.00% (p-value < 0.001) for the *POT - No Tender* stratum, 9.09% (p-value = 0.016) for the *POT - Tender* stratum, 20.95% (p-value < 0.001) for the *TRW - No Tender* stratum, and 22.81% (p-value = 0.015) for the *TRW - Tender* stratum (Table 4).

Differences between the initial and final selection rates were present among all but one partial coverage stratum in 2017. The only exception was the *HAL - Tender* stratum, in which four trips were logged and none were selected. For strata in which there were differences, a separation between initial and final selection rates tended to appear early and then persist throughout the remainder of the year (Fig. 2).

The fact that the final selection rates for most strata were greater than the initial selection rates results from the fact that cancelled trips that were originally selected for coverage are preserved through the inherit process, while cancelled trips that were not originally selected for coverage are not. These patterns are consistent with the hypothesis that trips selected for coverage are being delayed, and cancellation of selected trips results in a greater number of selected trips later in the year as the result of the inherit process. Various degrees of separation between the initial and final selection rates have been observed since the implementation of the restructured Observer Program (NMFS 2014, NMFS 2015b, NMFS 2016a, NMFS 2017).

In addition to the inherit process, the lack of linkage between the ODDS and *e*Landings contributes to the differences between programmed selection rates in ODDS and trips that are ultimately observed. Currently, ODDS provides users with a list of Report IDs from *e*Landings from which to close their logged trips, and *e*Landings has been updated to prompt the entry of ODDS trip numbers. However, these data are not validated or error checked, making them unreliable in their current state. This linkage between the logged (ODDS) trip (with its selection probability) and its associated landing information is necessary to evaluate potential improvements in deployment efficiency within the partial coverage fleet.

Evaluation of Deployment Rates

This section compares the coverage rate achieved against the expected coverage rates. Data used in this evaluation are stored in a special database generated specifically for this purpose that utilizes information within the Catch Accounting System (CAS, managed by the AKRO), the Observer Program database NORPAC (managed by the AFSC), and *e*Landings (under joint management by Alaska

Department of Fish and Game – ADF&G; the International Pacific Halibut Commission – IPHC; and the NMFS). Separate rate evaluations are conducted depending on whether the unit of observer deployment was at-sea fishing trips or dockside deliveries of pollock.

At-sea Deployments

The 2017 Observer Program had 10 different deployment strata to be evaluated. There was one full coverage stratum; it included trips taken both by vessels that were required to have full coverage (e.g., AFA vessels) and those fishing in the BSAI that opted into full coverage. There were nine partial coverage strata: six strata defined by gear and tender designation, one EM stratum, one zero coverage stratum, and one zero coverage EM research stratum.

Evaluations for the full coverage category and zero-selection pool are straightforward - either the coverage achieved was equal to 100% or 0%, respectively, or it was not. The program met expected rates of coverage in all full and zero coverage strata (Table 5). Partial coverage rates were expected to fall between upper and lower bounds of the expected value from the 0.025 and 0.975 quantiles of a binomial distribution (i.e., a 95% confidence interval). If coverage levels were within the 95% confidence intervals, then there was no evidence that coverage levels differed from the expected rates. Coverage rates were consistent with expected values in four of the six partial coverage strata, but were higher than expected within the *POT - No Tender* and *TRW - No Tender* strata (Table 5). The coverage rate for EM is based on information provided from the Pacific States Marine Fisheries Commission (PSMFC) that is available to analysts in the AFSC database. In 2017, the PSMFC did not review 49 trips for boats that were equipped with EM systems from the provider Saltwater, so the information available for analysis does not reflect the entire EM fleet. This exclusion was done at the direction of NMFS, so that resources could be allocated to higher priority projects. The coverage rate for vessels with EM systems from the provider Archipelago Marine Research was 20.8%, based on trips with video reviewed as of 30 March, 2018 (Table 5). This was lower than the programmed rate of 30%. The coverage achieved by EM is presented by gear type in Table 6.

Evaluation of the coverage achieved by the program as a whole is complicated somewhat by whether monitored EM trips are combined with observed trips. In 2017, EM data were not used in catch accounting. Therefore, the most accurate depiction of data collection from the Observer Program is to consider EM trips equivalent to zero-coverage. Under this evaluation, 4,220 trips (36.4%) and 407 vessels (36.4%) were observed among all fishing in Federal fisheries of Alaska (Table 5). If EM trips are included, 4,362 trips (37.6%) and 458 vessels (40.3%) were covered (Table 5).

Coverage Rates for Dockside Monitoring

Observers were assigned to monitor deliveries of walleye pollock (*Gadus chalcogrammus*). The objective of this monitoring was to obtain a count of the number of salmon caught as bycatch and to obtain tissue samples for genetic analysis from these fish in each observed pollock delivery. There have been many iterations of the sampling design used to obtain genetic samples from salmon bycatch for the purposes of stock of origin (Faunce 2015). The sampling design used for this objective in 2017 remained unchanged from that used since 2011; all deliveries of walleye pollock that are observed at sea were also observed dockside. While all Bering Sea pollock trips and deliveries are observed, this is not the case in the GOA (NMFS 2015c). For this analysis, pollock deliveries are defined as any delivery where the predominant species is pollock in *e*Landings.

Given the design, the level of dockside observation of walleye pollock deliveries should be 100% in the full coverage category, but evaluations of the partial coverage category are more elusive. As a matter of policy, no tender deliveries are observed. While it may seem intuitive that the expected coverage rate for deliveries within the *TRW - No Tender* stratum should be equal to the programmed trip selection rate of 17.57%, this assumption is likely untrue because observers are not deployed into the pollock fishery but into the entire trawl fishery, and the relationship between the number of deliveries and trips is not expected to be constant, especially when measured across ports. Therefore, we present the dockside observation rates for the *TRW - No Tender* stratum (Table 7), but do not include any formal statistical tests.

Bycatch estimates of Chinook salmon in the GOA are estimated using methods described in Cahalan et al. (2015). In the event that a delivery cannot be monitored (e.g., the case in a tendered delivery or non-pollock delivery), then estimation of bycatch comes by applying salmon bycatch rates to landed catch. Estimates of stock of origin from salmon bycatch are produced by the AFSC's Auke Bay Laboratories (e.g., Guthrie et al. 2017).

SAMPLE QUALITY

Temporal Patterns in Trip-Selection

The cumulative number of fishing trips in each stratum was multiplied by the stratum-specific selection rate to obtain the expected number of observed trips. Under the assumption that there is no temporal bias in observer coverage, 2.5% of values should be larger than the upper 95% confidence limit and 2.5% should be smaller than the lower limit. In 2017, the number of observed trips achieved was never outside of the expected number for any tender stratum (Fig. 3). The number of observed trips achieved was outside of the 95% confidence intervals for 60.3% of the year for the *HAL - No Tender* stratum, 94.0% of the year for the *TRW - No Tender* stratum, and 100.0% of the year for the *POT - No Tender* stratum (Fig. 3). In all cases, there was evidence that the observation rate was greater than expected. These values are not directly comparable to previous years, as expectation in previous years was only calculated on days for which there were trips, rather than all days of the year. However, it is clear that observation rates were outside of the 95% confidence intervals for more days in 2017 than 2016 (Faunce et al. 2017, NMFS 2017a). Results from the exact binomial test suggest no evidence that observation rates at the end of the year differed from expected rates for the *HAL - Tender* (expected rate = 0.250, realized rate = 0.000, p-value = 0.578), *POT - Tender* (expected rate = 0.039, realized rate = 0.053, p-value = 0.541), and *TRW - Tender* (expected rate = 0.143, realized rate = 0.188, p-value = 0.300) strata. Despite being outside of the 95% confidence intervals for portions of the year, there was also no evidence that observation rates at the end of the year differed from expected rates for the *HAL - No Tender* stratum (expected rate = 0.111, realized rate = 0.120, p-value = 0.163). There was evidence that observation rates at the end of the year did not meet expectations for the *TRW - No Tender* (expected rate = 0.176, realized rate = 0.207, p-value < 0.001) or *POT - No Tender* (expected rate = 0.039, realized rate = 0.077, p-value < 0.001) strata.

Spatial Patterns in Trip-Selection

Under a strictly random selection of trips and with a large enough sample size, the spatial distribution of observed trips should reflect the spatial distribution of all trips. The hypergeometric distribution can be used to describe the results of sampling from a population of items (fishing trips) with different characteristics (NMFS Area fished). The expected number of trips based on this distribution is the sample rate multiplied by the number of trips that fished in an area (observed and unobserved). Using this method, we compared the expected number of trips and the observed number of trips in each NMFS Reporting Area and stratum combination (Fig. 4). Note that in most cases, the sampling result is close to the expected result; larger differences tend to be associated with lower numbers of trips within a NMFS Area. The *HAL - Tender* stratum is excluded from Figure 4, since all *HAL - Tender* trips occurred within one NMFS Area (659), and none were selected, making the hypergeometric distribution inapplicable for evaluating spatial patterns of coverage for this stratum.

The hypergeometric distribution was also used to assess whether our results are within our expectations or are unusual given the fishing patterns of the fleet and our sampling rates. Using landings data, we calculated the probability of observing the number of trips we did, or a more unexpected number of trips, within a stratum and NMFS area. This calculation uses the sampling rate and the distribution of trips across NMFS Reporting Areas. This evaluation does not test whether the resulting coverage rate in a NMFS Area for a stratum is equal to the stratum selection rate, but instead tests whether the actual coverage rate (realized rate) in a NMFS Area for a stratum is unexpected compared to the stratum-wide realized observation rate. For the purposes of the following discussion, NMFS Areas with an unexpected number of trips (probability of our result is less than 0.05) are considered “low-p” areas.

The HAL - No Tender Stratum

Given that there were 18 NMFS Areas fished in the *HAL - No Tender* stratum, we would expect there to be one low-p area ($0.05 \times 18 = 0.9$). There were two (NMFS Areas 518 and 519) where the actual coverage for each was higher than expected by four trips. The percent of trips observed among NMFS Areas in this stratum ranged from 0% to 24.1% (median = 10.1%). The probability of these coverage rates or rates that deviated further from expected values is depicted in Figure 5. These results mean that, in 2017, there was evidence of some clustering of observed trips among NMFS Areas that was different from expected in the *HAL - No Tender* stratum. There were no consistent spatial patterns in trip clustering between the *HAL* stratum in 2016 and the *HAL - No Tender* stratum in 2017.

The POT - No Tender Stratum

Given that there were 14 NMFS Areas fished in the *POT - No Tender* stratum, we would expect there to be one low-p area ($0.05 \times 14 = 0.7$). There were three NMFS Areas where number of observed trips was greater than expected (NMFS Areas 518 and 650 by 2 trips, NMFS Area 610 by 8 trips). The percent of trips observed among NMFS Areas in this stratum ranged from 0% to 18.2% (median = 5.4%). The probability of these coverage rates or rates that deviated further from expected values is depicted in Figure 6. These results mean that, in 2017, there was some evidence of clustering of observed trips among NMFS Areas that was different from expected in the *POT - No Tender* stratum. However, it should be noted that the *POT - No Tender* stratum had a relatively low sample size, with only 72 trips observed in 2017. There were no consistent spatial patterns in trip clustering between the *POT* stratum in 2016 and the *POT - No Tender* stratum in 2017.

The TRW - No Tender Stratum

Given that there were six NMFS Areas fished in the *TRW - No Tender* stratum, we would expect there to be no low-p areas (0.05 × 6 = 0). There was one NMFS Area where the number of observed trips was less than expected (NMFS Area 620, by 16 trips). The percent of trips observed among NMFS Areas in this stratum ranged from 18.6% to 36.4% (median = 20.7%). The probability of these coverage rates or rates that deviated further from expected values is depicted in Figure 7. These results mean that, in 2017, there was some evidence of clustering of observed trips among NMFS Areas that was different from expected in the *TRW - No Tender* stratum. There were no consistent spatial patterns in trip clustering between the *TRW* stratum in 2016 and the *TRW - No Tender* stratum in 2017.

The HAL - Tender Stratum

Given that there was only one NMFS Area (659) fished in the *HAL - Tender* stratum, and none of the four trips fished were selected for coverage, the hypergeometric distribution was not used for evaluating spatial patterns of coverage for this stratum. A map of coverage rates is not included for this stratum. The *HAL - No Tender* and *HAL - Tender* strata were combined into the *HAL* stratum for 2018.

The POT - Tender Stratum

Given that there were seven NMFS Areas fished in the *POT - Tender* stratum, we would expect there to be no low-p areas for this stratum (0.05 × 7 = 0). There was one NMFS Area where the number of trips observed was greater than expected (NMFS Area 519, by one trip). The percent of trips observed among NMFS Areas in this stratum ranged from 0% to 20% (median = 0%). The probability of these coverage rates or rates that deviated further from expected values is depicted in Figure 8. These results mean that, in 2017, there was some evidence of clustering of observed trips among NMFS Areas that was different from expected in the *POT - Tender* stratum.

The TRW - Tender Stratum

Given that there were four NMFS Areas fished in the *TRW - Tender* stratum, we would expect there to be no low-p areas for this stratum ($0.05 \times 4 = 0$). There was one NMFS Area where the number of observed trips was greater than expected (NMFS Area 610, by one trip). The percent of trips observed among NMFS Areas in this stratum ranged from 0% to 20% (median = 0%). The probability of these coverage rates or rates that deviated further from expected values is depicted in Figure 9. These results mean that, in 2017, there was some evidence of clustering of observed trips among NMFS Areas that was different from expected in the *TRW - Tender* stratum.

Trip Metrics

This section is focused on answering one question related to the deployment of observers: are observed trips similar to unobserved trips? A permutation test (a.k.a., randomization test) was used to answer this question. This test evaluates the question "How likely is the difference we found if these two groups have the same distribution (in the metric we are comparing)?" Permutation tests compare the actual difference found between two groups to the distribution of many differences derived by randomizing the labels defining the two groups (e.g., observed and unobserved). Difference values in the permutation test were calculated by subtracting the mean metric value for the "No" condition from the mean metric value for the "Yes" condition. For example, the difference between vessel lengths in a permutation test for an observer effect would be the mean value for unobserved trips subtracted from the mean value for all observed trips. By randomizing group assignments, the combined distribution of randomized differences represents the sampling distribution under the null hypothesis that the two groups are equal. In this report 1,000 randomized trials are run for the permutation test. The p-value from the test is calculated as the number of randomized trials with greater absolute differences than the actual difference divided by the number of randomized trials. Similar to the other statistical tests used in this report, low p-values (< 0.05) indicate rare events and provide evidence against the hypothesis of equality.

In an attempt to improve clarity, although five values are calculated in the test; 1) the difference between groups, 2) the mean difference between groups from randomized trials, 3) #1 expressed as a percentage of the mean value of the metric being tested, 4) #2 expressed as a percentage of the mean value of the metric being tested, and 5) the p-value of the test, only values 1, 3 and 5 are presented.

Six trip metrics were examined in the permutation test. These metrics were as follows: the number of NMFS Areas visited in a trip, trip duration (days), the weight of the landed catch (t), the vessel length (ft), the number of species in the landed catch, and the proportion (0 to the most predominant species (pMax). The metric vessel length is used to help interpret the results from landed weight of catch since fishing power is positively correlated to vessel length. Specifically, differences in weight *and* length are interpreted as a failure to achieve a random sample of vessels of different sizes, whereas differences in weight only lend more evidence that there is an observer effect. The number of species within the landed portion of the catch is a measure of species richness. Our pMax metric follows the concepts behind Hill's diversity number N1 that depicts the number of abundant species (Hill 1973) and is a measure of how "pure" catch is since a value of 1 would indicate that only the predominant (and presumed desirable) species was landed.

Are observed trips similar to unobserved trips?

This comparison is the basis for examining if there is an observer effect (i.e., differential behavior when observed compared to when not observed) within partial coverage trips. Sample sizes for this test are presented in Table 8.

Of the six metrics compared in the *HAL - No Tender* stratum, four had low p-values. Observed trips in this stratum were 15.9% (0.8 days) shorter in duration, landed 7.6% (0.3) more species, landed catch that was 2.8% more diverse, and landed catch that weighed 17.7% (1.2 metric tons) less than unobserved trips (Table 9). Of the six metrics compared in the *POT - No Tender* stratum, one had low p-values. Observed trips in this stratum were 11.1% (0.4 days) shorter in duration than unobserved trips (Table 9).

Of the six metrics compared in the *POT - Tender* stratum, there were no metrics with low p-values (Table 9). Of the six metrics compared in the *TRW - Tender* stratum, there were no metrics with low p-values (Table 9). Of the six metrics compared in the *TRW - No Tender* stratum, four had low p-values. Observed trips in this stratum were 10.1% (0.2 days) shorter in duration, landed 15% (0.8) fewer species, landed catch that was 2.4% less diverse, and landed catch that weighed 4.2% (4.2 tons) less than unobserved trips (Table 9). The permutation test was not performed for *HAL - Tender* trips since no trips in this stratum were selected to be observed. A visual depiction of individual results of this permutation test for the non-tender strata is given in Figure 10 for illustration purposes.

Gear, tender, and observed status combinations

One of the first analyses presented in the 2013 Annual Report was a comparison of trip durations for combinations of observed and tendered status by stratum (Faunce et al. 2014, NMFS 2014). The rationale for this plot and focus on this metric was because of the concern that tendered trips were longer than non-tendered trips and therefore were being avoided for observer coverage. Frequency distributions showed that tendered trips had a long right tail compared to non-tendered trips, and that there were few observed trips in that long right tail (Faunce et al. 2014; Fig. 14). The OSC concluded that there were no major differences between observed and unobserved tendered trips based on the fact that there were observed trips (however few) in those long duration tendered trips. Since 2013, permutation tests have replaced these frequency plots. However, these permutation tests do not visually map the data for observed and tendered states together. To accomplish this, a plot of the trip durations for these states is included as Figure 11. From these plots it appears that observed trips in 2017 were of similar duration as unobserved trips.

ADEQUACY OF THE SAMPLE SIZE

In a well-designed sampling program, the observer coverage rate should be large enough to reasonably ensure that the range of fishing activities and characteristics are represented in the sample data. The Catch Accounting System post-stratifies data into groups of fishing activities with similar trip characteristics such as gear, trip targets, and NMFS Area (Cahalan et al. 2014). At low numbers of trips and low sampling rates, the probability of no observer data within a particular post-stratum is increased and may result in expansions of bycatch rates from one type of fishing activity against landings for a different type of fishing activity. This will result in biased estimates of bycatch. For this reason, it is important to have a large enough sample (observed trips and vessels) to have reasonable expectation of observing all types of fishing.

Over the course of an entire year, some NMFS Areas have low fishing effort and as a result have a relatively high probability of being missed by the simple random sampling represented by observer deployments. The fishing effort data for each stratum and the number of observed trips over the course of 2017 was used to illustrate their combined effect on the probability of a NMFS Area containing observer data using the hypergeometric distribution (Fig. 12). From this figure it can be seen how 1) the likelihood of at least one observation is increased with fishing effort and 2) is also increased with an increase in the selection rate. Given our sampling rates in the 6 partial coverage trip-selection strata, the probability of having no observed trips in a NMFS Reporting Areas increases quickly above 0.05 when there are fewer than 23 trips in the *HAL - No Tender* stratum, 36 trips in the *POT - No Tender* stratum, 38 trips in the *POT - Tender* stratum, 13 trips in the *TRW - No Tender* stratum, and 13 trips in the *TRW - Tender* stratum in a given area. Including additional factors such as week, gear, and target will decrease the number of trips with the same characteristics and hence increase the probabilities of obtaining no observer data of that character (post-strata of the CAS).

RESPONSE TO COUNCIL AND SSC COMMENTS

The SSC has requested that a specific section with responses to SSC comments be provided in the written report, as is done for SAFE documents. This section addresses comments (in italics) made by the Council and the SSC in response to the presentation of the 2016 Annual Report made at the June 2017 Council meeting.

The Council offered the following comments:

Evaluate pelagic trawl and non-pelagic trawl trips for evidence of an observer effect.

A preliminary evaluation of the differences between gear types is provided in the Appendix.

The SSC offered the following recommendations to the Observer Program:

Sampling of Chinook salmon in the GOA pollock trawl fishery should focus on estimating the actual amount of salmon PSC taken in portions of this fishery, rather than collecting an unbiased sample of tissues for genetics. Even if the genetic stock composition of Chinook is biased, the sample may still be an unbiased representation of the stock composition of the entire PSC due to overlap in areas fished and/or complete mixing of Chinook stocks over large areas of the GOA. The SSC agrees with the NMFS longer-term recommendation to explore plant monitoring of offloads, including tender offloads, combined with EM for compliance monitoring to address the issue of PSC estimation and tissue sampling.

The objective of observing a representative sample of pollock deliveries for the purposes of obtaining an unbiased sample of genetic tissues was dropped from the objectives of the 2018 observer program in recognition that the observer program is unable to conduct this task for tendered deliveries.

Although there is strong evidence of bias in unobserved trips relative to observed trips, and some vessels conducting an entire fishing season without carrying an observer the NMFS longer-term recommendation for 100% coverage of trawl vessels delivering to tenders may be impractical and may *not be necessary. Beyond longer-term improvement of methods to monitor offloads of tenders, a shorter-term analysis should be conducted to examine the magnitude of bias caused by tendering activities relative to the overall magnitude and precision of discard or PSC that is being monitored for compliance by management.*

The magnitude of bias caused by tendering activity is likely to be small, given the few number of trips that are tendered (Table 5). In order to minimize any bias that might be present, gear-based partial coverage strata were separated by tender status in 2017. We cannot directly compare the bycatch rate between observed and unobserved trips, as we have no at-sea information from unobserved trips to create an equivalent bycatch rate. Quantifying the bias resulting from unobserved trips being different from observed trips is therefore problematic. We support the NMFS recommendation of exploring longer-term solutions to this issue.

Linkage between information provided on the performance review in chapter 3 and the fishery information provided in chapter 4 is unclear. Additional explanation of this linkage (i.e., how does performance relate to the estimated quantities in each fishery) should be provided in the introduction to chapter 4.

The descriptive information provided in Chapter 4 was originally requested by industry and does not drive stratification and other aspects of deployment, the results of which are detailed in Chapter 3. With this Annual Report, NMFS has removed some of the tables from Chapter 4 and made the information available online. Chapter 4 includes an explanation why the proportion of catch weight observed for a subset of fishing activity should not be expected to equal the deployment rates specified in the ADP and which are evaluated in Chapter 3.

The SSC is unclear about the statement that "some video" was used as the hurdle in assessing whether video from a trip could be used in estimation and evaluation of the EM program. We encourage *use of a specific, justifiable quantity to judge adequacy of video data for use in directed harvest and PSC estimation.*

In the 2016 Annual Report, analysts considered a trip monitored if data were derived from review of video. This definition was the most generous definition of EM monitored we could derive since it does not consider specific quantity of data collected. This is comparable to the definition of an observed trip, which also does not consider the quantity or quality of data collected by an observer. However, NMFS recognizes that since EM is a new data collection method, there is interest in understanding the quality of the video and the reliability of EM systems.

The SSC requested that the following analyses be added to the list of analytical tasks:

As identified in previous reports, the SSC encourages additional progress toward resolving the calculation of mean weight of halibut discarded by the IFQ halibut fleet.

The OSC notes that this project is underway. It is outside the scope of OSC tasks related to the Annual Report.

The SSC requests that the list of observer program analytical tasks continue to include addressing issues with estimation of discards in the directed halibut fishery as detailed in our June 2016 report and IPHC public comments made at that meeting. We also ask that a table of the prevalent PSC species contributing to discards be included in the next Annual Report.

The OSC notes that this project is underway. It is outside the scope of OSC tasks related to the Annual Report. A table of PSC species falls outside the scope of this chapter, but summaries of PSC bycatch are available on the NMFS Alaska Region website.[1]

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[1] Online catch reports are available on the NMFS Alaska Region web site at https://alaskafisheries.noaa.gov/fisheries-catch-landings.

While the SSC greatly appreciates that the development of variances for use in planning of deployments and stock assessment is ongoing, we strongly urge the analysts to initiate a comparison of the likely magnitude of bias that has been detected between observed and unobserved trips with the overall magnitude and precision of discard or PSC that is being monitored for compliance by management. This comparison can be used to determine if remaining trip-related bias is worth addressing through changes to the observing system, or is small enough in magnitude to be deemed "good enough" relative to management objectives. The SSC also notes that these types of comparisons will be necessary given the nature of current constraints on observer deployment (e.g., funding of higher sampling rates and practical need for further stratification). It may be helpful to perform these analyses at the post-stratified levels used for catch accounting (e.g., pelagic and non-pelagic trawl) in order to better identify specific sources of bias.

It is not known whether the differences between observed and unobserved measures of retained catch, NMFS Areas, etc. in Chapter 3 directly translate to bias in PSC estimates. It is unclear to the OSC how such an analysis would be conducted. Further clarification and conversation with the SSC would help the OSC in the future on this issue.

OSC RECOMMENDATIONS TO IMPROVE DATA QUALITY

Recommendations from the 2016 Annual Deployment Review

The Observer Science Committee made the following recommendations in its 2016 review of observer deployment to be considered in developing the 2018 ADP (NMFS 2017b). Following each italicized recommendation is the outcome of that recommendation.

The Observer Science Committee's Recommendations to improve the 2018 ADP were as follows:

1. *The OSC reiterates its 3-year recommendation that the NMFS improve the linkages between ODDS and eLandings (OSC recommendation for 2013, 2014, 2015 version of this Review).*

   A voluntary field in *e*Landings for the ODDS trip number was created in 2016; however, this has not completely solved the problem and the OSC has additional recommendations in this report.

2. *The OSC reiterates its 2-year recommendation that the NMFS explore ways to reduce the impact of cancellations on the number of trips selected for observer coverage in the ODDS. This may be accomplished in a variety of ways that include, but are not limited to the following: reducing the number of trips that can be logged in advance (OSC recommendation from the 2014 and 2015 version of this Review), and/or reducing the incentive or ability to cancel trips selected for observer coverage or electronic monitoring.*

   The Council and NMFS support changes to ODDS to address the impact of trip cancellations and this project is currently on the list of analytical priorities. Major changes to ODDS programming must be complete by the start of each calendar year. NMFS will consider the additional changes for 2019. Implementation would require programming changes to both ODDS and CAS.

3. *The OSC recommends an alternative model of monitoring salmon bycatch be explored in the partial coverage fleet. Salmon bycatch in some fisheries constrains the catch of target species. Salmon are relatively rare in catches and are difficult to detect by observers or cameras. These factors can lead to imprecise catch estimates. For 3 years of deployment performance review, the observer program has been unsuccessful in achieving its goal of obtaining an unbiased sample from the pollock trawl fleet for enumerating salmon bycatch and determining stock of origin (see section on Coverage Rates for Dockside Monitoring in this report). A solution is to require full retention of salmon and full monitoring at the point of delivery. This solution could be achieved by prohibiting vessels that deliver to tenders from discarding salmon at sea, monitoring those vessels and associated tenders for compliance with electronic monitoring, and observing or monitoring all tender deliveries at the plant.*

For the 2018 ADP, NMFS did not include full shoreside accounting of salmon in the GOA as a monitoring objective. The methods for monitoring salmon bycatch in the partial coverage fleet have remained unchanged: shoreside offloads from observed catcher vessel trips continue to be 100% monitored, while catch from catcher vessels delivering to tenders is monitored at sea. In the longer term, the 2016 annual report recommended considering broader solutions for monitoring Chinook salmon PSC for trawl trips delivering to tenders in the GOA.

4. *The OSC has three recommendations concerning future at-sea coverage rates for observers (and potentially monitoring):*
    a. *We reiterate our recommendation from last year that sampling rates in future ADPs be high enough in each stratum to maximize the probability of achieving three observed trips in each of the NMFS Areas (under funding constraints). Based on the results of the draft 2017 ADP, the best design for achieving this goal would have been a strict three gear stratification. The results of this Review reinforce the results of simulated sampling evaluations of 2014 data that showed that most observer data gaps disappeared or were severely minimized at deployment rates greater than or equal to 15% (relative to a 50% probability of a post-strata being empty; NMFS 2015c, p. 98). It must be noted that the total number of observer days afforded by the Agency for the 2017 ADP has resulted in ODDS selection rates in most strata that are below those shown to result in spatial and temporal bias in past versions of this report regardless of the optimized allocation used. The comparatively low coverage rates in 2017 compared to 2013-2016 will affect our ability to interpret the results of the analyses in this Review with much certainty since power of test is a function of sample size.*

       The comparatively low sampling rates afforded by the 2017 budget did result in difficulties from an analytic standpoint. For instance, it becomes increasingly difficult to rely on differences detected (or not detected) by the permutation test when sample sizes are low. The budget for 2018 allows for an estimated 4,394 observer days (NMFS 2017b), a 41% increase from the 3,121 days allowed for in 2017 (NMFS 2016b, this report). The selection rates for all partial coverage strata in the 2018 ADP are above 15% (NMFS 2017b).

b. *The OSC recommends that future ADPs include in each proposed sampling design sample allocation that is proportional to fishing effort (equal rates among strata). This should be accomplished by adopting a 'hurdle model' approach to sample allocation in future ADPs, whereby if the total sample size (observer days) is insufficient to observe all strata at a 15% coverage rate of trips, then allocation of observer days among strata defaults to proportional to effort (all strata get equal coverage rates).*

   The 'hurdle model' was not used in the 2017 ADP, but was adopted for the 2018 ADP. The programmed selection rates in the 2017 ADP were above 15% for some partial coverage strata, and below 15% for others (NMFS 2016b, this report). However, the 'hurdle model' or '15% + Optimization' model was used to determine coverage rates in the 2018 ADP (NMFS 2017b).

c. *The OSC recommends that the SSC and Council request NMFS reinstate its funding for observer deployment in the North Pacific at levels necessary to ensure a minimum of 15% coverage among all strata in upcoming ADPs. If the critical 15% coverage rate is surpassed among all strata combined, then sampling days afforded in excess of this amount may be allocated among strata according to an optimization algorithm.*

   NMFS has not committed to funding observer deployment in the North Pacific. However, funding levels for the 2018 ADP were adequate to provide deployment rates above the recommended hurdle threshold.

Recommendations to Improve Data Quality and Guide the 2019 ADP

1. The OSC has three recommendations regarding the ODDS, its relationship to *e*Landings, and the effect of cancellations on achieved coverage:
   a. The OSC reiterates its 4-year recommendation that the NMFS improve the linkages between ODDS and *e*Landings (OSC recommendation for 2013, 2014, 2015, 2016 version of this Review).
   b. The OSC reiterates its 3-year recommendation that the NMFS explore ways to reduce the impact of cancellations on the number of trips selected for observer coverage in the ODDS (OSC recommendation from the 2014, 2015, and 2016 version of this Review). This may be accomplished in a variety of ways that include, but are not limited to the following: reducing the number of trips that can be logged in advance, and/or reducing the incentive or ability to cancel trips selected for observer coverage or electronic monitoring since the ability to change dates is already facilitated.
   c. This is the first year in which the OSC recommends that NMFS form an agency sub-group to document the way in which the ODDS currently operates and to describe alternatives for how it can be improved, particularly in regards to points a and b and whether technical improvements to ODDs could address these issues.

2. The OSC has two recommendations concerning stratification:
   a. The OSC recommends that the strata be kept the same between the 2018 and 2019 ADPs. These strata are as they were in 2017, with the exception of combining the HAL - No Tender and HAL - Tender strata into one HAL stratum. The OSC makes this recommendation both to preserve stability in methods across years, and because further stratification would likely decrease sample size within some strata to undesirably small sizes, as was seen with the HAL - Tender stratum in 2017.

b. The OSC provided evaluation of the Council's request to explore differences between NPT and PTR gear. Based on this evaluation, which considers factors pertinent to stratification, the OSC to recommend against stratifying trawl trips by pelagic and non-pelagic gear types. The supporting analysis for this recommendation can be found in the Appendix.

3. The OSC has two recommendations concerning future at-sea coverage rates for observers (and potentially monitoring):

    a. We reiterate our recommendation from last year that sampling rates in future ADPs be high enough in each stratum to maximize the probability of achieving three observed trips in each of the NMFS Areas.

    b. The OSC recommends that future ADPs include, as one option, a sample design in which strata are selected at the same rate. Although this design could be considered a baseline used for making comparisons to other proposed designs, under some scenarios, this option may be recommended.

4. The OSC recommends that the performance standards used to evaluate observer effects in the Annual Report be reassessed by the OSC. The performance standards were developed in 2013 with the restructuring of the Observer Program and have yet to be reviewed. The original purpose of this set of indicators was to evaluate the differences between the unobserved and observed population of trips using available information for the two groups; information that can be directly measured in both groups (e.g., total weight of landed catch). These metrics have been useful for evaluating whether the deployment of observers into the sampling strata has resulted in a representative sample of trips. However, an evaluation has not been conducted that relates these metrics to at-sea information. Additionally, the magnitude of the differences (the effect size) has not been evaluated relative to whether differences seen between the two groups are meaningful in the context of the overall data. We recommend evaluating the suite of metrics in context with how they relate to at-sea

data collections and, to the extent feasible, provide additional information regarding interpretation of effect sizes and p-values (e.g., consideration of sample sizes).

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TABLES

Table 1. -- Comparison between predicted and actual trip days for partial coverage strata in 2017. Predicted values come from the 2017 Annual Deployment Plan (ADP).

Strata	Predicted number of trip days in ADP	Actual number of trip days	% Difference from predicted
TRW - No Tender	8,310	4,980	-40.1
HAL - No Tender	12,661	11,978	-5.4
POT - No Tender	2,768	3,728	34.7
TRW - Tender	828	626	-24.4
HAL - Tender	32	9	-71.9
POT - Tender	707	761	7.6
Total	25,306	22,082	-12.7

Table 2. -- Trip cancellation rates in the ODDS for 2017. A trip is cancelled by the system if the user did not identify whether fishing had occurred by the end of the year. “Paper” indicates that a trip was logged when the ODDS was not available.

Strata	Random number outcomes	Logged (*a*)	Cancelled by system (*b*)	Trips remaining (*c* = *a*-*b*)	Cancelled by user (*d*)	Paper	% User cancellation (*d*/*c* * 100)
HAL - No Tender	Not Selected	2,162				0	
	Selected	272	0	272	64	0	23.5
HAL - Tender	Not Selected	11				0	
	Selected	5	0	5	2	0	40.0
POT - No Tender	Not Selected	885				0	
	Selected	43	0	43	9	0	20.9
POT - Tender	Not Selected	129				0	
	Selected	3	0	3	0	0	0.0
TRW - No Tender	Not Selected	1,796				0	
	Selected	414	0	414	49	0	11.8
TRW - Tender	Not Selected	129				0	
	Selected	30	0	30	12	0	40.0
Total		5,879	0	5,879	136	0	2.3

Table 3. -- Number of remaining trips after cancellation in each trip-selection strata (*TRW - No Tender*, *HAL - No Tender*, *POT - No Tender*, *TRW - Tender*, *HAL - Tender*, and *POT - Tender*) that were selected using the initial random number generator (Random Number Selection) and those that remained after user manipulation (Total Final Selected). The relative impact of waivers in trip-selection is also shown (% Reduction of Selected Trips due to Waivers). **Not from random numbers.

Strata	Total Trips	Random number selection (*r*)	Inherited selection** (*i*)	Randomly selected but waived (*w*)	Total final selected (*T*=*r*+*i*-*w*)	% Selected from inherits ((*i*/*T*)*100)	% Reduction of selected trips due to waivers (*w*/(*T*+*w*)*100)
HAL - No Tender	1,890	208	63	5	266	23.7	1.8
HAL - Tender	12	3	0	0	3	0.0	0.0
POT - No Tender	829	34	21	0	58	36.2	0.0
POT - Tender	99	3	6	0	9	66.7	0.0
TRW - No Tender	1,986	365	51	0	416	12.3	0.0
TRW - Tender	114	18	8	0	26	30.8	0.0

Table 4. -- Number of logged trips in each partial coverage stratum (*TRW - No Tender*, *HAL - No Tender*, *POT - No Tender*, *TRW - Tender*, *HAL - Tender*, and *POT - Tender*) that were selected using the initial random number generator (Random Selection Only) and those that remained after user manipulation (Final Expected). The relative impact of waivers in trip-selection is also shown (No Waivers).

Strata	Trip disposition	Selected trips	Total trips	Actual selection (%)	Programmed selection (%)	p-value (H0: Actual = Programmed)
HAL - No Tender	Initial Random Selection, *a*	272	2,434	11.18	11.09	0.897
	After Cancellations, *b* (*a*-*b*)	208	1,890	11.01	11.09	0.942
	With Inherits, *c* (*a*-*b*+*c*)	271	1,890	14.34	11.09	0.000
	After Waivers, *d* (*a*-*b*+*c*-*d*)	266	1,890	14.07	11.09	0.000
HAL - Tender	Initial Random Selection, *a*		16	31.25	25.00	0.567
	After Cancellations, *b* (*a*-*b*)	3	12	25.00	25.00	1.000
	With Inherits, *c* (*a*-*b*+*c*)	5	12	25.00	25.00	1.000
	After Waivers, *d* (*a*-*b*+*c*-*d*)	3	12	25.00	25.00	1.000
POT - No Tender	Initial Random Selection, *a*		928	4.63	3.88	0.233
	After Cancellations, *b* (*a*-*b*) 3	34	829	4.10	3.88	0.719
	With Inherits, *c* (*a*-*b*+*c*)	43	829	7.00	3.88	0.000
	After Waivers, *d* (*a*-*b*+*c*-*d*)	58	829	7.00	3.88	0.000
POT - Tender	Initial Random Selection, *a*		132	2.27	3.92	0.497
	After Cancellations, *b* (*a*-*b*) 58	3	99	3.03	3.92	1.000
	With Inherits, *c* (*a*-*b*+*c*)	3	99	9.09	3.92	0.016
	After Waivers, *d* (*a*-*b*+*c*-*d*)	9	99	9.09	3.92	0.016
TRW - No Tender	Initial Random Selection, *a*		2,210	18.73	17.57	0.154
	After Cancellations, *b* (*a*-*b*) 9	365	1,986	18.38	17.57	0.345
	With Inherits, *c* (*a*-*b*+*c*)	414	1,986	20.95	17.57	0.000
	After Waivers, *d* (*a*-*b*+*c*-*d*)	416	1,986	20.95	17.57	0.000
TRW - Tender	Initial Random Selection, *a*	30	159	18.87	14.29	0.112
	After Cancellations, *b* (*a*-*b*) 416	18	114	15.79	14.29	0.594
	With Inherits, *c* (*a*-*b*+*c*)	26	114	22.81	14.29	0.015
	After Waivers, *d* (*a*-*b*+*c*-*d*)	26	114	22.81	14.29	0.015

Table 5. -- Number of total vessels (*V*), sampled vessels (*v*), total trips (*N*), sampled trips (*n*) for each stratum and observer deployment method (vessel and trip-selection) in 2017. The Expected, Minimum Expected, and Maximum Expected Coverage columns are expressed as percentages of the total number of trips taken within each stratum. Fleet totals are reported with and without Electronic Monitoring (EM) data since EM were not used for catch estimation in 2017.

Coverage	Strata	*V*	*v*	*N*	*n*	% Observed or monitored by deployment method	Expected coverage	Minimum expected coverage	Maximum expected coverage	Meets expectations?
Full	FULL	164	164	3,422	3,422	100.0	100.0			Yes
Partial	*HAL - No Tender*	408	175	2,298	276	12.0	11.1	10.7	13.4	Yes
Partial	*POT - No Tender*	104	49	932	72	7.7	3.9	6.1	9.6	No
Partial	*TRW - No Tender*	78	70	2,090	433	20.7	17.6	19.0	22.5	No
Partial	*HAL - Tender*	3	0	4	0	0.0	25.0	0.0	60.2	Yes
Partial	*POT - Tender*	36	4	75	4	5.3	3.9	1.5	13.1	Yes
Partial	*TRW - Tender*	26	8	69	13	18.8	14.3	10.4	30.1	Yes
Gear-based Total			285	5,468	798	14.6				
Partial	EM	80	51	683	142	20.8	30.0	17.8	24.0	No
Partial	Zero Coverage	396	0	1,986	0	0.0	0.0			Yes
Partial	Zero Coverage EM Research	3	0	36	0	0.0	0.0			Yes
Zero Coverage Total	541	399	0	2,022	0	0.0				
Total Fleet (with EM coverage)	Total	1136	458	11,595	4,362	37.6% Trips; 40.3% Vessels				
Total Fleet (without EM coverage)	Total	1136	407	11,595	4,220	36.4% Trips; 35.8% Vessels				

Table 6. -- The total number of EM trips (*N*) and the number monitored (*n*), separated by gear type.

Gear	N	n	% Monitored
HAL	488	113	23.2
POT	194	29	14.9

Table 7. -- The number of *TRW - No Tender* pollock deliveries by port and coverage category. IFP: Inshore Floating Processor, Hbr: Harbor.

FMP	Coverage category	Port	Total deliveries (*N*)	Observed deliveries (*n*)	% Observed
Bering Sea	Full	Akutan	796	796	100.0
Bering Sea	Full	Dutch Hbr.	803	803	100.0
Bering Sea	Full	IFP	306	306	100.0
Bering Sea	Full	King Cove	75	75	100.0
Total	Full		1,980	1,980	100.0
Gulf of Alaska	Partial	Akutan	246	42	17.1
Gulf of Alaska	Partial	IFP	81	14	17.3
Gulf of Alaska	Partial	Kodiak	1,180	243	20.6
Gulf of Alaska	Partial	Sand Point	180	50	27.8
Total	Partial		1,687	349	20.7

Table 8. -- Number of trips by observation status in the 2017 trip-selection strata.

Strata	Observed	Unobserved
HAL - No Tender	276	2,022
POT - No Tender	72	860
TRW - No Tender	433	1,657
HAL - Tender	0	4
POT - Tender	4	71
TRW - Tender	13	56

Table 9. -- Results of permutation tests between observed and unobserved trips in the 2017 trip-selection strata. OD: Observed difference (Observed - Unobserved).

Strata	Metric	NMFS areas	Days fished	Vessel length (ft)	Species landed	pMax species	Landed catch (t)
HAL - No Tender	Observed difference	-0.016	-0.823	0.646	0.277	-0.024	-1.224
	OD (%)	-1.400	-15.877	1.202	7.642	-2.779	-17.670
	p-value	0.540	< 0.001	0.374	0.037	0.007	< 0.001
POT - No Tender	Observed difference	-0.004	-0.442	0.665	0.041	0.002	-5.258
	OD (%)	-0.352	-11.072	0.886	2.187	0.240	-17.870
	p-value	1.000	0.044	0.847	0.753	0.530	0.154
POT - Tender	Observed difference	0.123	1.958	-3.447	-0.944	0.003	-11.354
	OD (%)	10.874	19.294	-4.854	-32.615	0.350	-13.733
	p-value	1.000	0.610	0.760	0.267	0.190	0.835
TRW - Tender	Observed difference	-0.071	0.861	-2.953	0.624	0.008	139.241
	OD (%)	-6.751	9.489	-4.721	13.199	0.848	68.902
	p-value	0.582	0.761	0.468	0.394	0.380	0.097
TRW - No Tender	Observed difference	-0.019	-0.250	-1.194	-0.768	0.023	-4.247
	OD (%)	-1.780	-10.147	-1.392	-15.044	2.358	-4.183
	p-value	0.192	0.005	0.179	< 0.001	< 0.001	0.048

Figures

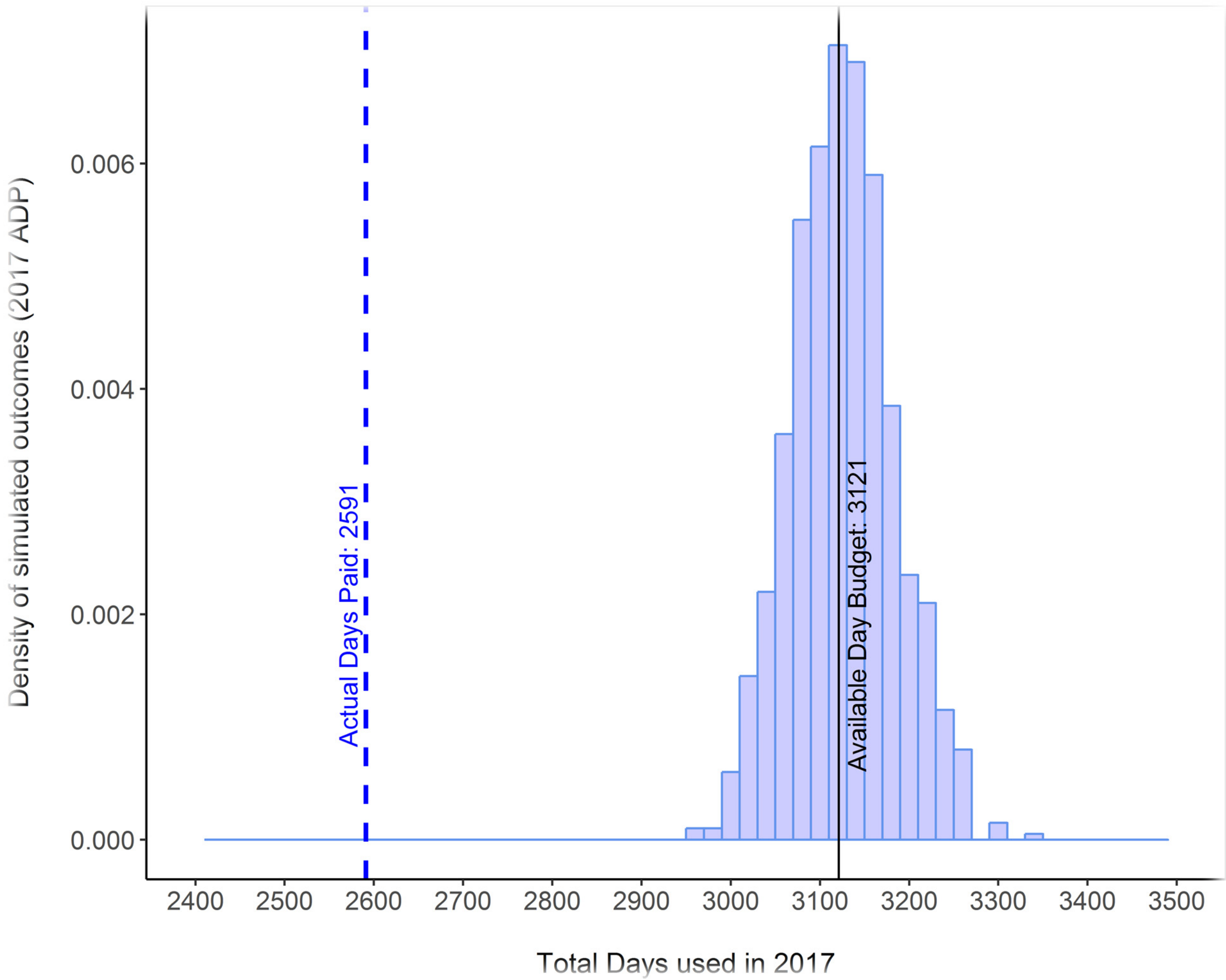

Figure 1. -- Actual paid sea-days in 2017 (dotted line) in relation to the range of potential budgetary outcomes estimated in December 2016 for the Final 2017 ADP (vertical bars).

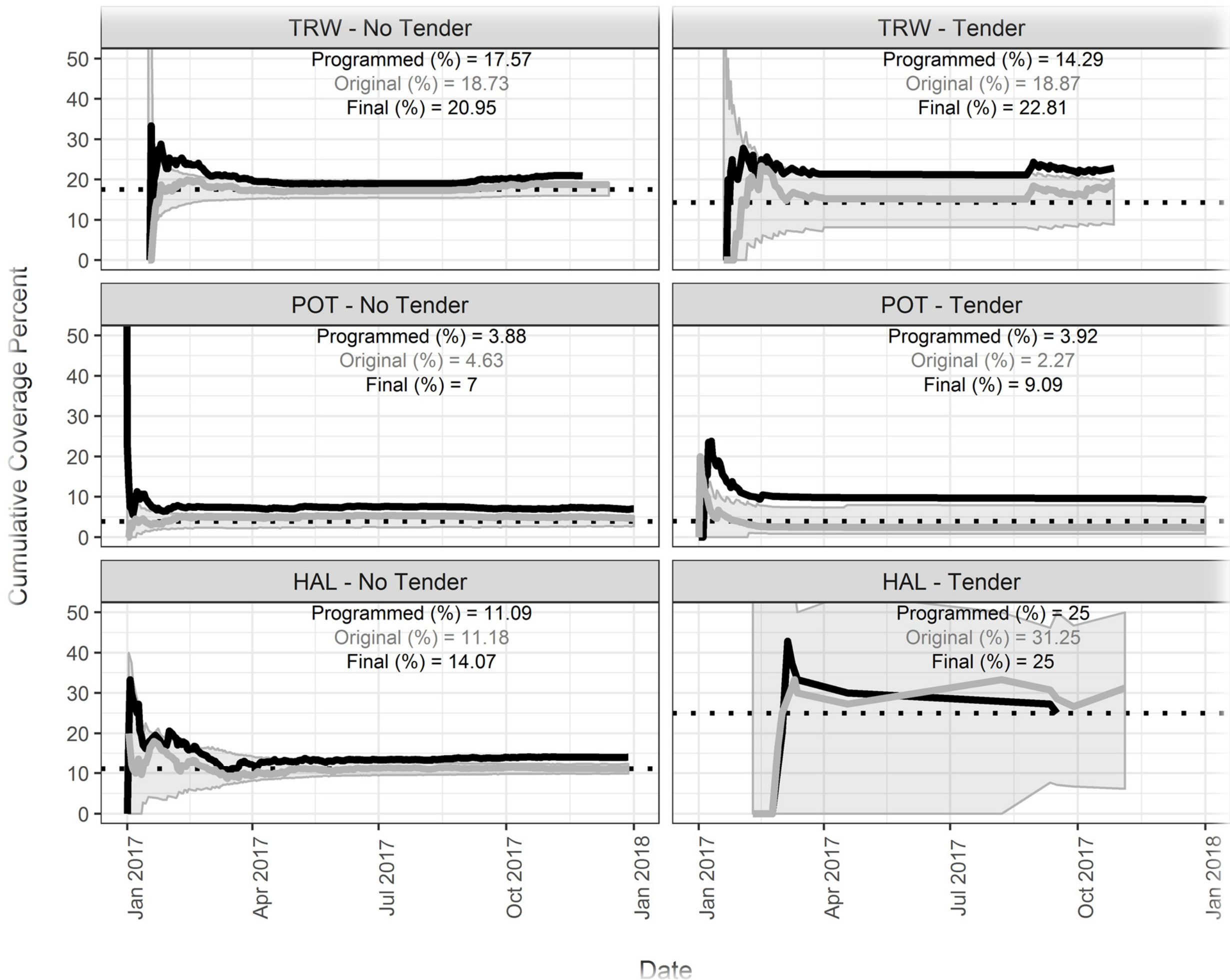

Figure 2. -- Rate of selected trips logged into ODDS organized by original date entered for all trips (grey line and grey text), and final date considering only non-cancelled trips (black line and black text). The programmed selection rate is depicted as the dotted line. Grey shaded areas denote the range of coverage rate corresponding to the 95% confidence intervals expected from the binomial distribution. The final coverage rates were higher than if trip dates had not been altered and/or cancelled.

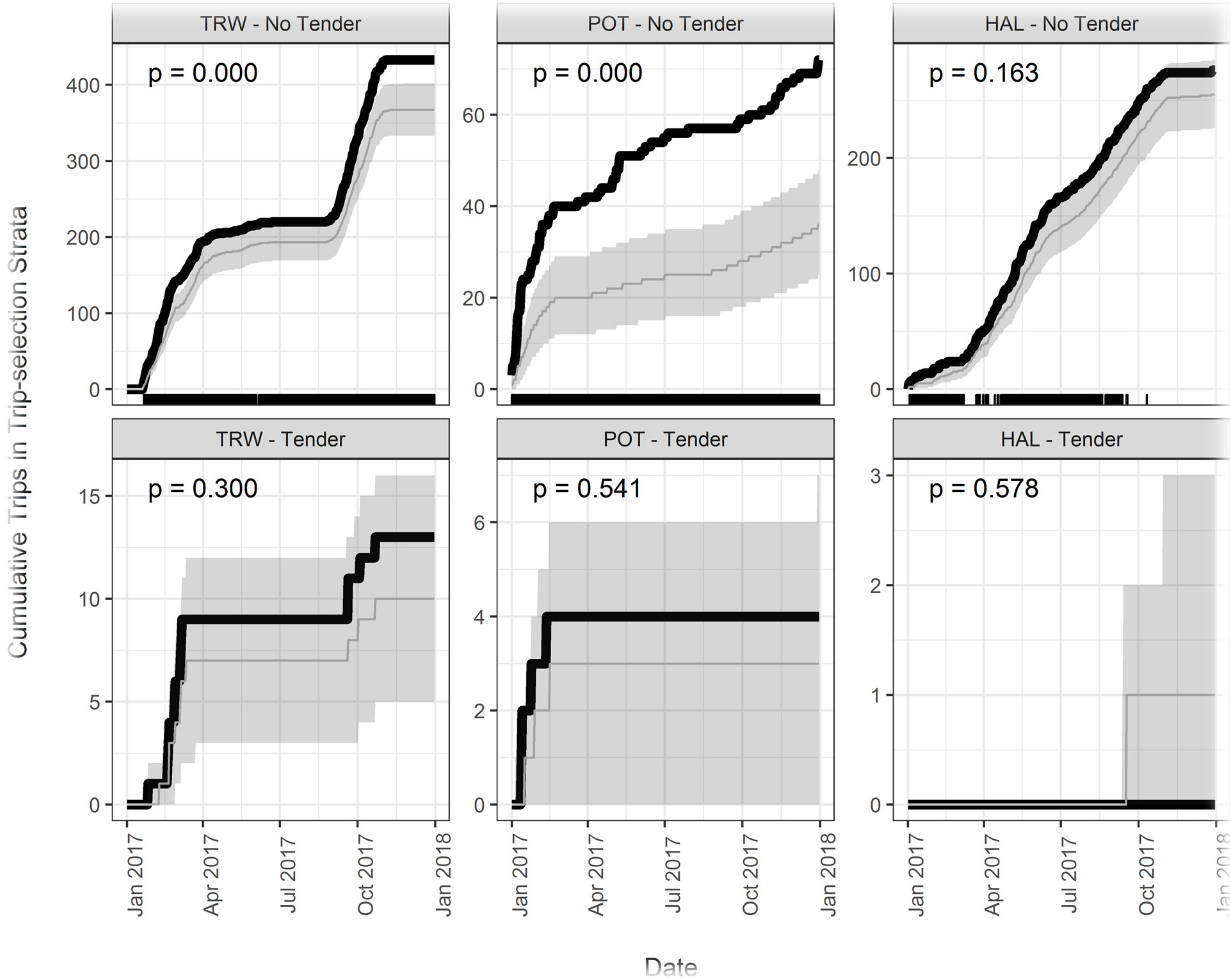

Figure 3. -- Cumulative number of trips observed during 2017 (black line) compared to the expected range of observed trips (shaded area) given fishing effort and sampling rates. Dates where the observed number of trips is outside of expected (less or more than the range; OOE) are depicted as tick marks on the horizontal x-axis. The results of tests that the observed rate derived from a binomial distribution sampled at the selection rate are denoted as p-values.

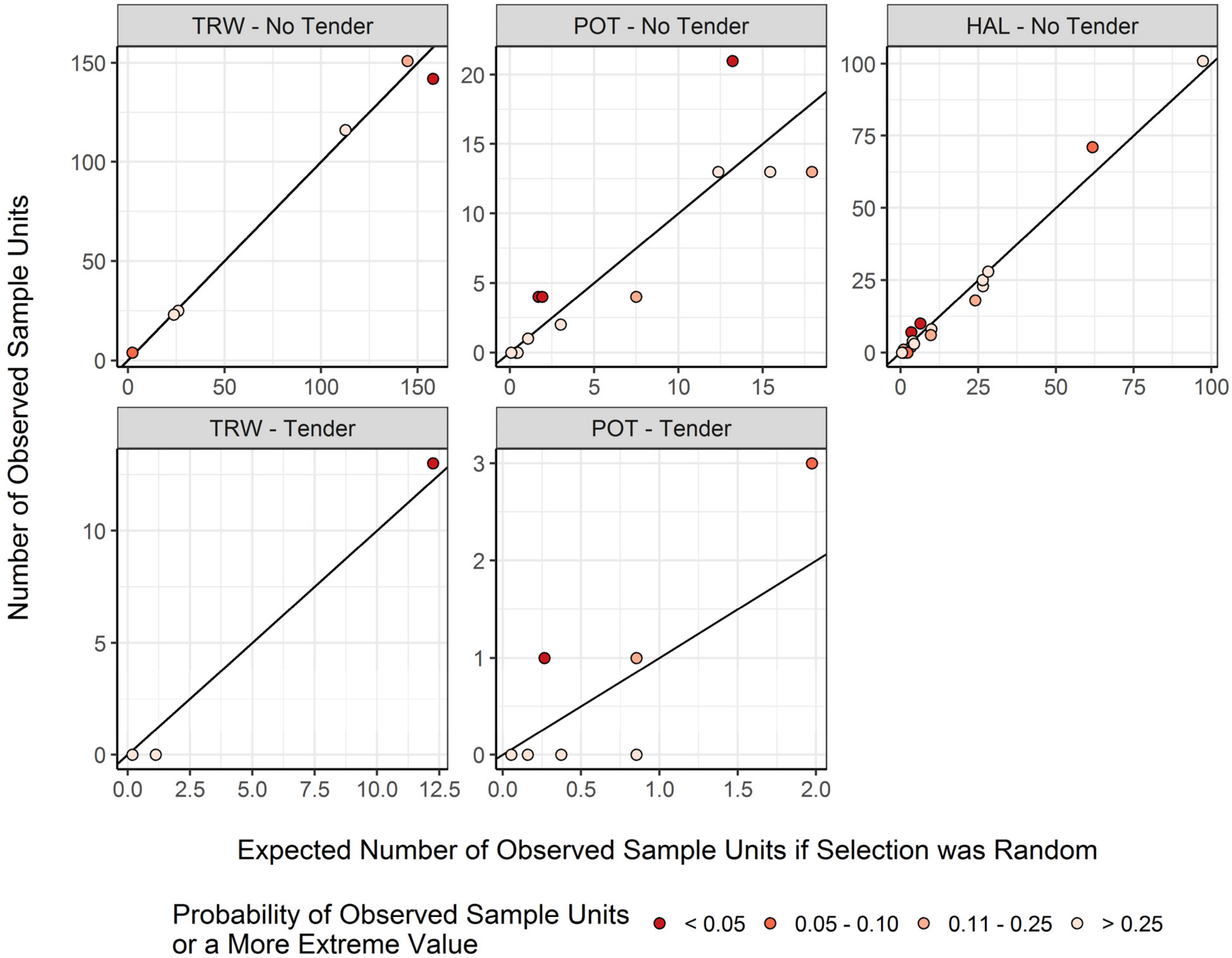

Figure 4. -- Comparison plots depicting the number of observed sample units compared to the number of expected observed sample units for each partial coverage stratum. Each point on a plot represents a NMFS Area. The darker the point, the more unusual the result.

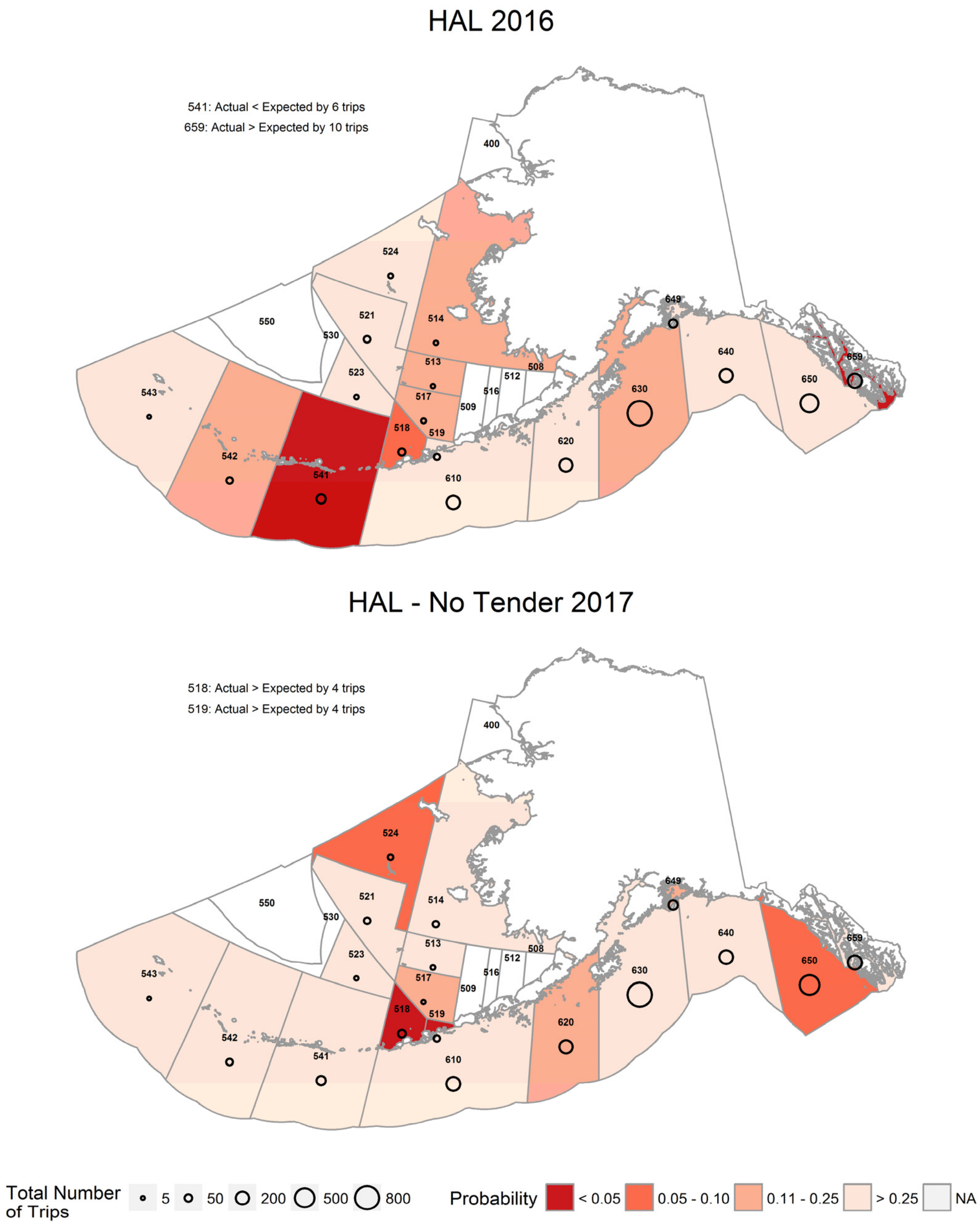

Figure 5. -- Probability of observing the realized or more extreme outcome (coverage rate) in a NMFS Reporting Area in the *HAL* stratum (2016) and *HAL - No Tender* stratum (2017). Reporting Areas where unlikely outcomes occurred are shaded in darker colors.

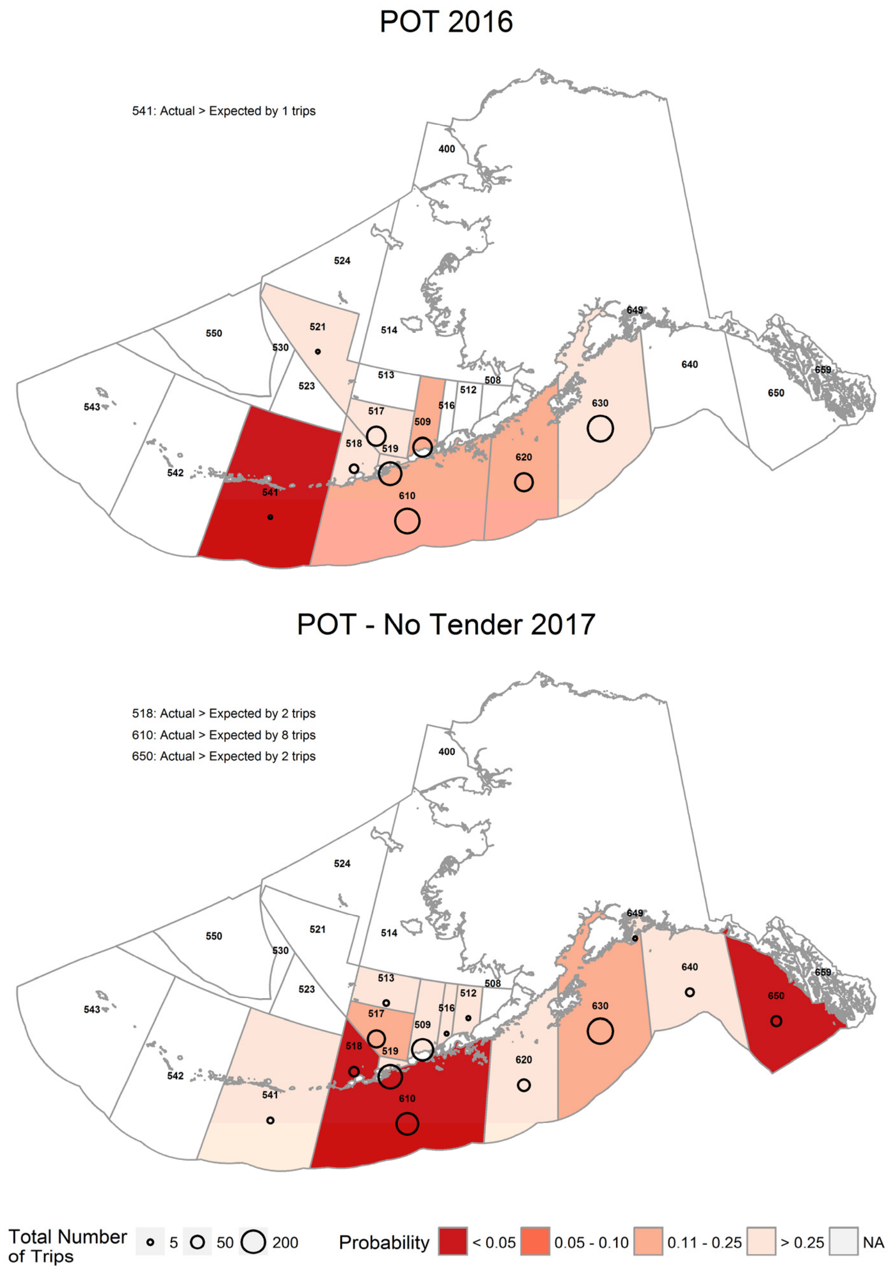

Figure 6. -- Probability of observing the realized or more extreme outcome (coverage rate) in a NMFS Reporting Area in the *POT* stratum (2016) and *POT - No Tender* stratum (2017). Reporting Areas where unlikely outcomes occurred are shaded in darker colors.

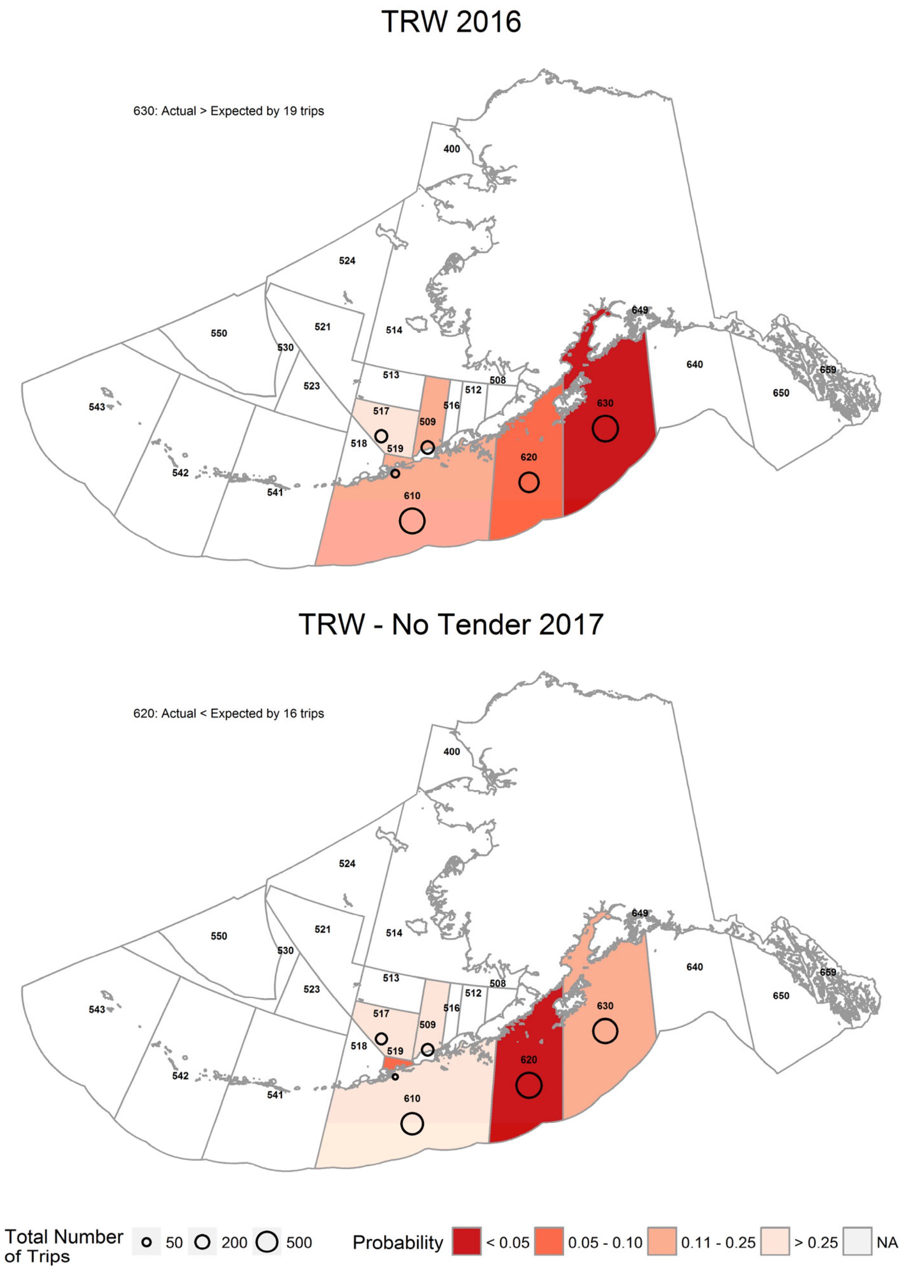

Figure 7. -- Probability of observing the realized or more extreme outcome (coverage rate) in a NMFS Reporting Area in the *TRW* stratum (2016) and *TRW - No Tender* stratum (2017). Reporting Areas where unlikely outcomes occurred are shaded in darker colors.

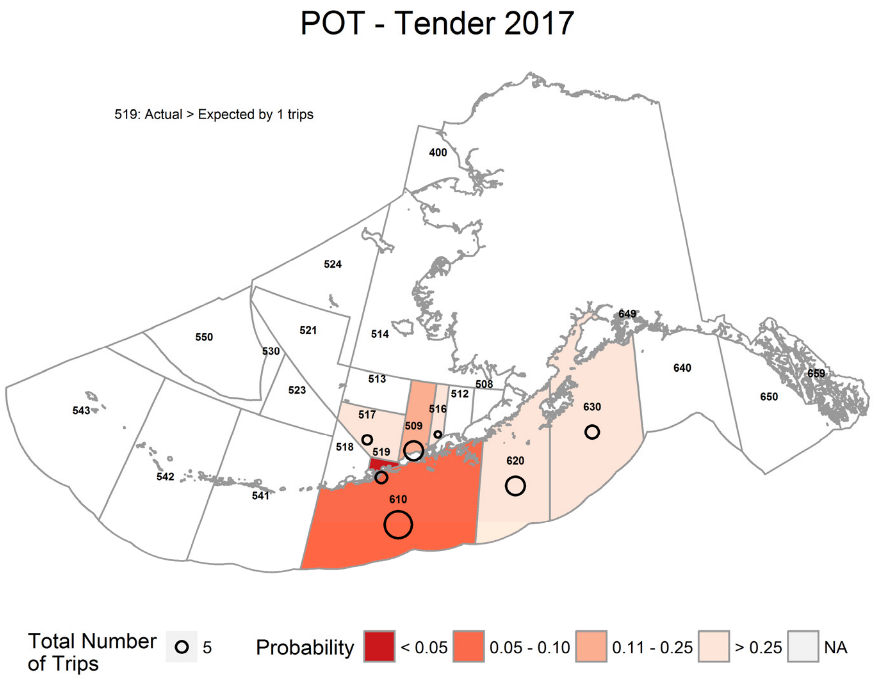

Figure 8. -- Probability of observing the realized or more extreme outcome (coverage rate) in a NMFS Reporting Area in the *POT - Tender* stratum. Reporting Areas where unlikely outcomes occurred are shaded in darker colors.

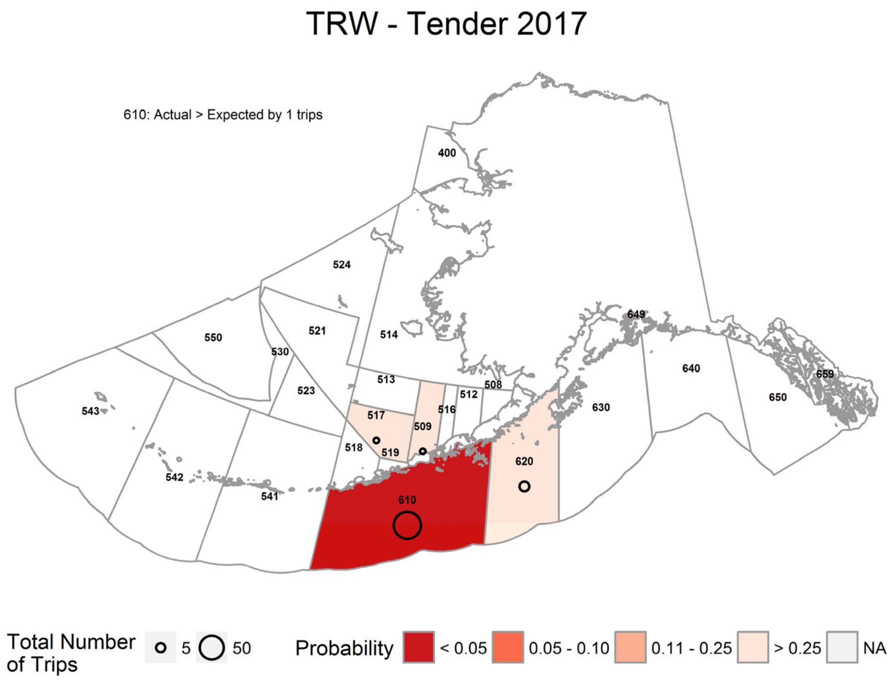

Figure 9. -- Probability of observing the realized or more extreme outcome (coverage rate) in a NMFS Reporting Area in the *TRW - Tender* stratum. Reporting Areas where unlikely outcomes occurred are shaded in darker colors.

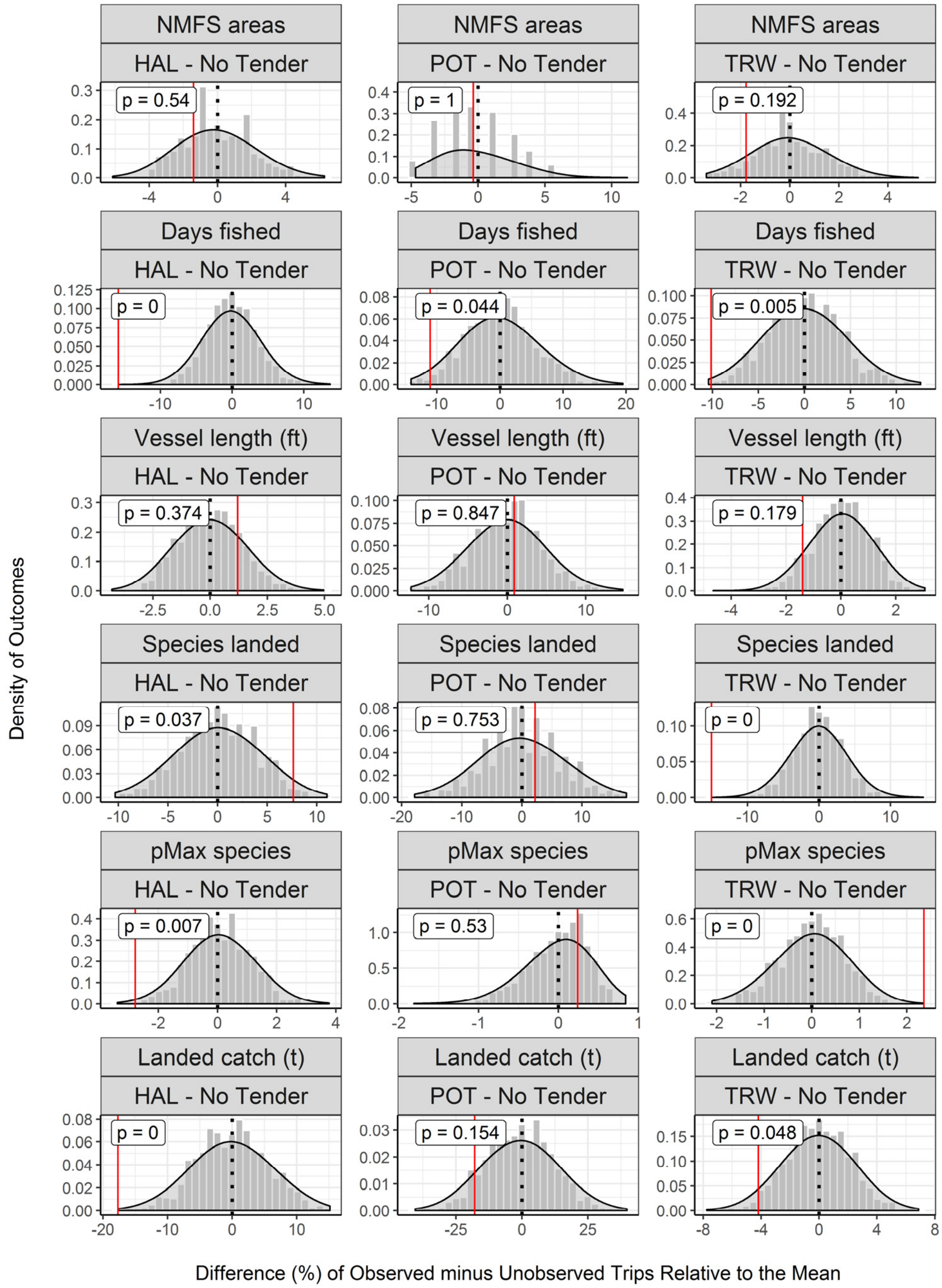

Figure 10. -- Example of results from permutation tests depicting percent differences between observed and unobserved trips for each strata in the partial coverage category. Grey bars depict the distribution of differences between observed and unobserved trips where the assignment of observed status has been randomized (this represents the sampling distribution under the null hypothesis that observed and unobserved trips are the same). The vertical line denotes the actual difference between observed and unobserved trips. Values on the x-axis have been scaled to reflect the relative (%) differences in each metric. The p-value for each test is denoted in the upper left corner. Low p-values are reason to reject the null hypothesis and conclude that there is an observer effect. Results from all permutation tests can be found in the Tables section of this report.

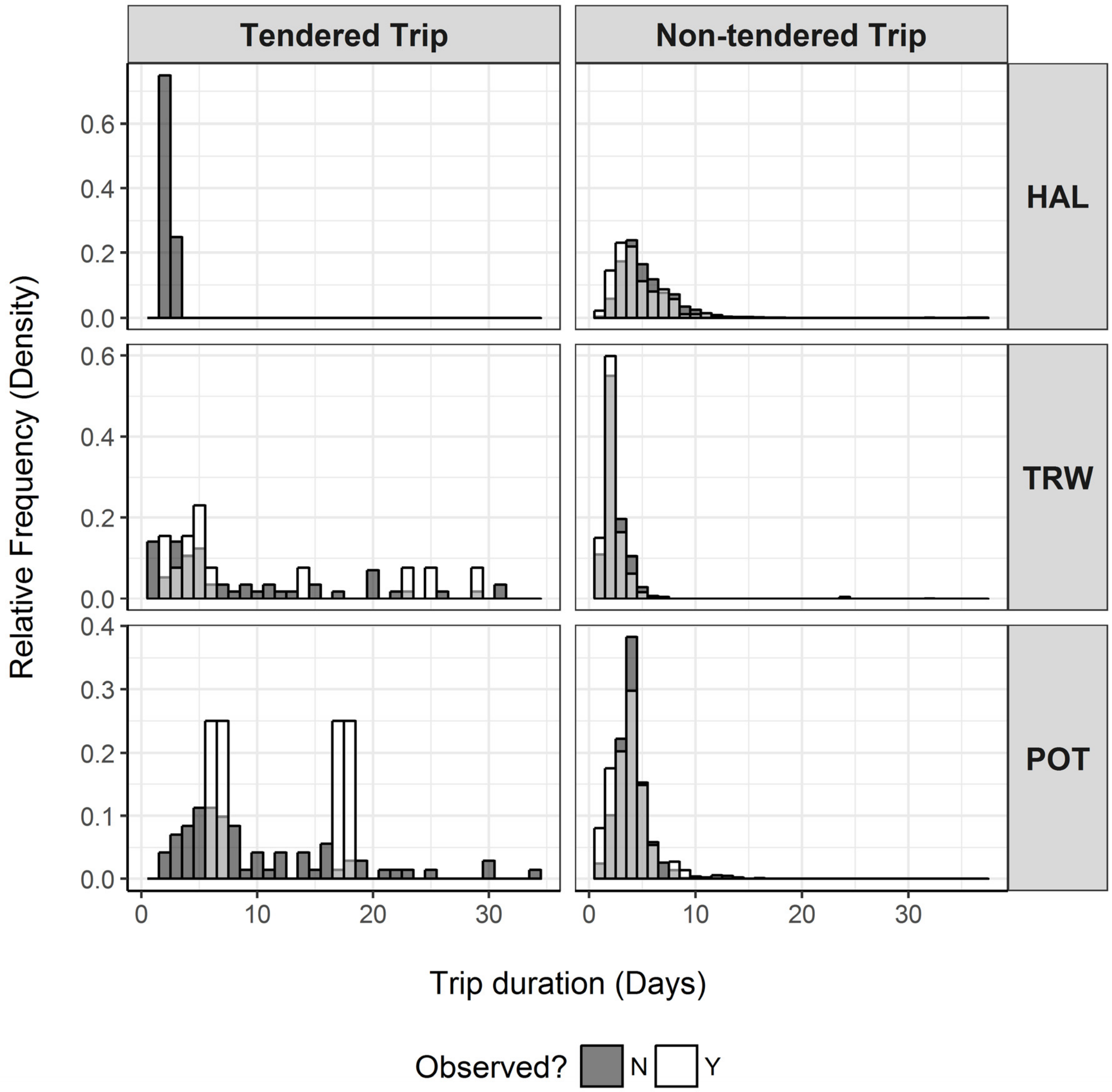

Figure 11. -- Distribution of trip durations for vessels in the partial coverage category by gear and observation status. Observed trips are depicted as transparent white bars overtop of solid black bars for unobserved trips. Trip durations where both observed and unobserved status exist are depicted in gray (This is not the same as a stacked bar chart, in which the height of the bar would reflect observed and unobserved on top of one another- this plot has each observation status in front of the other).

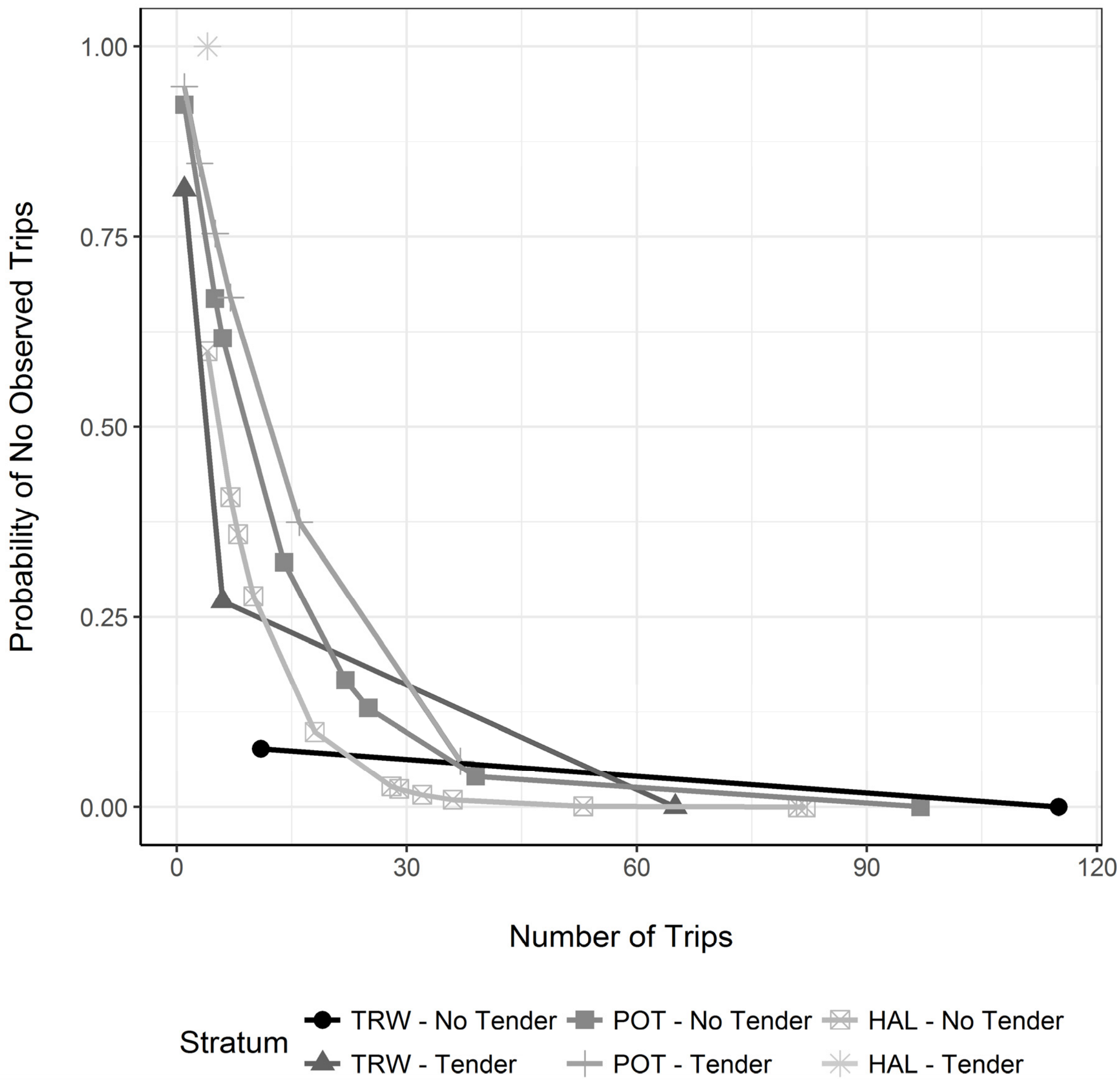

Figure 12. -- Probability of observing no trips in a NMFS Area and stratum given fishing effort and sampling rate. The x-axis has been truncated to increase resolution at low levels of fishing effort. The likelihood of having no observer data decreases with increasing total fishing effort and selection rate. The selection rate is 17.57% in the *TRW - No Tender* stratum, 11.09% in the *HAL - No Tender* stratum, 3.88% in the *POT - No Tender* stratum, 14.29% in the *TRW - Tender* stratum, 25% in the *HAL - Tender* stratum, and 3.92% in the *POT - Tender* stratum.

APPENDIX

At its June 2017 meeting, the Council requested that NMFS evaluate whether there is evidence of an observer effect in either pelagic trawl (PTR) or non-pelagic trawl (NPT) gear fished by partial coverage vessels. The recommendation followed an OAC request for the evaluation, including a discussion about the "pros and cons" of separate observer deployment strata for those two gear types.

One concern identified is vessels selected for observer coverage being directed to fish for pollock in order to avoid the at-sea sampling of salmon PSC that is done on non-pollock trips in the Gulf of Alaska. This type of activity can only occur when pollock is open for directed fishing, but would result in a vessel avoiding an at-sea sample for salmon by taking a pollock trip when observed. Such behavior would result in higher observer coverage in PTR gear since it is used to target pollock. For example, salmon accounting for observed vessels fishing with NPT gear is based on highly variable at-sea samples, whereas observed vessels fishing for pollock (usually using PTR gear) usually have salmon accounted for during the offload at the shoreside processing plant. In management situations where salmon PSC caps are a concern, industry may choose to fish such that their offload is primarily pollock thus obtaining a shoreside count of salmon PSC. Conversely, if halibut PSC limits are a management concern, industry may direct more observed vessels to fish with NPT gear to obtain a larger sample of fishing activity with that gear type.

The Council motion was unclear whether their concern was also related to observer effects within each trawl gear type. A brief response to this concern is also provided in our response to the Council request for information.

Background

Pelagic trawl gear and NPT gear are equated to different styles of fishing, with NPT gear associated with bottom contact and PTR gear typically fished in the water column. While this is often the case, both gear types can be fished on the bottom. Most vessels fishing PTR gear under partial coverage regulations are targeting pollock, while NPT gear targets species such as Pacific cod and flatfish with a generally higher catch of halibut PSC and lower catch of salmon PSC.

The 2017 Annual Deployment Plan separates trawl strata by tender status, not by whether the gear being used is pelagic or non-pelagic. The catch accounting system (CAS) post-stratifies observer and landings data based on whether the trip is recorded as NPT or PTR on the landing report ("fish tickets") or in the observer data. In both cases, the vessel operator is reporting the gear type being used to the observer (usually through the logbook) or through *e*Landings. Although the gear information is "self-reported", regulations at, 50 CFR 679.2 (definitions) define pelagic and non-pelagic trawl gear to be of certain configurations (e.g., floats, mesh configurations, line configurations).

The primary use for PTR gear is to target mid-water pollock and rockfish (in the rockfish program which is full coverage). Since 2013 approximately 90% of the partial coverage category PTR landings had a catch composition of at least 95% pollock, which falls into the CAS "pelagic" pollock target (suggesting mid-water tows). Nearly all of the remaining landings were in the "bottom" pollock target category, which is based on the pollock being the predominant species retained (but less than 95% of the retained catch). Of note is that mixed gear trips, where the vessel fishes both pelagic and non-pelagic gear during a trip, are not uncommon (Appendix Table 1). Since 2011, the proportion of trips with a pollock target using NPT gear in the partial coverage trawl stratum has been stable with an annual average of approximately 12%. Since 2013 there are no apparent trends in the proportion of observed trips using NPT or PTR gear within the pollock target.

Appendix Table 1. -- Number of total trips (*N*) and observed trips (*n*) for all trawl trips, separated by whether the vessel used pelagic gear (PTR), non-pelagic gear (NPT), or both gear types during that trip.

Gear	N	n	% Observed
PTR	1565	354	22.6
NPT	555	91	16.4
NPT & PTR	39	1	2.6

The two gear types are also associated with differing fishery management issues, with salmon bycatch being the primary issue for the pollock pelagic trawl fishery and halibut PSC being of concern for the non-pelagic trawl fishery. Being a relatively rare species, salmon are accounted for shoreside when an observer is onboard and the vessel is not delivering to a tender. These counts are extrapolated to unobserved trips. In contrast, halibut discard estimates are only based on data collected by observers at sea, and extrapolated from observed to unobserved trips.

Evaluation

In evaluating this issue, we considered it in context with the ADP and the potential ramifications on NMFS ability to estimate catch in these fisheries. To this point, there are a couple important high-level issues to consider:

- The type of "observer effect"
- CAS estimation procedures
- The occurrence of mixed gear NPT/PTR trips
- The underlying incentives associated with manipulating observer coverage and how these relate to the deployment plan
- Bias introduced by a misspecified sampling frame

Sampling rates between the two-gear types and within the trawl sampling strata were compared for this report. The realized rates for non-tender trawl gear types were 16.4% of trips observed for NPT and 22.6% of trips observed for PTR gear, respectively (Appendix Table 1). However, note that there should not be an expectation that these rates would equal the trawl deployment rate for 2017 set in ODDs of 17.57%, nor a deployment rate adjusted for trip cancelations (20.7%, this report). There are several factors that contribute to this apparent inconsistency, including number of trips selected (sample size), variability due to random chance, the ratio of number of trips in each of the trawl gear types, and lack of independence between the two coverage rates (as more trips are selected of one type, fewer of the other type will be selected, contributing to the total number selected).

Observer effect: within a gear type

The observer effect issue (i.e., a vessel behaving differently when an observer onboard) is an inherent problem with any at-sea observer program. In the context of the Annual Deployment Plan, stratification is used to group similar types of fishing trips together in order to control variance and for logistical reasons. Stratification is not a tool that can be used to correct for "observer effects" within trawl gear (assuming the observer effect exists and is resulting in biased estimates). In short, we would still require representative sampling within each stratum, and simply establishing a new strata in the ADP would not change this reality. Gear-specific sampling strata would not reduce a vessel operator's ability to change behavior based on observer coverage. Further, since NPT and PTR gear is somewhat fluid within the fishery, gear strata would create incentives for vessels to declare a gear type in an effort to obtain a certain coverage rate, but then fish a different gear type than declared for coverage, which would undermine the sample design, increase variance, and potentially result in biased estimates of bycatch due to over- or under-representation of trips among strata.

Observer effect: PTR versus NPT deployment allocation

Hence, the use of the CAS post-strata to account for any differences in realized coverage rates between PTR and NPT gear. In general, CAS post strata are defined by gear type and trip target for both PSC and groundfish discards. Discard estimates in these post-strata are based on the available observer information, which is derived from samples of fishing activity. Unrepresentative sampling problems could arise if observer coverage was manipulated such that the sample of observed trips does not include certain fishing activities that are in the unobserved fleet. However, in the current situation, the vessel is choosing a different fishing target when observed in order to avoid having at-sea samples used for estimation of salmon bycatch; that is not to say the vessel is fishing differently for pollock than unobserved vessels.

The post-stratification procedures in CAS are an estimation tool that is used to balance the sample so that subgroups within the sample are contributing to the estimates appropriately. In this case, the CAS estimation procedures group trips within the trawl stratum to NPR and PTR post-strata, and hence if one group has a higher realized sample rate than the other, the final estimates for each group will not be biased.

Specification of a new stratification scheme within trawl gear in the ADP would not change a vessel's ability to choose a gear type or fishing target, nor will it mitigate unrepresentative fishing activities. Moreover, CAS uses post-stratification methods to account for both NPT and PTR gear activities, which is a more appropriate method of dealing with the variability associated with each gear type than an ambiguous sampling strata definition.

Other issues with trawl gear stratification

There are a number of other reasons stratification of the sampling plan by NPT and PTR is not recommended:

- Each fishing trip needs to be assigned to one (and only one) stratum so that selection rates for that stratum can be used to determine whether a trip was to be observed. Hence vessels would need to be assigned to the stratum in ODDS and assigned an observer at the stratum-specific rate. For this to occur, they would need to indicate the gear type they intended to fish before they leave port. There is no regulatory requirement that the vessel actually fish that gear, nor would this always be known at the time of logging a trip. For example, a fishery closure may occur and the vessel would switch gear types to operate in a different fishery. A consequence of this is the very problem that stratification is intended to solve would occur: realized deployment would be different from programmed rates specified in the ADP. In addition, since stratification would no longer be grouping similar trips (due to gear changes after assignment to a strata), variance of the estimates will increase.
- A number of vessels fish both NPT and PTR gear on the same trip, requiring them to be their own stratum. There were 39 trips in 2017 that uses both NPT and PTR gear (Appendix Table 1).

- Incentives can change over time. During years of high halibut catch, the incentive may switch from a desire to avoid salmon to one that prioritizes halibut.
- The concern over potentially differential sampling rates within the trawl stratum appears due to a perceived salmon accounting issue. This can best be addressed through changes to salmon accounting methods rather than by a change to the stratification definitions.

Conclusion

The OSC does not support stratification by type of trawl gear (i.e., NPT and PTR strata). The flexibility of vessels to use both gear types adds considerable ambiguity in the sampling plan design and its assessment that cannot be solved by trawl gear type stratification. The realized rates between non-tender trawl gear types were different for NPT and PTR gear in 2017; however, these differences are accounted for in estimation through the post-stratification process. If there is continued concern about this issue, the Council's new focus on trawl within the EM workgroup (in particular, ongoing research on new ways to account for salmon) could provide more robust, longer-term solutions.

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