-Draft-
2019 Annual Deployment Plan for Observers in the Groundfish and Halibut Fisheries off Alaska

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Contents

Executive Summary

This draft 2019 Annual Deployment Plan (ADP) documents how the National Marine Fisheries Service (NMFS) intends to assign fishery observers and electronic monitoring (EM) to vessels fishing in the partial observer coverage category (50 CFR 679.51(a)) in the North Pacific during the calendar year 2019.

- Under regulations at § 679.51(a)(4), the owner of a trawl catcher vessel in the partial observer coverage category may request placement in the full observer coverage category for all directed fishing for groundfish using trawl gear in the BSAI for the upcoming calendar year. Requests may be submitted in the Observer Declare and Deploy System (ODDS)[1] and must be received by **October 15, 2018,** for the 2019 fishing year.

- **Trip selection** will be the sole method of assigning both observers and EM to at-sea fishing events for vessels in the partial observer coverage category in 2019. Trip selection is facilitated through vessels logging their trips into ODDS and being notified by the system if the trip is selected for coverage.

- ***EM trip-selection pool***:
    - Under regulations at § 679.51(f) vessels fishing with non-trawl gear may submit a request to NMFS through ODDS before **November 1, 2018,** to opt into or out of the EM selection pool. Any vessel that does not request to participate by this deadline will not be eligible for the 2019 EM selection pool and will be in the observer trip-selection pool for the duration of the year.
    - Based on available funding for EM, the EM selection pool will be composed of up to 141 fixed gear vessels. If additional funds become available, the number of EM boats could increase to the Council's recommendation of 165 boats.
    - If funding is insufficient to accommodate all the vessels that request to participate in the EM selection pool, NMFS will prioritize placement in the EM selection pool as follows:
        - vessels that are already equipped with EM systems;
        - vessels which are wired for EM systems but are not yet fully equipped; and
        - vessels 40-57.5 ft LOA where carrying an observer is problematic due to bunk space or life raft limitations.
    - If funding is not sufficient to accommodate all vessels in any one of these prioritized categories, NMFS will randomly select vessels from that category until funding is exhausted.

- ***No-selection pool*:** As in all deployment plans, NMFS recommends the no-selection pool continue to be composed of: 1) fixed-gear vessels less than 40 ft LOA and vessels fishing with jig gear, which includes handline, jig, troll, and dinglebar troll gear; 2) vessels voluntarily participating in EM innovation and research.

- ***Observer trip-selection pool* –** NMFS recommends the following sampling strata for the deployment of observers:
    - Hook-and-line vessels greater than or equal to 40 feet(ft) length overall (LOA)
    - Pot vessels greater than or equal to 40 ft LOA
    - Trawl vessels greater than or equal to 40 ft LOA
    - Pot vessels greater than or equal to 40 ft LOA delivering to tenders

[1] The request to be part of the EM selection pool can also be made online at http://odds.afsc.noaa.gov or by calling the ODDS call center at 1-855-747-6377.

- Trawl vessels greater than or equal to 40 ft LOA delivering to tender

- ***NMFS recommends an observer deployment allocation strategy of 15% plus optimization based on discarded groundfish and halibut PSC, Chinook PSC, and crab PSC.*** This allocation strategy provides a balance between minimizing the variability of discard estimates, prioritization of PSC-limited fisheries, and the need to reduce gaps in observer coverage in the partial coverage category.

- Appendix B provides an evaluation of hurdle thresholds to evaluate whether the 15% threshold is warranted for all gear-specific strata. The analysis looks at the chances of observing 3 or more trips in each NMFS Reporting Area under varying levels of observer coverage in 3 years (2015-2017). This enables an assessment of the amount of risk of few observed trips that can be tolerated across NMFS Reporting Areas and the figures in Appendix B use the 50% probability of observing three or more trips per area as the risk threshold to enable comparisons between NMFS areas, Fishery Management Plan (FMP) Area, and years.

  While 15% coverage is sufficient to meet a 50% probability of observing three trips or more in most areas for the hook-and-line and trawl strata, it does not achieve this probability of observation in the other strata. Over the course of a year, some NMFS Areas will have low fishing effort and even at a 15% threshold, there is a relatively high probability that there will be no observed trips for those area. While it is possible to pool data across areas to produce bycatch estimates, these estimates suffer from lower resolution and variance estimates are not able to be produced. The NMFS recommendation of a 15% minimum level of sampling for the hurdle approach for all strata, which precautionary with respect to avoiding bias and increasing the chance of getting data across all gear types and areas.

- NMFS uses estimates of anticipated fishing effort and available sea-day budgets to determine selection rates for each stratum. As a preliminary budget for this draft ADP, NMFS estimated total expenditures in 2019 of $4.45M that will result in 3,110 observer days. The final budget for 2019 is not yet certain and once it is established and EM participants identified, an updated estimate of anticipated fishing effort will be used to estimate expected coverage rates in the final 2019 ADP. NMFS anticipates that the final ADP will include sufficient days to enable optimization above the 15% hurdle. The rates for observer deployment will be based on ***proportion of the observer days*** resulting from the 15% + Optimization (including crab PSC) and will be allocated among strata as: Hook-and-line - 0.18; Pot - 0.15; Tender Pot - 0.01; Trawl - 0.64; and Tender trawl - 0.02 (note that these are NOT the same as deployment rates).

- NMFS will continue to collect genetic samples from salmon caught as bycatch in groundfish fisheries to support efforts to identify stock of origin. For vessels delivering to shoreside processors in the GOA pollock fishery the sampling protocol will remain unchanged; trips that are randomly selected for observer coverage will be completely monitored for Chinook salmon bycatch by the vessel observer during offload of the catch at the shoreside processing facility. For trips that are delivered to tender vessels and trips outside of the pollock fishery, NMFS recommends that salmon counts and tissue samples will be obtained from all salmon found within observer at-sea samples of the total catch.

1. Introduction

Purpose and Authority

This draft 2019 Annual Deployment Plan (ADP) describes how the National Marine Fisheries Service (NMFS) intends to assign at-sea and shoreside fishery observers and electronic monitoring to vessels and processing plants engaged in halibut and groundfish fishing operations in the North Pacific. This plan is developed under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP), the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA FMP), and the Northern Pacific Halibut Act of 1982. Details on the legal authority and purpose of the ADP are found in the Final Rule for Amendment 86 to the BSAI FMP and Amendment 76 to the GOA FMP (77 FR 70062, November 21, 2012). Details on the integration of EM deployment into the ADP process are found in the final rule to integrate electronic monitoring (EM) into the North Pacific Observer Program (82 FR 36991).

The ADP describes the science-driven method for observer deployment to support statistically reliable data collection. The ADP is a core element in implementation of section 313 of the MSA (16 U.S.C 1862), which authorizes the North Pacific Fishery Management Council (Council) to prepare a fisheries research plan that requires the deployment of observers into the North Pacific fisheries and establishes a system of fees. The purpose of the research plan is to collect data necessary for the conservation, management, and scientific understanding of the groundfish and halibut fisheries off Alaska.

Data collection by observers contributes to the best available scientific information used to manage the fisheries in the North Pacific. Information collected by observers provides a reliable and verifiable method for NMFS to gain fishery discard and biological information on fish, and data concerning seabird and marine mammal interactions with fisheries. Observers collect biological samples such as species composition, weights, and tissue samples and information on total catch, including bycatch, and interactions with protected species. Managers use data collected by observers to manage groundfish catch and bycatch limits established in regulation and to document fishery interactions with protected resources. Managers also use data collected by observers to inform the development of management measures that minimize bycatch and reduce fishery interactions with protected resources. Scientists use observer-collected data for stock assessments and marine ecosystem research. Much of this information is expeditiously available (e.g., daily or at the end of a trip, depending on the type of vessel) to ensure effective management.

Process and Schedule

On an annual basis, NMFS develops an ADP to describe how observers and EM will be deployed for the upcoming calendar year and prepares an annual report that evaluates the performance of the prior year's ADP implementation. NMFS and the Council created the ADP process to provide flexibility in the deployment of observers and EM to gather reliable data for estimation of catch in the groundfish and halibut fisheries off Alaska. The ADP process ensures that the best available information is used to evaluate deployment, including scientific review and Council input, to annually determine deployment methods.

The ADP specifies the selection rate—the portion of trips that are sampled—and NMFS and the Council recognized that selection rates for any given year would be dependent on available revenue generated from fees on groundfish and halibut landings. The selection rates can change from one calendar year to the next to achieve efficiency, cost savings, and data collection goals. The annual decision about how to apportion fees between observer deployment and EM system deployment is also made during the ADP process. The ADP process allows NMFS to adjust deployment in each year so that sampling can be achieved within financial constraints.

Some aspects of deployment can be adjusted through the ADP, including the assignment of vessels to a specific partial coverage selection pool, and the allocation strategy used to deploy observers and EM in the partial coverage category. The ADP also defines the criteria for vessels to be eligible to participate in the EM selection pool and can include factors such as gear type, vessel length, home or landing port, and availability of EM systems.

The Council's role in the annual deployment plan process is described in the analysis that was developed to support the restructured observer program (NPFMC 2011) and in the preamble to the proposed rule to implement the restructured observer program (77 FR 23326). The preamble to the proposed rule notes that: "NMFS would consult with the Council each year on the deployment plan for the upcoming year. The Council would select a meeting for the annual report consultation that provides sufficient time for Council review and input to NMFS. The Council would likely need to schedule this review for its October meeting. The Council would not formally approve or disapprove the annual report, including the deployment plan, but NMFS would consult with the Council on the annual report to provide an opportunity for Council input. The final deployment plan would be developed per NMFS' discretion to meet data needs for conservation and management. (77 FR 23344 & 23345)."

The annual analysis and evaluation of the data collected by observers and the ADP development is an ongoing process and this ADP follows the process envisioned by the Council and NMFS when the restructured observer program was developed and implemented. NMFS is committed to working with the Council throughout the annual review and deployment cycle to identify improved analytical methods and ensure Council and public input is considered. The schedule for the 2018 ADP is as follows:

- **June 2018:** NMFS presented the 2017 Annual Report (AFSC/AKR 2018) to the Council and the public. The Annual Report process informs the Council and the public about how well various aspects of the program are working. The review highlights areas where improvements are recommended to 1) collect the data necessary to manage the groundfish and halibut fisheries, 2) maintain the scientific goal of unbiased data collection, and 3) accomplish the most effective and efficient use of the funds collected through the observer fees. The 2017 Annual Report provided a comprehensive evaluation of Observer Program performance including costs, sampling levels, issues, and potential changes for the 2019 ADP.

- **September 2018:** Based on information and analyses from the 2017 Annual Report and Council recommendations, NMFS prepared and released this draft 2019 ADP containing recommendations for deployment methods in the partial coverage category.

- **September – October 2018:**

    - *Review of the draft ADP*: The Council and its Scientific and Statistical Committee will review this draft 2019 ADP and any associated Plan Team and Fishery Monitoring Advisory Committee recommendations. Based on input from its advisory bodies and the public, the Council may choose to clarify objectives and provide recommendations for the final 2019 ADP. NMFS will review and consider these recommendations; however, extensive analysis and large-scale revisions to the draft 2019 ADP are not feasible. This constraint is due to the short time available to finalize the 2019 ADP prior to the December 2018 Council meeting, and practical limitations on planning for deployment (including modifying a federal contract with the observer provider) and associated processes that need to be in place by January 1, 2018.

  - *Requests to participate in EM selection pool*: Vessels in the partial coverage category using fixed gear may request to be in the 2019 EM selection pool using the Observer Declare and Deploy System (ODDS) by November 1, 2018.

- **December 2017:** NMFS will finalize the 2019 ADP and release it to the public prior to the Council meeting.

The analysis and evaluation of the data collected by observers and the ADP development is an ongoing process; in June 2019, NMFS will present the 2018 Annual Report that will form the basis for the 2020 ADP.

2. Annual Report Summary

As described in the previous section, NMFS releases an annual report in June of each year that evaluates observer deployment under the ADP and includes an overview of the fees and budget associated with deployment, enforcement of the Observer Program regulations, a summary of public outreach events, and a scientific evaluation of observer deployment conducted by the Observer Science Committee (OSC) (e.g. Ganz et al. 2018). NMFS has released five annual reports starting with the 2013 Annual Report (NMFS 2014), which was presented to the Council in June 2014, and most recently the 2017 Annual Report (AFSC/AKR 2018), which was presented to the Council in June 2017. This draft 2019 ADP builds on NMFS recommendations in the annual reports and input from the Council (Appendix A).

The sampling design used for dockside monitoring in 2017 remained unchanged from previous years. All vessels participating in the BSAI pollock fisheries are in the full coverage category and dedicated plant observers monitor all deliveries to account for salmon bycatch. In the GOA, all pollock trawl catcher vessels are in the partial coverage category and observers deployed on selected trips monitor the delivery at the shoreside processors to obtain counts of salmon caught as bycatch within the trawl pollock fishery and to obtain tissue samples to enable stock of origin to be determined using genetic techniques. When an observed trawl vessel in the GOA delivers its pollock catch to a tender vessel instead of a shoreside processor, the observer is unable to monitor the delivery and collect additional tissue samples. In this situation, the trip would be monitored, but there is no offload monitoring. Subsequently, NMFS used this sampling design in 2018 and recommended maintaining the status quo for dockside monitoring in 2019. NMFS also recommended that the reconstituted EM workgroup consider longer-term solutions for monitoring salmon bycatch in the trawl fisheries, including how to monitor tender deliveries.

Nine partial coverage deployment strata were evaluated in the 2017 Annual Report: six observer strata defined by gear and tender designation, one EM stratum, one zero coverage stratum, and one zero coverage EM research stratum. Observer coverage rates met expected values in four of the six partial coverage strata with coverage rates higher than expected within the pot (non-tendered) and trawl (non-tendered) strata. Coverage rates in the EM selection pool were lower than expected, because not all video submitted was reviewed due to the pre-implementation status of the EM strata and video review resources were allocated to higher priority projects.

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. NMFS uses a sample size with a gap analysis to determine whether enough samples were collected to ensure adequate spatial and temporal coverage.

In 2017, the observation rate was greater than expected for the majority of the year in the hook-and-line, trawl, and pot strata. This was likely a result of the ODDS inherit process, which created a greater number of selected trips later in the year. ODDS is programmed to automatically select a vessel's next logged trip if a previously selected trip is cancelled by the user. This process of inheriting trips preserves the *number* of selected trips in a year, but it allows selected trips to be *delayed* to later in the year. 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.

Because of the potential temporal bias observed in 2017, NMFS recommended the formation of an Agency subgroup to explore ways to improve the linkages between ODDS and eLandings and ways to reduce the impact of cancellations of trips selected for observer coverage, while still maintaining flexibility for vessels to plan in advance and accommodate changes in fishing plans.

To evaluate spatial representativeness, NMFS used the hypergeometric distribution method (gap analysis), to compare the expected number of trips and the observed number of trips in each NMFS Reporting Area and stratum combination. 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. There was some evidence of clustering of observed trips among NMFS Areas that was different from expected in all strata evaluated.

Six trip metrics evaluated to compare if observed trips were similar to unobserved trips and identify potential observer effects. No observer effects were detected in the tender pot and tender trawl strata. Observed trips were 11.1% (0.4 days) shorter in duration than unobserved trips in the pot stratum.

In the hook-and-line stratum, four trip metrics identified potential observer effects. Observed hook-and-line 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 t) less than unobserved trips. In the trawl stratum, four trip metrics identified potential observer effects. Observed trips 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 t) less than unobserved trips.

Based on the results in the 2017 Annual Report, NMFS recommended evaluating the suite of trip metrics used to evaluate the observer effect. In particular, evaluating how they relate to at-sea data collections and, to the extent feasible, providing additional context regarding the interpretation of effect sizes and p-values (e.g., consideration of sample sizes).

NMFS recommends continuing trip-selection in the EM pool for 2019 where trips will be selected prior to departure, and for selected trips, the vessel will be required to use the EM system. NMFS will continue to evaluate the monitoring effect in the EM selection pool and, in the future, may recommend post-selection of trips. NMFS recommended that priority for placing vessels in the EM selection pool in 2019 be given to 1) vessels that are already equipped with EM systems and 2) vessels 40-57.5 ft length overall (LOA) where carrying an observer has been problematic due to bunk space or life raft limitations.

Recognizing the challenging logistics of putting observers on small vessels, NMFS continues to recommend that vessels less than 40 ft be in the no selection pool for observer coverage. The agency recognizes that the Council's next priority for EM research has shifted to trawl vessels, so the evaluation of data collected on fixed-gear less than 40 ft will not begin immediately. However, since there is no monitoring data from this segment of the fleet, NMFS does continue to recommend that vessels less than 40 ft LOA could be considered for the EM selection pool in the future.

3. 2019 Deployment Methods

The Observer Program uses a stratified hierarchical sampling design where trips and vessels represent the primary sampling units. Observers and EM are deployed into strata that are defined through a combination of regulations and the annual deployment process. Subsequent and lower levels of the sampling design at sea include the sampling of hauls, conducting species composition, obtaining lengths and biological tissues including those used for ageing, sexual maturity and genetics. Dockside monitoring consists solely of conducting complete enumerations of salmon bycatch within the pollock fishery.

At-Sea Deployment Design

The sampling design for at-sea deployment of observers and EM in the partial coverage category involves three elements: 1) the selection method to accomplish random sampling; 2) division of the population of partial coverage trips into selection pools or strata (stratification scheme); and 3) the allocation of deployment trips among strata (allocation strategy).

Selection Method

Trip selection will be the sole method of assigning both observers and EM to at-sea fishing events in 2019. Trip-selection refers to the method of selecting fishing trips as the sampling unit. Trip selection is facilitated through vessels logging their trips into the Observer Declare and Deploy System (ODDS) and being notified if the trip is selected for coverage.

In addition to logging each of their trips, vessels in the EM selection pool will also use ODDS to close each trip following the instructions in their Vessel Monitoring Plan (VMP) (Appendix F).

Selection Pools (Stratification Scheme)

<u>Electronic Monitoring (EM) Selection Pool:</u>
Vessels in the partial coverage category using fixed gear may request to be in the 2019 EM selection pool using the Observer Declare and Deploy System (ODDS).[2] Any vessel in the EM selection pool in 2018 will remain qualified to be in the EM selection pool unless a request is submitted to not be in the EM selection pool for 2019 or NMFS has disapproved the vessel's 2018 VMP. All these requests, to be in or out of the EM selection pool for 2019 must be received by November 1, 2018. Any vessel that does not request to participate by this deadline will not be eligible for placement in the 2019 EM selection pool and will be in the partial coverage trip selection pool for observer coverage.

[2] The request to be part of the EM selection pool can also be made online at http://odds.afsc.noaa.gov or by calling the ODDS call center at 1-855-747-6377.

The number of vessels in the EM selection pool will be based on the amount of funding. Currently there is funding available for EM selection pool of up to 141 fixed gear vessels.[3]

If funding is insufficient to accommodate all the vessels that request to participate in the EM selection pool, NMFS will prioritize placement in the EM selection pool as follows:

1) vessels that are already equipped with EM systems;
2) vessels that are wired for EM systems but are not yet fully equipped; and
3) vessels 40-57.5 ft LOA where carrying an observer is problematic due to bunk space or life raft limitations.

If funding is not sufficient to accommodate all vessels in any one of these prioritized categories, NMFS will randomly select vessels from that category until funding is exhausted.

NMFS will notify vessel owners whether that vessel has been approved or denied for placement in the EM selection pool. Once NMFS notifies a vessel that they are in the EM selection pool, that vessel will remain in the EM selection pool for the duration of the calendar year. Vessels in the EM selection pool are required to submit and follow an NMFS-approved Vessel Monitoring Plan (see Appendix F).

EM system installations will be scheduled in the primary ports of Homer, Kodiak, and secondary ports such as Juneau, Petersburg, Sand Point, King Cove, and Dutch Harbor may have periodic EM installation services available. Vessels not available during scheduled dates of EM installation in a secondary port will be required to travel to a primary port for EM installation services prior to the date of their first logged trip in ODDS. Primary and secondary port services apply to EM equipment installation and servicing only, there are no restrictions on where a vessel may make landings associated with this program. Once installed, the EM sensors and cameras will remain on the vessel until either 1) the boat opts out of the EM pool for the following year; or 2) NMFS determines that the vessel will not be eligible to participate in the EM selection pool the following year.

Trip-Selection Pools for Observer Deployment:

NMFS recommends that the observer trip selection strata implemented in 2018 remain the same for 2019. This follows the Observer Science Committee (OSC) and the Scientific and Statistical Committee (SSC) recommendation to stabilize the sampling design across years.

Summary of 2019 Deployment Strata:

NMFS recommends the following deployment strata for vessels in the partial coverage category (50 CFR 679.51(a)) in 2019:

- ***No-selection pool*****:** The no-selection pool is composed of vessels that will have no probability of carrying an observer on any trips for the 2019 fishing season. These vessels are: 1) fixed-gear vessels less than 40 ft LOA[4] and vessels fishing with jig gear, which includes handline, jig, troll, and dinglebar troll gear; 2) vessels voluntarily participating in EM innovation and research.

[3] Additional National Fish and Wildlife (NFWF) funds are also being requested by industry and if this request is successful, the number of EM boats could increase to the Council's recommendation of 165 boats total.

[4] Length overall (LOA) is defined in regulations at 50 CFR 679.2 and means the centerline longitudinal distance, rounded to the nearest foot.

- ***Electronic monitoring (EM) trip-selection pool:*** Based on the amount of available funding that is currently available[5] for EM, the EM selection pool will be composed of up to 141 fixed gear vessels.
- ***Observer Trip-Selection Pool:*** NMFS recommends 5 sampling strata in the trip-selection pool for the deployment of observers:
  - ***Hook-and-line:*** This pool is composed of all vessels in the partial coverage category that are greater than or equal to 40 ft LOA that are fishing hook-and-line gear.
  - ***Pot:*** This pool is composed of all vessels in the partial coverage category that are greater than or equal to 40 ft LOA that are fishing pot gear.
  - ***Pot vessels delivering to tenders:*** This pool is composed of all vessels in the partial coverage category that are greater than or equal to 40 ft LOA that are fishing pot gear and are delivering to tendering vessels.
  - ***Trawl***: This pool is composed of all catcher vessels in the partial coverage category fishing trawl gear.
  - ***Trawl vessels delivering to tenders:*** This pool is composed of all catcher vessels in the partial coverage category that are greater than or equal to 40 ft LOA that are fishing trawl gear and are delivering to tendering vessels.

Allocation Strategy

Allocation strategy refers to the method of allocating deployment trips among strata. In 2018, the NMFS implemented the observer allocation strategy of 15% hurdle plus optimization where observer sea days are first allocated equally up to a threshold coverage rate and the remaining sea-days are allocated using an optimal allocation algorithm that maximizes precision for chosen metrics (such as discards or retained catch) for the least cost. Appendix E provides more information on the hurdle approach and the methods used to evaluate the chances of data being available to inform inseason management under varying observer coverage levels. Appendix B provides an evaluation of hurdle thresholds to evaluate whether the 15% threshold that was implemented in 2018 is appropriate for all gear-specific strata. The analysis looks at the chances of observing 3 or more trips in each NMFS Reporting Area under varying levels of observer coverage in 3 years (2015-2017). This enables an assessment of the amount of risk of few observed trips that can be tolerated across NMFS Reporting Areas and the figures in Appendix B use the 50% probability of observing three or more trips per area as the risk threshold to enable comparisons between NMFS areas, Fishery Management Plan (FMP) Area, and years.

While 15% coverage is sufficient to meet a 50% probability of observing three trips or more per year in most areas for the hook-and-line and trawl strata, it does not achieve this probability of observation in the other strata. ***It is important to note that the 15% minimum threshold does not guarantee that all areas will have at least 3 observed trips. Instead, it represents the point at which many (but not all) areas have a greater than 50% chance of at least 3 observed trips in a year.*** Over the course of a year, some NMFS Areas will have low fishing effort and even at a 15% threshold, there is a relatively high probability that there will be no observed trips for those area. While it is possible to pool data across areas to produce bycatch estimates, these estimates suffer from lower resolution and variance estimates are not able to be produced. ***NMFS continues to recommend the 15% minimum level of sampling for the***

[5] Additional National Fish and Wildlife (NFWF) funds are also being requested by industry and if this request is successful, the number of EM boats could increase to the Council's recommendation of 165 boats total.

hurdle approach for all strata, which precautionary with respect to avoiding bias and increasing the chance of getting data across all gear types and areas.

For the 15% plus optimization strategy, two metrics for optimization were evaluated: 1) discards of groundfish, halibut PSC and Chinook salmon PSC; 2) discards of crab PSC in addition to groundfish, halibut PSC, and Chinook salmon PSC. There was no difference between the gaps in coverage between the equal allocation and 15% plus optimization designs (Appendix C). This is due to the fact that estimated budget used in this draft ADP only afforded the 15% base coverage; so although the weightings for optimized observer days were produced, their effect in Appendix C on the number of trips predicted to be observed in a NMFS area is negligible. However, as described below, when the final ADP is developed the weightings resulting from the optimization will be used to determine the final deployment rates.

NMFS recommends an observer deployment allocation strategy of 15% plus optimization based on discarded groundfish and halibut PSC, Chinook PSC, and crab PSC. This allocation strategy provides a balance between minimizing the variability of discard estimates, prioritization of PSC-limited fisheries, and the need to reduce gaps in observer coverage in the partial coverage category.

Estimated Deployment Rates

Based on recommendations from the Council (Appendix A), NMFS recommends maintaining 30% selection rate for the EM selection pool for 2019.

NMFS uses estimates of anticipated fishing effort and available sea-day budgets to determine selection rates for each stratum. The final budget for 2019 is not yet certain and as preliminary budget for this draft ADP, NMFS estimated total expenditures in 2019 of $4.45M that will result in 3,110 observer days.

In order to evaluate the relative performance of alternative stratification schemes and allocation strategies, the analysis in Appendix C is based on necessary assumption of future fishing effort, namely that fishing in 2019 will be identical to that in 2017. The analysis does not incorporate uncertainty in observer fee projections for 2019 nor uncertainty in the timing when the observer fees will be available. To mitigate this uncertainty the deployment rates from Appendix C were set at the 15% minimum hurdle for each strata. Once a final budget for the 2019 ADP is established and EM participants identified, an updated estimate of anticipated fishing effort and simulation models (following methods outlined in NMFS 2015) will be used to estimate expected coverage rates in the final 2019 ADP. NMFS anticipates that the final ADP will include sufficient days to enable optimization above the 15% hurdle. Allocation of observer days among strata results from the number of days needed to achieve base rate in addition to those afforded for optimization. The rates for observer deployment in the final ADP and will be based on ***proportion of the observer days*** resulting from the 15% + Optimization (including crab PSC) and will be allocated among strata as (note that these are NOT the same as deployment rates):

- Hook-and-line - 0.18
- Pot - 0.15
- Tender Pot - 0.01
- Trawl - 0.64
- Tender trawl - 0.02

Chinook Salmon Sampling in the Gulf of Alaska

For vessels delivering to shoreside processors in the in the GOA pollock fishery the sampling protocol for Chinook salmon will remain unchanged. Trips that are randomly selected for observer coverage will be completely monitored for Chinook salmon bycatch by the vessel observer during offload of the catch at the shoreside processing facility.

For trips in the GOA pollock fishery that are delivered to tender vessels and trips outside of the pollock fishery, salmon counts and tissue samples will be obtained from all salmon found within observer at-sea samples of the total catch.

Conditional Release Policy

For 2019, NMFS will not grant any conditional releases or temporary exemptions to any vessels subject to observer coverage. The integration of EM into the Observer Program in 2019 is a mitigating factor in not granting any conditional releases. Vessels in the EM selection pool will carry EM equipment as described in the Vessel Monitoring Plan (Appendix F) and will not be subject to carrying an observer.

Annual Coverage Category Requests

Partial coverage catcher/processors

Under Observer Program regulations at 50 CFR 679.51(a)(3), the owner of a non-trawl catcher/processor can request to be in the partial observer coverage category, on an annual basis, if the vessel processed less than 79,000 lb (35.8 mt) of groundfish on an average weekly basis in a particular prior year. The deadline to request placement in the partial observer coverage category for the following fishing year is July 1 and the request is accomplished by submitting a form[6] to NMFS. Six catcher/processors requested, and NMFS approved, placement in the partial coverage category for the 2019 fishing year.

Full coverage catcher vessels

Under Observer Program regulations at 50 CFR 679.51(a)(4), the owner of a trawl catcher vessel may annually request the catcher vessel to be placed in the full observer coverage category for all directed fishing for groundfish using trawl gear in the BSAI management area for the upcoming year. Requests to be placed into the full observer coverage in lieu of partial observer coverage category must be made in ODDS[7] prior to October 15, 2018 for the 2019 fishing year. NMFS will publish the list of catcher vessels that have been approved to be in the full coverage category on the website at: https://alaskafisheries.noaa.gov/fisheries/observer-program.

Observer Declare and Deploy System (ODDS)

For 2019, the user experience in ODDS will not change for a vessel operator. As in 2017 and 2018, there will be a selection box to indicate whether the vessel will be delivering to a tender. NMFS will retain the current business operating procedure of allowing vessels to log up to three trips in advance and programming that prevents a 40 – 57.5’ fixed gear vessel from being randomly selected for a third

[6] The form for small catcher/processors to request to be in partial coverage is available at: https://alaskafisheries.noaa.gov/sites/default/files/obspartialcovreq.pdf

[7] Instructions for catcher vessels to request to be in full coverage using ODDS are available at: https://alaskafisheries.noaa.gov/fisheries/observer-program

consecutive observer trip. Any observed trip that is canceled would automatically be inherited on the next logged trip. As described in the 2017 Annual Report, vessels are allowed to cancel or change any unobserved trips (logged trips that have not been selected to carry observer coverage) themselves, but any observed trips (logged trips that have been selected for observer coverage) that must be rescheduled need to be coordinated by contacting A.I.S., Inc., through the ODDS call center (1-855-747-6377). NMFS has identified an improvement to the programming in ODDS that would allow vessels to change the dates for future observed trips, rather than having the current cancel and inherit process. This modification is a priority for NMFS and the Council (Appendix A), and NMFS will consider whether it is feasible to include this programming change to ODDS in 2019.

Vessels are allowed to cancel or change any unobserved trips (logged trips that have not been selected to carry observer coverage) themselves, but any observed trips (logged trips that have been selected for observer coverage) that must be rescheduled need to be coordinated by contacting A.I.S., Inc., through the ODDS call center (1-855-747-6377).

4. Communication and Outreach

NMFS will continue to communicate the details of the ADP to affected participants through letters, public meetings, and information on the internet:

- Information about the Observer Program and Frequently Asked Questions about EM and Observer deployment are available at https://alaskafisheries.noaa.gov/fisheries/observer-program
- For Frequently Asked Questions regarding ODDS go to http://odds.afsc.noaa.gov/ and click the "ODDS FAQ" button.

Observer Program staff are available for outreach meetings upon request by teleconference and/or WebEx pending staff availability and local interest. A community partner would be needed to organize a location and any necessary equipment to facilitate additional meetings. To request a meeting or suggest a topic for discussion, please contact Jennifer Ferdinand at 1-206-526-4076.

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6. List of Preparers and Contributors

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Appendix A. Council motion on the Annual Report and ADP

Council Motion
June 7, 2018
Agenda Item C-1: Observer Program Annual Report & OAC Report

1. The Council supports the NMFS recommendations for the draft 2019 Annual Deployment Plan that are listed in section 7.1 (pg. 102) of the 2017 Annual Report.

2. Based on input from the OAC and AP, the Council also recommends the following:

    - In the draft 2019 ADP, include an evaluation of a gear-specific hurdle that reduces the impact of NMFS regulatory areas with low fishing effort in determining the observer coverage rates for the hurdle.
    - For the EM selection pool in 2019, the Council recommends:
        - If funds are available, expand the EM selection pool up to a maximum of 165 vessels.
        - Continue to implement a 30% trip-selection rate, using the pre-trip selection method.
    - In the 2018 Annual Report (to be presented in June, 2019), the Council recommends that NMFS:
        - Include an evaluation of observer effects at finer resolution than gear-level strata, so that observer effects in pelagic and non-pelagic trawl can be investigated.
        - Continue to provide details on EM in Chapter 4 and also include information in the report about the number of EM trips selected, the number monitored, and the number reviewed, for clarification.
        - Add an appendix that describes details of cost calculations for EM and observer days over time.
    - The Council also recommends that NMFS communicate with the OAC on the results from the proposed ODDS agency subgroup.

3. The Council supports the continued participation of the OAC Subgroup in the development of the fee analysis, including the opportunity for OAC review of the analysis before Initial Review at the Council.

4. The Council appreciates the preliminary survey report from OLE and acknowledges the evidence of disparate work environment for female and male observers. The Council encourages efforts to further understand these work conditions and develop solutions.

Appendix B. Gear Based Hurdle Approach

Prepared by the AFSC / FMA Division

Purpose

The Observer Science Committee and NMFS recommendation for the 2018 ADP (a base 15% "hurdle' + optimization) was derived from Final Supplement to the Environmental Assessment For Restructuring the Program for Observer Procurement and Deployment in the North Pacific prepared by NMFS in 2015 (NMFS 2015). This analysis grouped trips according to a different stratification scheme (trip and vessel selection strata) than the gear-based strata that is currently used in deployment. The SEA also evaluated the potential for empty (no data) post-strata at a much higher resolution (smaller in-season post-strata) than are used in draft ADP evaluations (NMFS 2015). The purpose of the analysis in this appendix is to evaluate strata-specific hurdle thresholds.

Methods

Fishing effort data from 2015-2017 (same as the draft 2019 ADP analysis), was relabeled to represent the draft 2019 ADP strata, and then used to estimate the probability of observing less than three trips in a NMFS Area based on the hypergeometric distribution (hereafter simply 'probability estimations'). The details of hypergeometric distribution and this type of analysis are described in more detail in Appendix E.

In prior ADPs, trips that occurred in more than one area were given partial trip values in these analyses. However, after investigation (Appendix D), it was decided that this resulted in too conservative an estimate of probabilities of observation, and instead whole values were used for each area a trip occurred in.[8] Probability estimations were repeated over a range of sample sizes (total number of observed trips) to illustrate the effect of observer sampling rate on the probability of observing three or more trips from an area. Estimations were repeated over each prior year of fishing effort to illustrate between-year variability. The 2019 ADP electronic monitoring (EM) strata was also included to compare the results from this analysis to the 30% trip selection rate adopted by the Council and NMFS though their EM workgroup. Definitions of the EM stratum were based on 2018 participants.

Results

Results are presented as a series of plots organized to enable comparisons between NMFS areas, Fishery Management Plan (FMP) Area, and years. Each plot contains a horizontal dashed line at 50% probability of three or more trips being observed within a year. This value of 50% was also used in the SEA. Each plot also contains a vertical dashed line at 15% coverage that represents the 2018 ADP minimum coverage threshold for the "hurdle".

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[8] Even though the sum of the trips among areas is greater than the total number of trips, this seems the correct approach since each probability estimation is independent of the other areas, and practically, observing or not observing a trip in multiple areas would result in all areas having the same observed or unobserved outcome.

The current 30% selection for EM appears to be sufficient to achieve a 50% probability of observing three trips in nearly every NMFS area in the Gulf of Alaska, all but three areas in the Bering Sea, and no area in the Aleutian Islands (Figure 1).

Figure 2 shows the probabilities for observing at least three trips from each NMFS area under varying sampling rates for the three main gear groups: Hook and Line (HAL), Pot (POT) and Trawl (TRW). For Hook and Line gear (HAL), the current 15% coverage threshold appears sufficient to achieve a 50% probability of observing at least three trips in two of three areas in the Aleutians, three of six areas in the BSAI in most years, and all areas in the Gulf of Alaska. For Pot gear the minimum threshold of 15% coverage appears insufficient to achieve a 50% probability of observing at least three observed trips in areas of the Aleutian Islands, but is sufficient for three of four to six areas in the Bering Sea, and all areas in the Gulf of Alaska in years prior to 2017. In 2017, however, the results from the Gulf of Alaska were different and the 15% coverage rate would be sufficient to achieve a 50% probability of observing three trips in only three of five areas. The current 15% minimum trip threshold for trawl gear appears sufficient to achieve a 50% probability of observing at least three trips in two of two to three areas of the Bering Sea, and all areas in the Gulf of Alaska (with the exception of West Yakutat District, Area 640, in 2015, due to low effort; Table 1).

Figure 3 shows the probabilities for observing at least three trips from each NMFS area under varying sampling rates for the two main gear groups that engage in tendering activity. The strata comprised of trips where pot gear is used in combination with tendering activity (POT TENDER) is rare enough in the Bering Sea to result in a less than 50% chance of observing three trips in all NMFS areas at 15% coverage. The results for the pot tender trips in the Gulf of Alaska are variable among years; the coverage rate of 15% does appear to be sufficient to achieve a 50% probability of observing three pot tender trips in all areas in 2015, and 1-2 of the 3 areas in 2016 and 2017. For the trawl-tender strata, a 15% coverage rate appears insufficient to achieve a 50% probability of observing three trips in any area of the Bering Sea due to low fishing effort, but does seem sufficient to achieve a 50% probability of observing three trips in area 610 in the Gulf of Alaska.

Figure 4 summarizes the results and shows the proportion of NMFS areas that achieve a 50% chance of observing three trips or more. While 15% coverage is sufficient to meet a 50% probability of observing three trips or more in most areas for the hook-and-line and trawl strata, it does not achieve this probability of observation in the other strata. Some strata may indicate trends of diminishing total trips; from 2015 to 2017, the Pot and Trawl-Tender plots show that 15% coverage would result diminishing proportion of areas achieving 50% probability of being observed.

Catches of each of the metrics used in optimization routines in the ADP are presented for reference in Table 2.

The results of the probability estimations presented here depend on which year of fishing effort is being examined, which makes sense since the hypergeometric distribution used the number of trips in a NMFS Area and strata as inputs in the calculation. Given the inter-annual variation, an alternative approach could be to merge multiple years into a more stable, generalized “super-year” as is done in the draft ADP optimization routine.

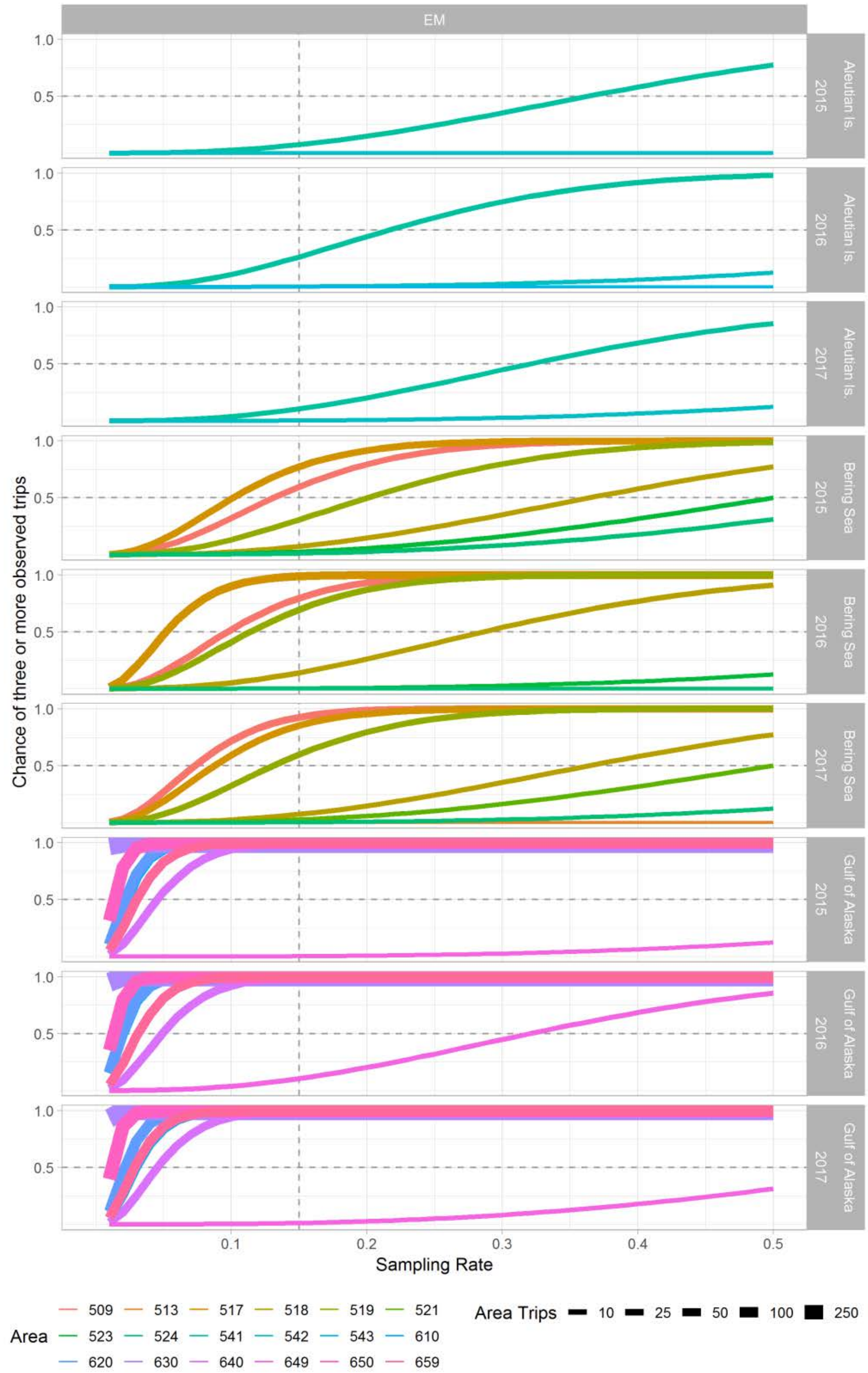

Figure 1. Chance of observing three or more trips in a NMFS Area presented by FMP and Year for the Electronic Monitoring (EM) 2019 ADP stratum.

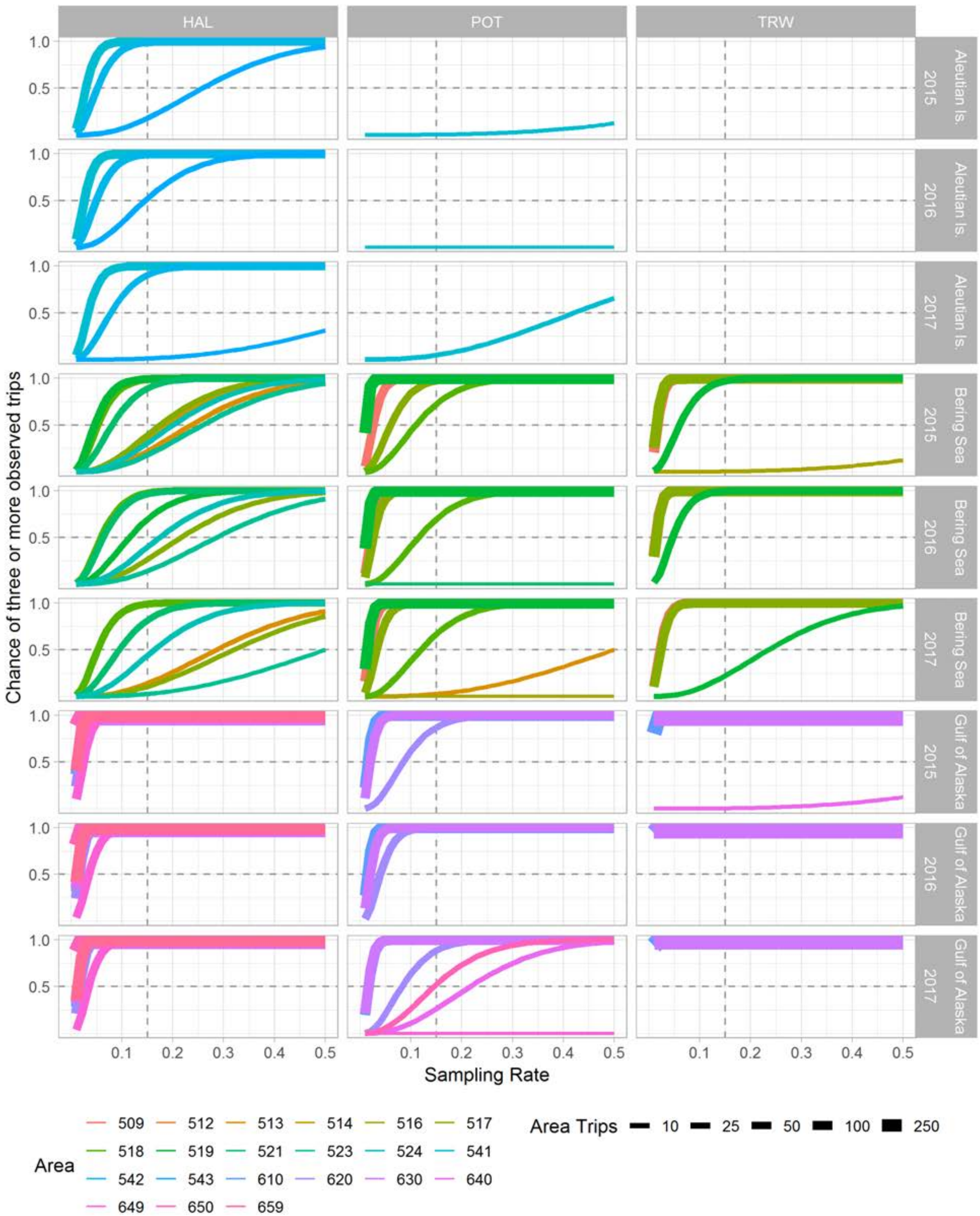

Figure 2. Chance of observing three or more trips in a NMFS Area presented by FMP and Year for the Hook and Line (HAL), Pot (POT) and Trawl (TRW) 2019 ADP stratum.

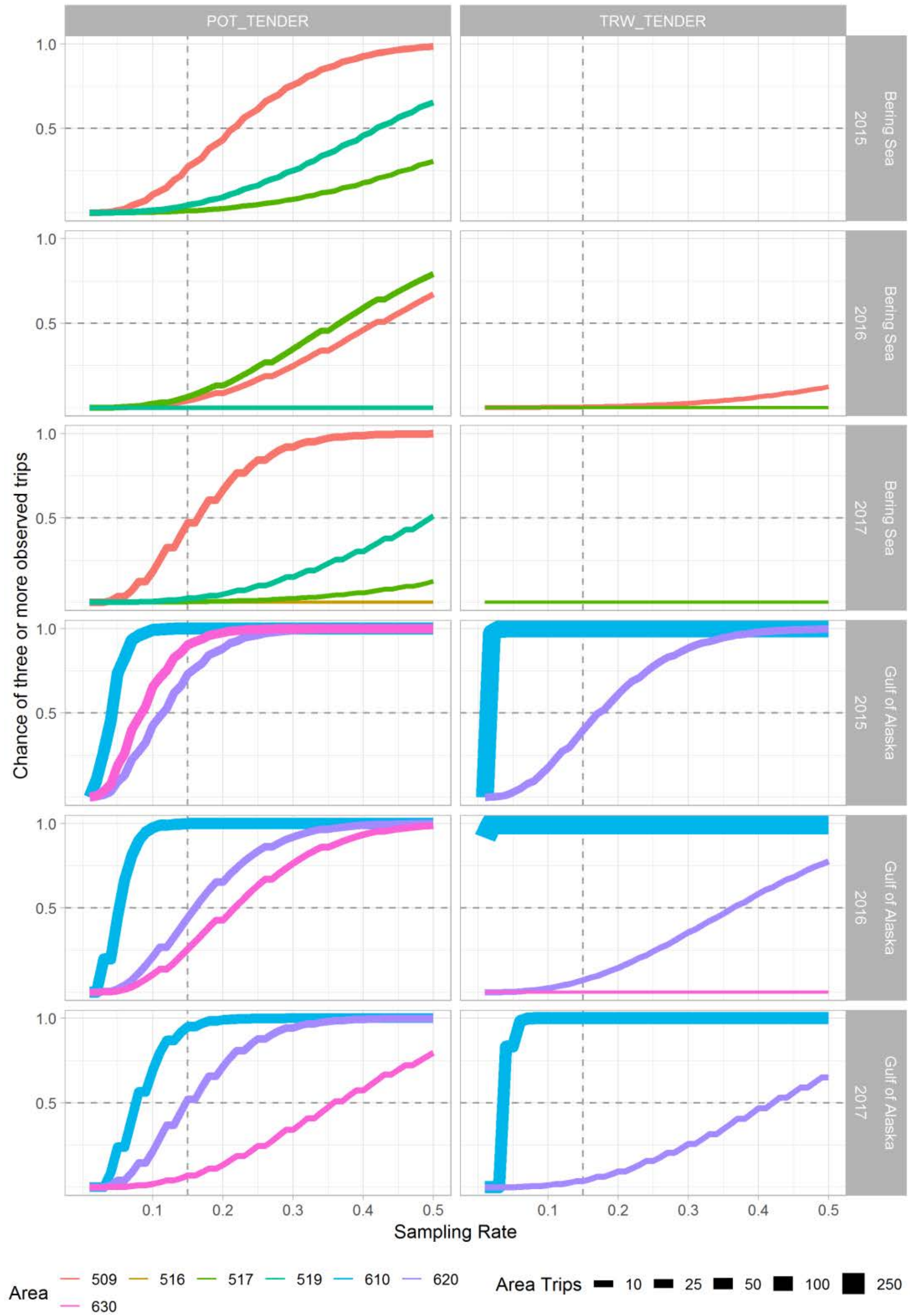

Figure 3. Chance of observing three or more trips in a NMFS Area presented by FMP and Year for the Pot and Tendering (POT_TENDER) and Hook and Trawl Tendering (TRW_TENDER) 2019 ADP stratum

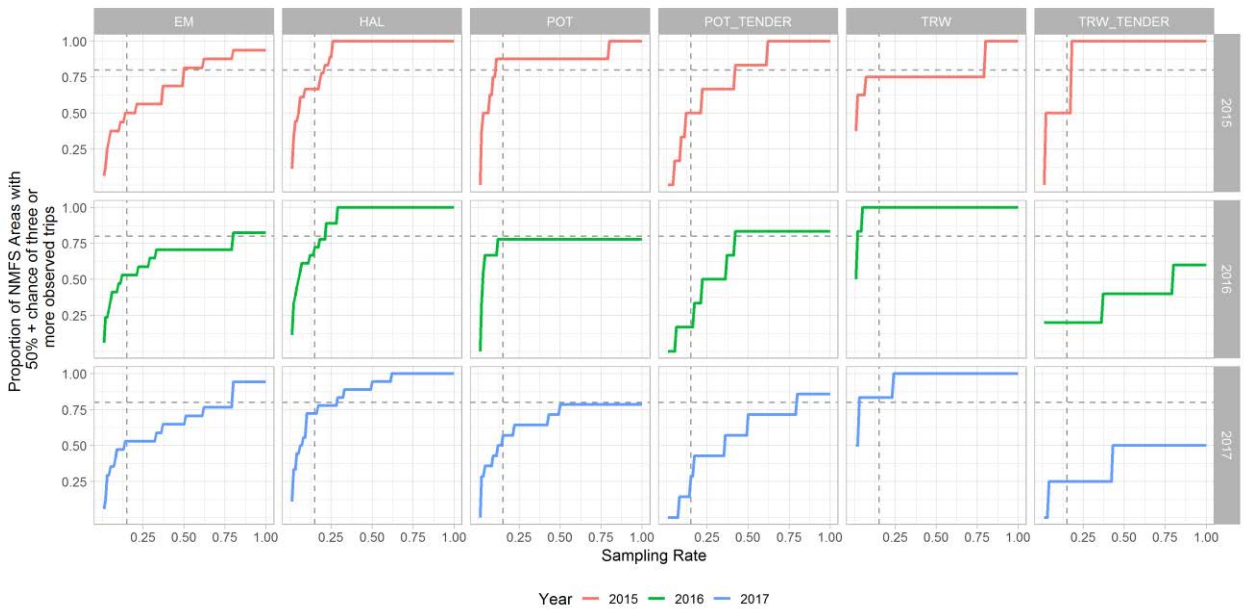

Figure 4. Proportion of all NMFS Areas having a greater than 50% chance of observing three or more trips presented by Year for 2019 ADP stratum.

Table 1. Number of trips that occurred in each area for each prior year of fishing re-categorized according to the 2019 draft ADP strata. Only those areas where more than three vessels fished are presented.

ADP	2019 Strata	AREA	TRIPS_CELL
2015	EM	509	20
2015	EM	517	26
2015	EM	518	7
2015	EM	521	5
2015	EM	523	5
2015	EM	524	4
2015	EM	541	7
2015	EM	610	116
2015	EM	620	121
2015	EM	630	594
2015	EM	640	58
2015	EM	650	196
2015	EM	659	87
2015	HAL	513	11
2015	HAL	514	14
2015	HAL	517	15
2015	HAL	518	51
2015	HAL	519	58
2015	HAL	521	33
2015	HAL	523	10
2015	HAL	524	13
2015	HAL	541	93
2015	HAL	542	52
2015	HAL	543	10
2015	HAL	610	212
2015	HAL	620	165
2015	HAL	630	881
2015	HAL	640	228
2015	HAL	649	113
2015	HAL	650	468
2015	HAL	659	225
2015	POT	509	102
2015	POT	517	44
2015	POT	519	240
2015	POT	610	177
2015	POT	620	31
2015	POT	630	132
2015	POT_TENDER	509	12
2015	POT_TENDER	610	65
2015	POT_TENDER	620	23
2015	POT_TENDER	630	31
2015	TRW	509	160
2015	TRW	517	179
2015	TRW	519	44
2015	TRW	610	416
2015	TRW	620	842

ADP	2019 Strata	AREA	TRIPS_CELL
2015	TRW	630	944
2015	TRW	640	3
2015	TRW_TENDER	610	167
2015	TRW_TENDER	620	15
2016	EM	509	27
2016	EM	517	51
2016	EM	518	9
2016	EM	519	23
2016	EM	523	3
2016	EM	541	12
2016	EM	610	134
2016	EM	620	137
2016	EM	630	512
2016	EM	640	54
2016	EM	649	8
2016	EM	650	204
2016	EM	659	85
2016	HAL	513	9
2016	HAL	514	12
2016	HAL	517	12
2016	HAL	518	45
2016	HAL	519	23
2016	HAL	521	42
2016	HAL	523	9
2016	HAL	524	15
2016	HAL	541	105
2016	HAL	542	54
2016	HAL	543	18
2016	HAL	610	198
2016	HAL	620	172
2016	HAL	630	760
2016	HAL	640	212
2016	HAL	649	77
2016	HAL	650	414
2016	HAL	659	234
2016	POT	509	125
2016	POT	517	103
2016	POT	518	23
2016	POT	519	220
2016	POT	610	185
2016	POT	620	67
2016	POT	630	134
2016	POT_TENDER	517	7
2016	POT_TENDER	610	51
2016	POT_TENDER	620	16
2016	POT_TENDER	630	12
2016	TRW	509	192
2016	TRW	517	186

ADP	2019 Strata	AREA	TRIPS_CELL
2016	TRW	519	57
2016	TRW	610	718
2016	TRW	620	555
2016	TRW	630	1021
2016	TRW_TENDER	610	264
2016	TRW_TENDER	620	7
2017	EM	509	36
2017	EM	517	30
2017	EM	518	7
2017	EM	519	20
2017	EM	521	5
2017	EM	523	3
2017	EM	541	8
2017	EM	542	3
2017	EM	610	89
2017	EM	620	122
2017	EM	630	489
2017	EM	640	58
2017	EM	649	4
2017	EM	650	224
2017	EM	659	92
2017	HAL	513	9
2017	HAL	514	28
2017	HAL	517	8
2017	HAL	518	51
2017	HAL	519	28
2017	HAL	521	28
2017	HAL	523	5
2017	HAL	524	16
2017	HAL	541	80
2017	HAL	542	34
2017	HAL	543	4
2017	HAL	610	186
2017	HAL	620	161
2017	HAL	630	695
2017	HAL	640	203
2017	HAL	649	78
2017	HAL	650	464
2017	HAL	659	212
2017	POT	509	146
2017	POT	517	82
2017	POT	519	194
2017	POT	610	160
2017	POT	620	32
2017	POT	630	166
2017	POT	640	12
2017	POT	650	18
2017	POT_TENDER	509	16

ADP	2019 Strata	AREA	TRIPS_CELL
2017	POT_TENDER	517	3
2017	POT_TENDER	519	5
2017	POT_TENDER	610	32
2017	POT_TENDER	620	17
2017	POT_TENDER	630	7
2017	TRW	509	122
2017	TRW	517	113
2017	TRW	519	11
2017	TRW	610	543
2017	TRW	620	762
2017	TRW	630	698
2017	TRW_TENDER	610	65
2017	TRW_TENDER	620	6

Table 2. Proportion of catch categories for the partially sampled portion of the fleet in past years (ADP) re-categorized according to 2019 draft ADP strata.

ADP	2019 Strata	Chinook PSC	Crab PSC	Discarded Groundfish	Halibut PSC	Retained Groundfish
2015	EM	0	0.154	0.190	0.160	0.061
2015	HAL	0.002	0.002	0.482	0.214	0.063
2015	POT	0	0.703	0.040	0.021	0.085
2015	POT_TENDER	0	0.067	0.013	0.003	0.022
2015	TRW	0.876	0.074	0.244	0.579	0.714
2015	TRW_TENDER	0.122	0	0.030	0.023	0.056
2016	EM	0.002	0.140	0.170	0.179	0.055
2016	HAL	0.004	0.002	0.455	0.256	0.049
2016	POT	0	0.470	0.036	0.023	0.089
2016	POT_TENDER	0	0.048	0.006	0.002	0.014
2016	TRW	0.937	0.338	0.312	0.504	0.712
2016	TRW_TENDER	0.057	0.002	0.021	0.036	0.081
2017	EM	0.001	0.140	0.185	0.194	0.046
2017	HAL	0.002	0.001	0.426	0.160	0.047
2017	POT	0	0.623	0.021	0.016	0.088
2017	POT_TENDER	0	0.069	0.003	0.002	0.021
2017	TRW	0.887	0.166	0.346	0.617	0.750
2017	TRW_TENDER	0.110	0.001	0.018	0.010	0.048

References

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Appendix C. Comparison of alternative sampling designs for 2019

Prepared by the AFSC / FMA Division

Introduction

The North Pacific Observer Program uses a hierarchical sampling design with randomization at all levels to achieve unbiased data from fishing operations in the region. The Annual Deployment Plan (ADP) documents how NMFS plans to deploy observers in the partial coverage category onto fishing trips in the upcoming year under the limits of available funding

The ADP provides an annual process for NMFS and the Council to evaluate deployment and improve the sampling design. In the Draft 2018 ADP, NMFS presented six alternative deployment designs for observers (NMFS 2017a). The adopted design in the Final 2018 ADP allocates observed trips among five strata defined by gear and tendering activity according to an optimized allocation resulting from the interactions of stratum size and variance from a combination of discarded groundfish and Pacific halibut Prohibited Species Catch (PSC), and Chinook salmon PSC (NMFS 2017b). The most recent Annual Report (NMFS 2018) and subsequent Council motion (June 7, 2018) recommended that the 2019 draft ADP continue the 2018 ADP design, and include an evaluation of 1) minimum rates that can be afforded; 2) 15% minimum in all strata (as was implemented in 2018); and 3) gear-specific hurdle approach. Within budget constraints, observer deployment beyond the minimum hurdle was directed to be that which resulted from optimization based on discarded groundfish, Pacific halibut, and Chinook salmon. However, NMFS was also directed to consider the addition of other PSC species (crab). While specifics according to a gear-specific “hurdle” is addressed elsewhere in this document (Appendix B), this analysis provides a comparison of the relative performance of alternative stratification and allocation designs for the deployment of observers into the partial coverage fleet for consideration in 2019.

Methods

Data Preparation: Defining the partial coverage fleet

The partial coverage fleet in general consists of the catcher vessel fleet and some catcher processors when not participating in a catch sharing or cooperative style management program. Changes to this general design have resulted from NMFS policy, Council Action, and regulations. Activities expected to occur in 2019 that will continue to be excluded from observer coverage include 1) catcher vessels while fishing in state-managed fisheries, 2) catcher vessels fishing with jig gear, 3) catcher vessels fishing that are sized < 40 feet in length overall (LOA), and 4) vessels that volunteer for EM. It was assumed that AFA-endorsed trawl catcher vessels that volunteered to carry full observer coverage when fishing in the Bering Sea and Aleutian Islands in 2018 will continue to do so in 2019.

A database containing 2016, 2017, and 2018 species-specific catch amounts, dates, locations, and disposition, and observation status was first enhanced with additional information from the Alaska Regional Office and FMA, then parsed to reflect the partial coverage fleet subject to observer coverage in 2019, and finally re-labelled according to the alternative deployment designs (if any) described below.

Budget Forecasting

The available budget for observer days in 2019 was set such that total number of observer days would remain stable between 2019 and 2020 under the condition that expenditures in 2020 equaled available revenue in that year. Budget forecasting is necessary to determine not only the number of sea-days expected for each upcoming year, but also how much money should be expected to be allocated for each fiscal year, which are offset by six months. For this reason, calendar years were divided into a first half (FH) period from 1 January to 17 June 17 and a second half (SH) from 18 June to 31 December.

The exercise of determining the available budget requires that several assumptions are made given what is known. We have known expenditures through the first half of the current calendar year, and estimates for the cost of an observer day for future years. The value for sea day and travel expenditures for the second half of the current calendar year first need to be determined. This was estimated by using a ratio estimator. The ratio of the number of days used in the first half and second half of the prior calendar year was multiplied by the number to days used in the first half of the current calendar year to determine the expected number of days in the second half of the current calendar year. The expected travel expenditures for the second half of the current calendar year derived from the ratio between the number of observer days used and the travel expended during the second half of the prior year and multiplying this value by the estimated number of observer days for the second half of the current year. Now, the expected cost of the current calendar year could be estimated from 1) the sum of observer days in each half of the year multiplied by the cost of an observer day and 2) the actual and estimated travel for both halves of the year.

The expected available budget for the current ADP calendar year was determined by deducting the expected cost of observing the prior year by the available budget. Expected fee revenues were added to this figure and expected to arrive in the second half of the year.

Under the assumption that the program size in terms of total observer days is to remain equal, two values are required to move forward. The first of these is for how long would the FMA and NMFS like to retain this size program, and the second of these is the ratio between the number of observer days expected in the first half and the second half of the year. The first question is a matter of policy, and here was set at the period 2019 and 2020. The second question is derived from a three step iterative process. The first step is to assume that the ratio of observer days in the first and second half of the current year will be the same as that in future years, and that the ratio of travel expenditures to observer days will also follow the same pattern and relationship. Using the same calculations as for the second half of the current year, the number of observer days can be increased until the budget expenditures in following years is met. Summing the expected cost and total number of observer days for the ADP year and dividing one by the other gets the total expected cost of an observer day. These values are then passed into ADP algorithms that determine the expected trip duration, number of trips and coverage rates per ADP stratum. Depending on the design chosen for the ADP, an updated ratio of the expected number of days used in the first half and second half of the ADP year is produced. This ratio is then used to update the budget scenarios for the ADP and future years, and the number of days afforded is increased or decreased in the first half of the ADP year as appropriate. This yields another set of cost of an observer day, total observer days, and cost of the program that act as the final inputs to the ADP.

Deployment Design

The sampling design for observer deployment (hereafter ‘deployment design’) involves two elements; how the population of partial coverage trips is subdivided (*stratification*), and what proportion of the total observer deployments are to occur within these subdivisions (*allocation*).

Stratification

Stratification is the partitioning of units in the population into independent groups (or sub-populations). These groupings are individually called stratum (strata if plural). Stratified random sampling is the act of obtaining independently random samples from within each stratum. For this reason, strata need to be defined based on criteria known prior to the draw of the sample. This means that elements of fishing trips known prior to departure are valuable in defining deployment strata, whereas catch is not.

There are numerous reasons for creating strata. These include: when a separate estimate for a sub-population is desired, when administrative convenience (field logistics) requires it, and to increase the precision of sample-based estimates of the total. Increased precision is accomplished through the division of a heterogeneous population into homogeneous sub-populations, and the resulting variance of the population total being calculated from the variance of the individual stratum (Cochran 1977). The collection of strata that together subdivide the population of trips in partial coverage constitutes a stratification. In this study only one stratification was considered. This stratification (with the number of the individual strata in parentheses) was as follows:

1. Gear × Tender excepting the Hook and Line + Tender combination (5 strata)

This *status quo* stratification divides the partial coverage trips into five strata based on gear and tendering status.

- Hook and Line ≥ 40' LOA (HAL).
- Pot ≥ 40' LOA (POT).
- Tender Pot ≥ 40' LOA (Tender POT).
- Trawl (TRW).
- Tender Trawl (Tender TRW).

Sample Allocation

Sample allocation refers to the allotment of trips afforded to a stratum. Two types of sample allocations were compared for 2019 observer deployment (the full workflow for the methods used in these designs is found in Figure 1). These types are:

1. Equal Allocation

This allocation design estimates the equal coverage rate (trips sampled/total trips) across strata that can be afforded with available funding. This design allocates samples proportional to fishing effort in a stratum. Similar to past years, the number of fishing trips (N) that occur within H strata was assumed to be equal to the most recent years' fishing activity. The cost of an observed trip in each stratum (c_h) is estimated as the product of the mean trip duration in a stratum and the cost of an observer day. The equal coverage rate afforded (r) across all strata was then calculated as

$$r_h = \frac{F_{2019}}{\sum_{h=1}^{H} c_h N_h}, \qquad (1)$$

where F_{2019} is the estimated funds from the budget forecasting.

2. 15% + Optimized

Unlike equal rates afforded, this sample allocation adopts a "hurdle" approach to optimization. First, observer sea days are allocated equally up to a 15% coverage rate (the base-rate, or hurdle). Once 15% has been met, an optimal allocation algorithm (described below) is used to allocate remaining resources among strata. If available funding does not permit equal allocation up to 15%, the total amount of additional funds needed to meet 15% is estimated. The minimum 15% coverage rate was recommended by the Observer Science Committee because it has been shown to eliminate or minimize severe gaps in observer data (Faunce et al. 2017, NMFS 2017a, NMFS 2015c p. 98), and was adopted by NMFS in the 2018 ADP (NMFS 2017b). This allocation first estimates the number of trips left over in each stratum after 15% coverage has been met using

$$N_{h+} = N_h - (0.15 \times N_h) \qquad \textit{(2)}$$

and then calculates the new budget (F_+) available for optimized allocation among strata using

$$F_{2019+} = \sum_{h=1}^{H} c_h \, N_{h+} \, . \qquad \textit{(3)}$$

The F_{2019+} and N_{h+} is then allocated following the optimized design. Optimal allocation beyond the 15% minimum hurdle maximizes precision for the chosen metrics for the least cost. If n_+ is the number of optimized observed trips afforded among all partial coverage fishing trips above 15% mimimum coverage in each strata (N_{h+}), and the estimate of total discarded catch including halibut PSC from these trips (the chosen metric) has S^2 variance, the number of samples that is considered optimum for each stratum (n_{h+}) is denoted by the product of the total sample size and the optimal weighting (W_{hopt}),

$$n_{h+} * W_{hopt}, \quad where \;\; W_{hopt} = \frac{\frac{N_{h+}S_h}{\sqrt{c_h}}}{\sum_{h=1}^{H}\left(\frac{N_{h+}S_h}{\sqrt{c_h}}\right)} \qquad Cochran\ (1977). \quad \textit{(4)}$$

While equation 4 gives the allocation of observed trips among strata, it does not give the total sample size of optimized trips. To obtain this we can rearrange equation 4 as

$$n_+ = \frac{F_{2019+}\sum_{h=1}^{H}\left(\frac{N_{h+}S_h}{\sqrt{c_h}}\right)}{\sum_{h=1}^{H}(N_{h+}S_h\sqrt{c_h})} \qquad Cochran\ (1977). \qquad \textit{(5)}$$

Cochran (1977) shows that the *blended optimal allocation* (m_{h+}) is derived from the average number of optimal sample sizes measured across L metrics,

$$m_{h+} = n_+ \times \overline{n}_{h+}, \quad where \;\; \overline{n}_{h+} = \frac{\sum_{l=1}^{L} n_{l,h+}}{L}. \qquad \textit{(6)}$$

It is worth noting that unless n_{h+} among all metrics are positively correlated, the resulting compromise allocations may be substantially different from n_{h+} for any individual target metric. Optimized sample allocations were generated using the variance of a) discarded groundfish catch, halibut Prohibited Species Catch (PSC), and Chinook salmon PSC, and b) discarded groundfish catch, halibut PSC, and Chinook salmon PSC, and crab PSC.

The three types of deployment designs that are presented include:
1. Equal rates afforded (allocations are distributed by fishing effort - all strata get the same coverage rate)
2. 15% + Optimized based on groundfish discards, halibut PSC, and chinook salmon PSC.
3. 15% + Optimized based on groundfish discards, halibut PSC, chinook salmon PSC, and crab PSC.

Data from 2015, 2016, and 2017 were combined and treated as a single meta-year for the calculation of optimal allocation weightings (W_{hopt}) in each strata. Distributions of the trip duration, discarded catch, halibut PSC, Chinook PSC, and crab PSC for each stratification scheme were plotted since these form the raw ingredients for the sample size allocation formulae (Figure 2).

Evaluation of Alternative Designs

Observers provide an invaluable service to the generation of total catch estimates; if there are no observer data in a given domain of interest, then data must be borrowed from similar or adjacent sampling units, resulting in poor inference about the total catch. An insufficient level of observer coverage can have implications for in-season quota management, catch estimation, stock assessment, and management of protected resources. The evaluation of alternative designs was determined using gap analysis following previous evaluations of observer program deployments (NMFS 2015a, NMFS 2015b, NMFS 2016a, NMFS 2016b) with a slight change in the calculations described in Appendix D. Gap analysis estimates the probability of observing a trip in a given domain of interest; the fewer the gaps, the better the design.

The gap analyses and all subsequent analyses were performed using 2017 data under the assumption that immediate past fishing activity is a good predictor of future fishing activity. Similar to the past ADPs, the number of partial coverage trips corresponding to each stratification scheme was summed into domains defined by gear and NMFS reporting area (NMFS 2016a, NMFS 2017a).

The hypergeometric distribution was used to calculate the probability of observing at least one and three trips within a domain for each stratification and allocation design. These probabilities were made binary (0 and 1) based on whether or not they exceeded 50%. This value was chosen as the minimum acceptable value since it represents equal chance of meeting the needs of variance calculation within a domain. The proportion of domains that passed the three or more criteria was calculated for comparison and represented as a G score (G) for each allocation design scheme. This G score was divided by the maximum G score within a given stratification scheme to provide a relative metric. This relative G score ranges from 0.00 to 1.00, where 1.00 is best.

Uncertainty due to Electronic Monitoring

In 2018 there were 141 vessels included in the EM stratum. Although the council recommended that the EM pool be expanded to 165 vessels if funding is sufficient (June 7, 2018 Motion, Appendix A), this draft ADP does not evaluate the addition of any new EM vessels beyond the 2018 vessels.

Results and Discussion

The total number of observer days available for deployment in the Observer Program is dependent upon the available budget, the anticipated fishing effort and the average cost of an observed day. This analysis uses a total amount of observer days that should remain constant for 2019 and the next. However, the expected program expenditures will result in a negative balance during deployment between January 1 and June 16 2021. The number of total observer days that results from this projection is 3,110. Depending on the deployment design chosen, approximately 50.9% of available sea days will be used between January 1 and June 16 of the 2019 calendar year.

The optimization algorithm employed here puts more samples where 1) strata are larger, 2) variance of a chosen metric is larger, and 3) costs are lower (Cochran 1977). The methods used herein cannot only be used to accommodate differential trip duration but also differential costs between observation types (for example human vs. cameras) in future ADPs. Moreover, the comparison of coverage rates using equal allocation, 15% plus optimization, and optimization elucidates the trade off between minimizing gaps in coverage and emphasizing the importance of certain metrics such as groundfish discards and PSC.

A focus on resulting coverage rates in the Draft ADP is not as productive as focusing on how those observer days are allocated and the potential for gaps in coverage. This is because estimates of fishing effort and budgets are preliminary during the Draft ADP. Instead of focusing on deployment rates, focusing on observer day allocations and potential gaps ensures that the correct design is chosen for the Final ADP based on the merits of the design and not the expected deployment rates. An exception to this is the equal rates afforded, which provides context as to the relative impact that optimization dollars will have on final deployment rates. Based on current budget and fishing effort used in this document, the equal rates afforded deployment rate (%) is 15. Coverage rates do not differ substantially between equal allocation and the 15% + optimization designs because the budget does not afford any optimized days above the base coverage (Figure 3, Table 1).

Optimized observer day allocations differ in their weightings depending on whether or not crab PSC is included as a metric or not. One way to think about optimized allocations is that of every optimized dollar, in allocations that do not include crab PSC, 72 cents goes to TRW, 23 cents goes to HAL, and 2 cents goes to POT strata. In comparison, the identical summary for allocations including crab PSC put 64 cents to TRW, 18 cents to HAL, and 15 cents to POT gear (see column W_{opt} in Table 1).

The 15% + optimized allocation is a balance between the prioritization of PSC-limited fisheries in optimization weighting schemes and the need to reduce gaps in observer coverage in the partial coverage category. Allocation that includes crab PSC vastly outperformed that where it was not included. For these reasons **FMA recommends the 15% + Optimization design with allocation of optimized observer days based on blended discarded groundfish catch with halibut, Chinook, and crab PSC**.

This analysis relies on several key assumptions. First, we assume that discarded catch on each sampled trip is known without variance, and a simple single stage estimator of trip variances are used in optimization algorithms. The variances used in this analysis are not the same that will arise from the five-stage sampling design of the observer program (Cahalan et al. 2014). Previous studies have demonstrated that although the vessel was a significant factor in estimating total discards, the first stage of nested sampling designs (vessel or trip) is often the stage with the least amount of variance (Allen et al. 2002, Borges et al. 2004). Multi-stage based estimates of variance for each stratum and metric will be used in subsequent analyses when they become available.

Again, it is important that the reader understand that the resulting coverage rates for observer deployment depend upon the amount of fishing effort and the available number of observer days which is dependent upon budget and trip duration. Since this analysis is focused on the *relative* performance of alternative deployment designs, it uses a simplified assumption of future fishing effort- namely that fishing in 2017 will be identical to that in 2019. This assumption is made in anticipation that for the Final 2019 ADP, when a deployment design is selected, a more careful estimate of anticipated fishing effort will be made for 2019, and resulting rates will be adjusted to reflect this new prediction. This analysis uses a simplified assumption for trip duration - namely that trips within a stratum are of identical duration. Finally budget values are always expected to change from draft to final versions of the ADP. Consequently, **the resulting coverage rates presented in this study should only be considered preliminary estimates and may differ from rates determined in the Final ADP.** Once a stratification design for the Final ADP is established in the draft, updated values for expected fishing effort will be generated, and a more robust simulated sampling procedure that takes true trip duration into account at an afforded total sample size using updated budget values will be used to estimate expected coverage rates following the methods described in the Final 2016, 2017, and 2018 ADPs (NMFS 2015b, NMFS 2016b, NMFS 2017b).

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Tables

Table 1. Comparison of the number of trips in a stratum (N_{h2019}), the optimal sample weighting (W_{hopt}), preliminary predicted observed trips (n_h), days (d_h), and coverage rates (r_h) resulting from the Gear x Tender stratification scheme under two allocation designs: (1) Equal allocation and (2) 15% + Optimized. Metrics used for optimization included (1) discarded groundfish catch with Pacific halibut and Chinook prohibited species catch (PSC) and (2) discarded groundfish catch with Pacific halibut, Chinook, and crab PSC.

Stratum (*h*)	**Metric**	N_{h2018}	W_{hopt}	n_h	d_h	r_h (%)
Equal Allocation						
TRW	None	2,085		313	1,014	15.00
HAL	None	2,013		302	1,530	15.00
POT	None	811		122	450	15.00
Tender TRW	None	69		10	52	15.00
Tender POT	None	71		11	63	15.00
15% + Optimized						
TRW	Discards w/ halibut PSC + Chinook PSC	2,085	0.72	313	1,014	15.00
HAL	Discards w/ halibut PSC + Chinook PSC	2,013	0.23	302	1,530	15.00
POT	Discards w/ halibut PSC + Chinook PSC	811	0.02	122	450	15.00
Tender TRW	Discards w/ halibut PSC + Chinook PSC	69	0.03	10	52	15.00
Tender POT	Discards w/ halibut PSC + Chinook PSC	71	0.00	11	63	15.00
TRW	Discards w/ halibut PSC + Chinook PSC + crab PSC	2,085	0.64	313	1,014	15.00
HAL	Discards w/ halibut PSC + Chinook PSC + crab PSC	2,013	0.18	302	1,530	15.00
POT	Discards w/ halibut PSC + Chinook PSC + crab PSC	811	0.15	122	450	15.00
Tender TRW	Discards w/ halibut PSC + Chinook PSC + crab PSC	69	0.02	10	52	15.00
Tender POT	Discards w/ halibut PSC + Chinook PSC + crab PSC	71	0.01	11	63	15.00

Table 2. Results of gap analyses by deployment design. G scores are the proportion of cells with at least a 50% chance of observing three (G3) or one (G1) trips during the year. G Relative is the G score for each allocation design divided by the maximum, where G relative equal to 1.00 represent the designs with the fewest predicted gaps in coverage. Allocations are listed in descending order by G3.

Allocation design	G3	G3 Relative	G1	G1 Relative
Gear x Tender Stratification				
Equal Allocation	0.59	1.00	0.84	1.00
15% + Optimized on Discards + Halibut + Chinook PSC	0.59	1.00	0.84	1.00
15% + Optimized on Discards + Halibut + Chinook + Crab PSC	0.59	1.00	0.84	1.00

Table 3. The number of trips and associated likelihood of observing at least three trips within each NMFS Reporting Area and stratum combination in the Bering Sea and Aleutian Islands for each allocation design under the Gear x Tender stratification scheme. If the likelihood of observing at least three trips is less than 0.50, the cell is bolded in order to identify potential gaps more easily. The sum of area-specific trips may be greater than the overall number of trips, since some trips span more than one area and therefore count as multiple area-specific trips.

BSAI Gear x Tender Stratification

NMFS Area_Stratum	**Trips**	**Equal Allocation**	**15% + Optimized on Discards + Halibut + Chinook PSC**	**15% + Optimized on Discards + Halibut + Chinook + Crab PSC**
509_POT	146.0	1.00	1.00	1.00
509_POT_TENDER	16.0	**0.47**	**0.47**	**0.47**
509_TRW	122.0	1.00	1.00	1.00
509_TRW_TENDER	1.0	**0.00**	**0.00**	**0.00**
512_POT	1.0	**0.00**	**0.00**	**0.00**
513_HAL	9.0	**0.14**	**0.14**	**0.14**
513_POT	5.0	**0.03**	**0.03**	**0.03**
514_HAL	28.0	0.81	0.81	0.81
516_POT	1.0	**0.00**	**0.00**	**0.00**
516_POT_TENDER	1.0	**0.00**	**0.00**	**0.00**
517_HAL	8.0	**0.10**	**0.10**	**0.10**
517_POT	82.0	1.00	1.00	1.00
517_POT_TENDER	3.0	**0.00**	**0.00**	**0.00**
517_TRW	113.0	1.00	1.00	1.00
517_TRW_TENDER	1.0	**0.00**	**0.00**	**0.00**
518_HAL	51.0	0.99	0.99	0.99
518_POT	22.0	0.67	0.67	0.67
519_HAL	28.0	0.81	0.81	0.81
519_POT	194.0	1.00	1.00	1.00
519_POT_TENDER	5.0	**0.02**	**0.02**	**0.02**
519_TRW	11.0	**0.22**	**0.22**	**0.22**

BSAI Gear x Tender Stratification				
NMFS Area_Stratum	**Trips**	**Equal Allocation**	**15% + Optimized on Discards + Halibut + Chinook PSC**	**15% + Optimized on Discards + Halibut + Chinook + Crab PSC**
521_HAL	28.0	0.81	0.81	0.81
523_HAL	5.0	**0.03**	**0.03**	**0.03**
524_HAL	16.0	**0.44**	**0.44**	**0.44**
541_HAL	80.0	1.00	1.00	1.00
541_POT	6.0	**0.05**	**0.05**	**0.05**
542_HAL	34.0	0.90	0.90	0.90
543_HAL	4.0	**0.01**	**0.01**	**0.01**

Table 4. The number of trips and associated likelihood of observing at least three trips within each NMFS Reporting Area and stratum combination in the Gulf of Alaska for each allocation design under the Gear x Tender stratification scheme. If the likelihood of observing at least three trips is less than 0.50, the cell is bolded in order to identify potential gaps more easily. The sum of area-specific trips may be greater than the overall number of trips, since some trips span more than one area and therefore count as multiple area-specific trips.

GOA Gear x Tender Stratification				
NMFS Area_Stratum	**Trips**	**Equal Allocation**	**15% + Optimized on Discards + Halibut + Chinook PSC**	**15% + Optimized on Discards + Halibut + Chinook + Crab PSC**
610_HAL	186.0	1.00	1.00	1.00
610_POT	160.0	1.00	1.00	1.00
610_POT_TENDER	32.0	0.95	0.95	0.95
610_TRW	543.0	1.00	1.00	1.00
610_TRW_TENDER	65.0	1.00	1.00	1.00
620_HAL	161.0	1.00	1.00	1.00
620_POT	32.0	0.88	0.88	0.88
620_POT_TENDER	17.0	0.52	0.52	0.52

GOA Gear x Tender Stratification

NMFS Area_Stratum	Trips	Equal Allocation	15% + Optimized on Discards + Halibut + Chinook PSC	15% + Optimized on Discards + Halibut + Chinook + Crab PSC
620_TRW	762.0	1.00	1.00	1.00
620_TRW_TENDER	6.0	**0.04**	**0.04**	**0.04**
630_HAL	695.0	1.00	1.00	1.00
630_POT	166.0	1.00	1.00	1.00
630_POT_TENDER	7.0	**0.07**	**0.07**	**0.07**
630_TRW	698.0	1.00	1.00	1.00
640_HAL	203.0	1.00	1.00	1.00
640_POT	12.0	**0.26**	**0.26**	**0.26**
649_HAL	78.0	1.00	1.00	1.00
649_POT	1.0	**0.00**	**0.00**	**0.00**
650_HAL	464.0	1.00	1.00	1.00
650_POT	18.0	0.52	0.52	0.52
659_HAL	212.0	1.00	1.00	1.00

Figures

Figure 1. Flow chart depicting methods used in this analysis for each allocation and stratification design under consideration for the 2019 ADP. Blocks highlighted in bold are methods that were not necessary to employ this year.

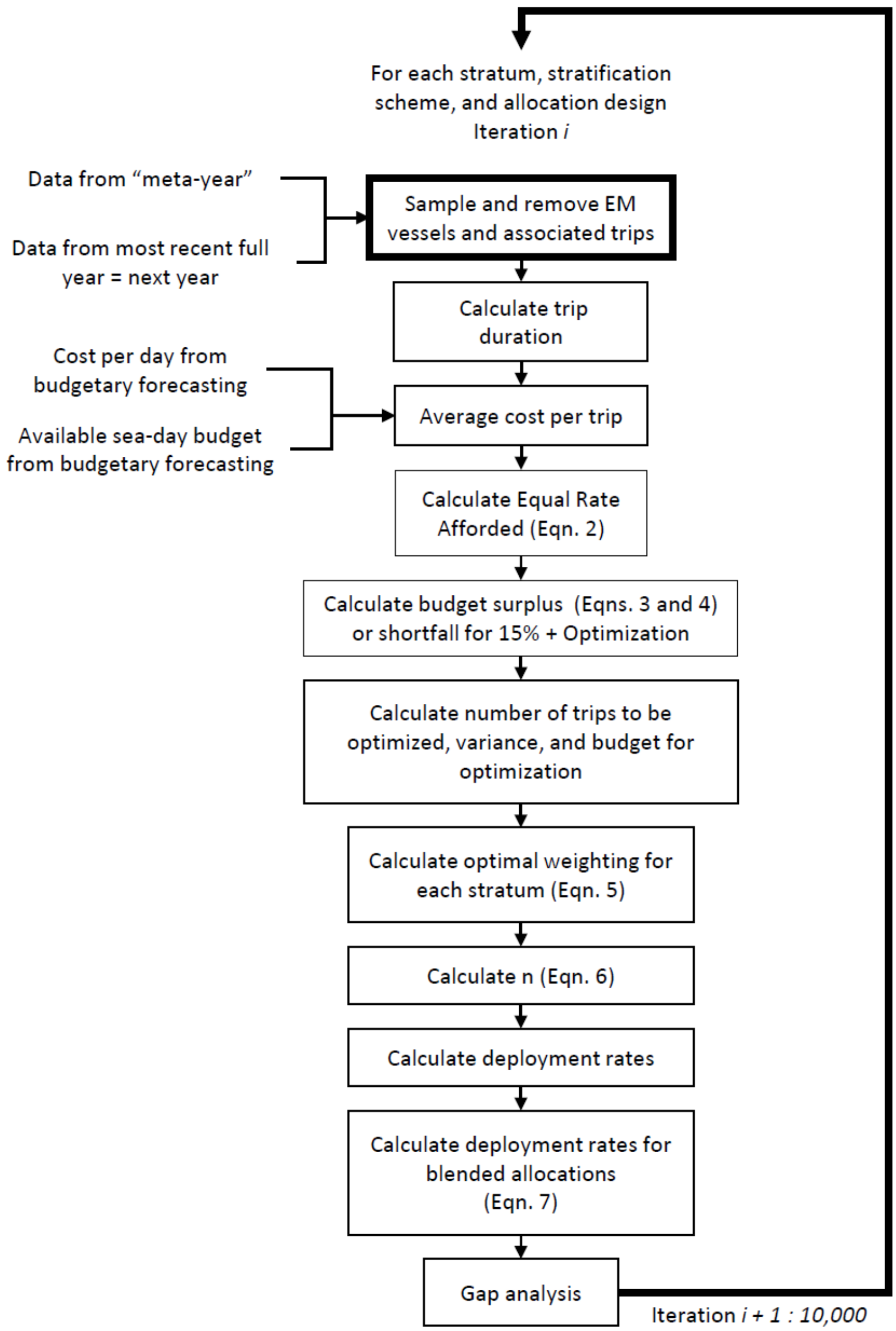


Figure 2. The distributions of trip duration in days, discarded groundfish catch, Pacific halibut prohibited species catch (PSC), Chinook PSC, and crab PSC for each stratum in the Gear x Tender stratification scheme. Shaded boxes denote the 25th, 50th, and 75th percentiles, and individual trips are shown as open circles.

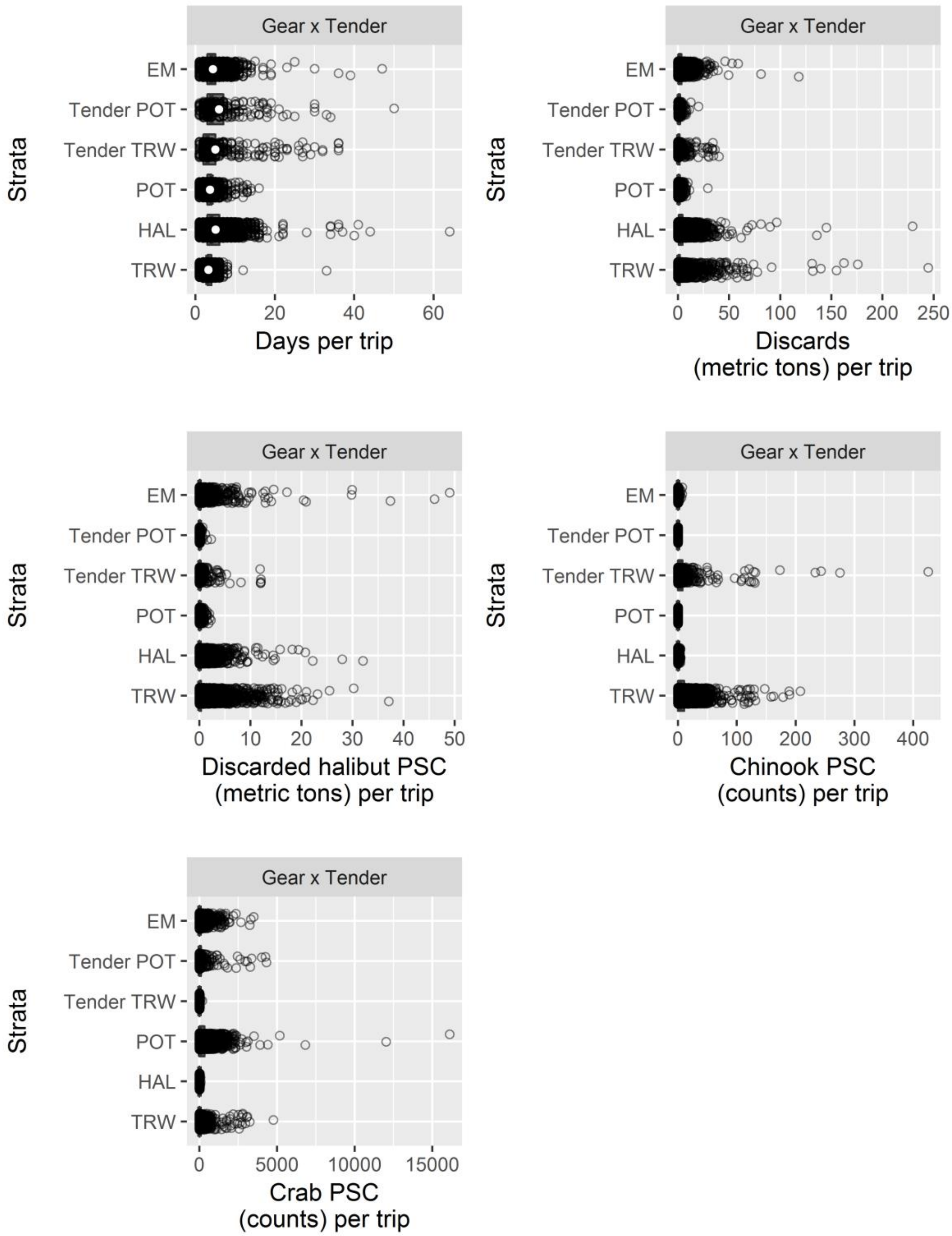


Figure 3. Comparison of preliminary draft coverage rates resulting from the Gear x Tender stratification scheme and two allocation designs (Equal Allocation and 15% + Optimized). Metrics used for optimization included discarded groundfish catch with Pacific halibut and Chinook prohibited species catch (PSC) (teal) and discarded groundfish catch with Pacific halibut, Chinook, and crab PSC (pink). Rates in the top panels are shown in black because no optimization occurred.

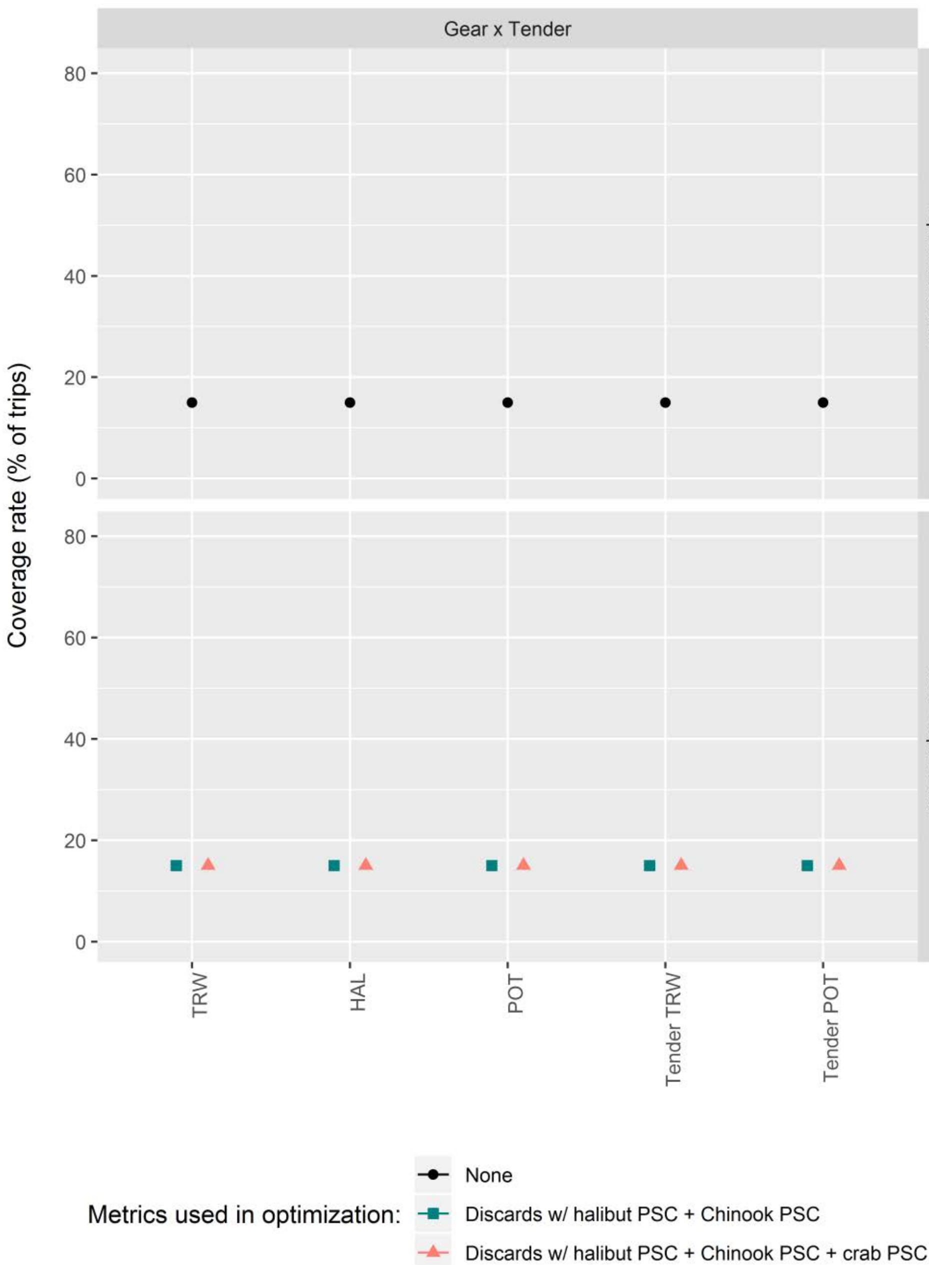
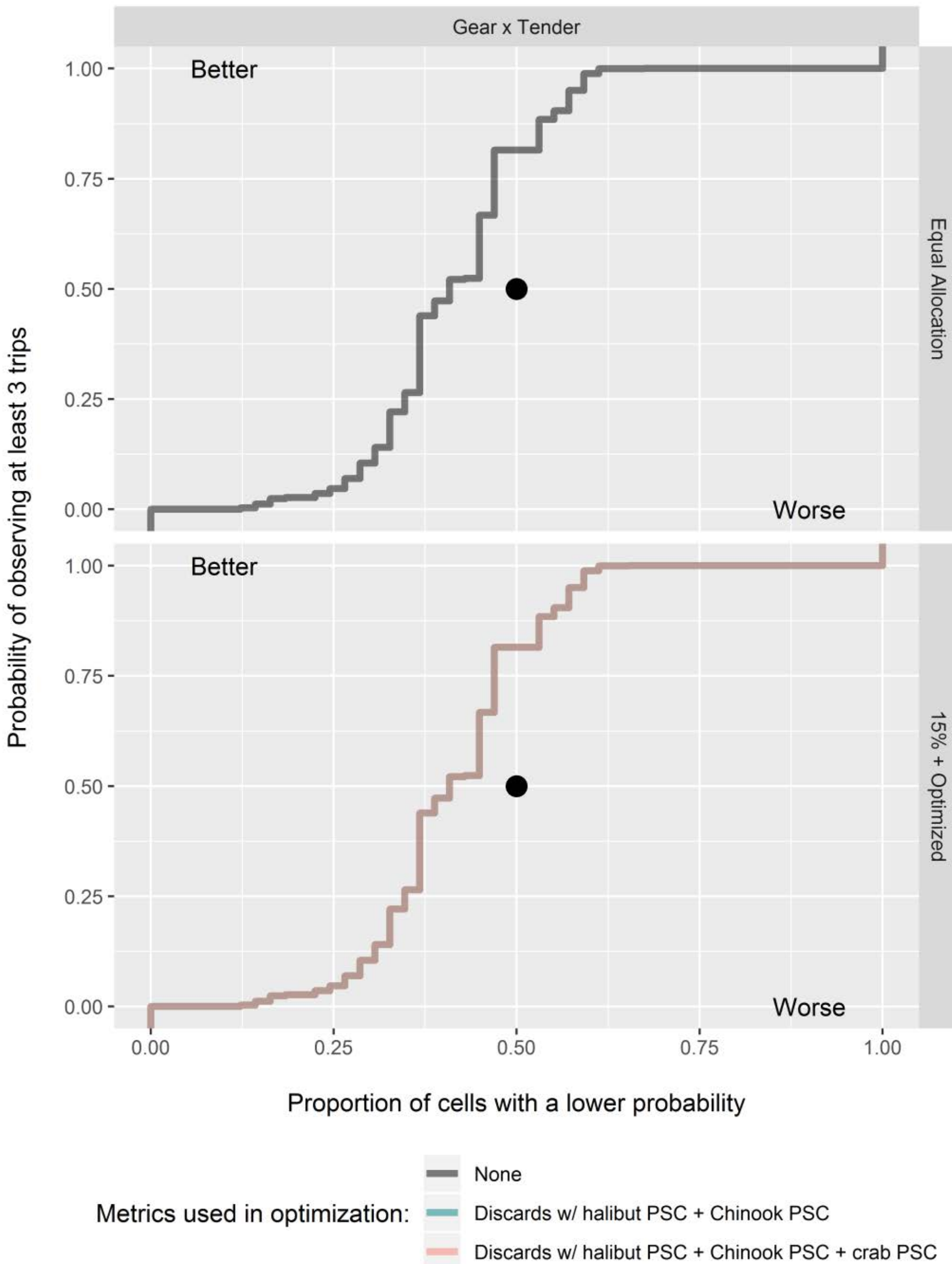


Figure 4. Empirical cumulative distribution curves for the probability of observing at least three trips in a domain defined by NMFS Area and stratum for the Gear x Tender stratification scheme and two allocation designs (Equal Allocation and 15% + Optimized). Metrics used for optimization included discarded groundfish catch with Pacific halibut and Chinook prohibited species catch (PSC) (teal) and discarded groundfish catch with Pacific halibut, Chinook, and crab PSC (pink). Curves in the top panels are shown in black because no optimization occurred. Better performing designs are those that reach a value of 1 furthest to the left of the plot.



Appendix D. How should split area trips be treated in coverage probability estimations for evaluating ADPs?

Prepared by the AFSC / FMA Division

Purpose

Annual Deployment Plans (ADPs) since 2013 in Alaska have included analyses that evaluate the likelihood of observing a given number of trips given a number of fishing trips in an area or domain of interest, the total number of trips in a deployment strata and the total available sample size (observer days). The hypergeometric distribution (Appendix E) is appropriate for this analysis; a problem arises, however, when a fishing trip spans multiple NMFS areas. In past ADPs, if a trip spanned multiple areas, the value for each area for that trip was one divided by the number of areas the trip spanned. In this way, the sum of the number of trips among all NMFS areas would equal the sum of the number of unique trips. This approach may be too conservative for estimating how many trips need to be monitored before a minimum number of observed trips in a NMFS area is achieved since only partial trips are accounted for in each area in the case of split area trips.

An alternative method for trips that span NMFS areas would be to treat split trips as entire trips in each NMFS area in which they occur. While the result of this approach would be a greater number of trips when summed among NMFS areas than actually occurred, this may be beneficial for two reasons. First, the probability estimates using the hypergeometric distribution are independent among areas, and therefore an entire fishing trip does in fact occur in each area. Furthermore, in practical terms, if that fishing trip were to be observed or unobserved, all areas the trip occurred in would be observed or unobserved.

This purpose of this analysis is to compare the probabilities of having a set number of observed trips within a NMFS area for those areas that have split area trips, and to determine whether or not the method for accounting for those trips in each area dramatically and meaningfully affects the outcome.

Methods

Fishing effort data from 2015-2017 (same as the draft 2019 ADP analysis), was relabeled to represent the draft 2019 ADP strata, and then used to estimate the probability of observing three or more trips in a NMFS Area based on the hypergeometric distribution (hereafter simply ‘probability estimations’). Split-area trips were handled in two ways. In the first way, trip counts in each area were the result of one divided by the number of areas the split was split between. This method is termed the weighted method and is denoted as TRIPS_CELL_wgtd in Figure legends, where a cell is a NMFS area. The second method counts an entire trip for each NMFS area and is denoted as TRIPS_CELL in Figure legends.

Probability estimations were repeated over a range of sample sizes (total number of observed trips) to illustrate the effect of observer sampling rate on the probability of observing no trips from an area. Estimations were repeated over each prior year of fishing effort to illustrate between-year variability. The 2019 ADP electronic monitoring (EM) strata is also included to enable evaluation of the 30% trip selection rate adopted by the Council and NMFS though their EM workgroup. Definitions of the EM stratum were based on 2018 participants.

Results

Results are presented as a series of plots, each organized so that comparisons between NMFS areas and split-cell methods. Each plot contains a horizontal dashed line at 50% probability that represents the minimum threshold at which an area has a greater chance of being observed with three trips than not. Each plot also contains a vertical dashed line at 15% coverage that represents the 2018 ADP minimum coverage threshold for the "hurdle".

While not consistent among all areas, substantial differences were evident in areas for all gear types examined and for EM (Figures 1-3). When split-area trips were weighted, the outcomes were more conservative in the number of trips in a NMFS area, and resulted in less chance of observing a given number of trips than the whole-trip method.

Conclusions

The way in which split-area trips were treated in past ADPs was more conservative and resulted in a lower probability of observing a given number of trips at a sample size than treating each NMFS area as its own trip. Given this result, and its logical merits, the method used to split trips in the 2019 ADP and Appendices is the non-weighted, whole trip (TRIPS_CELL) method.

These results to not imply that past analyses in draft and final ADPs were incorrect. In draft ADPs coverage probability estimations are performed to compare competing observer program sampling designs, each with their own stratification schemes and allocation strategies. Since the methods used to compare them is identical, the differences between them are still meaningful and valid.

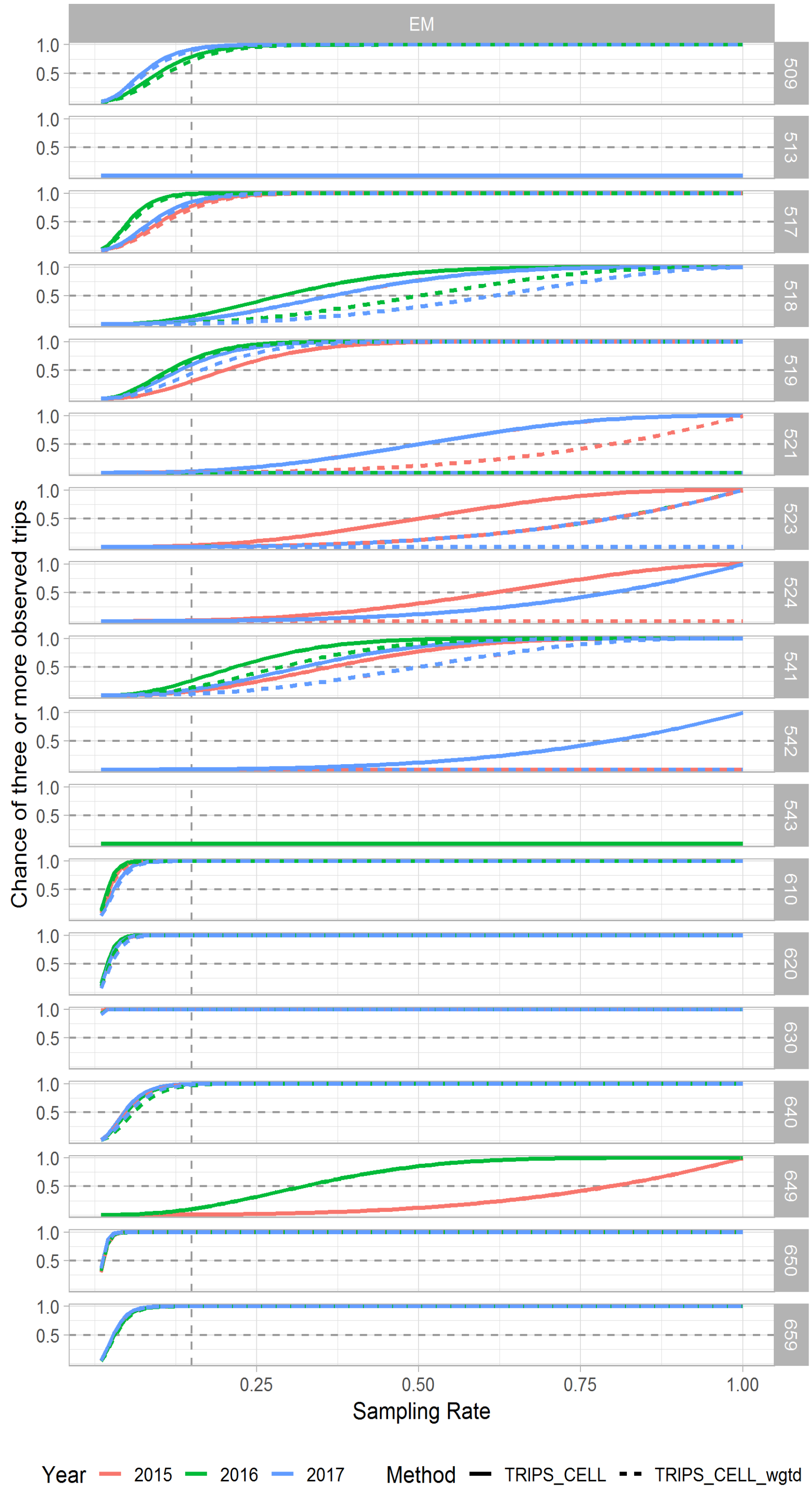


Figure 1. Chance of observing three or more trips in a NMFS Area presented by FMP and Year for the Electronic Monitoring (EM) 2019 ADP stratum for two methods of accounting for split trips. Only areas with split trips are depicted.

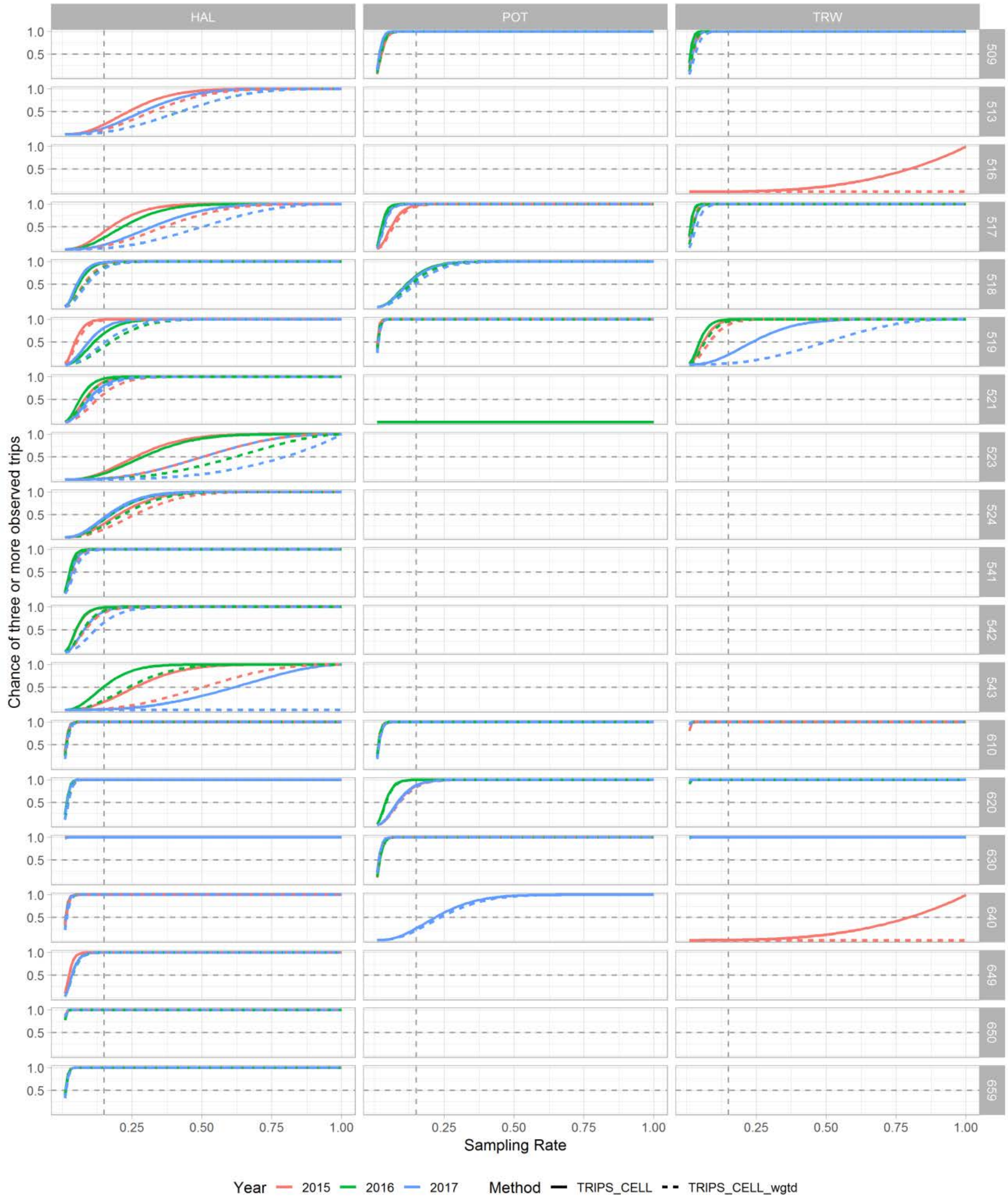


Figure 2. Chance of observing three or more trips in a NMFS Area presented by FMP and Year for the Hook and Line (HAL), Pot (POT) and Trawl (TRW) 2019 ADP stratum for two methods of accounting for split trips. Only areas with split trips are depicted.

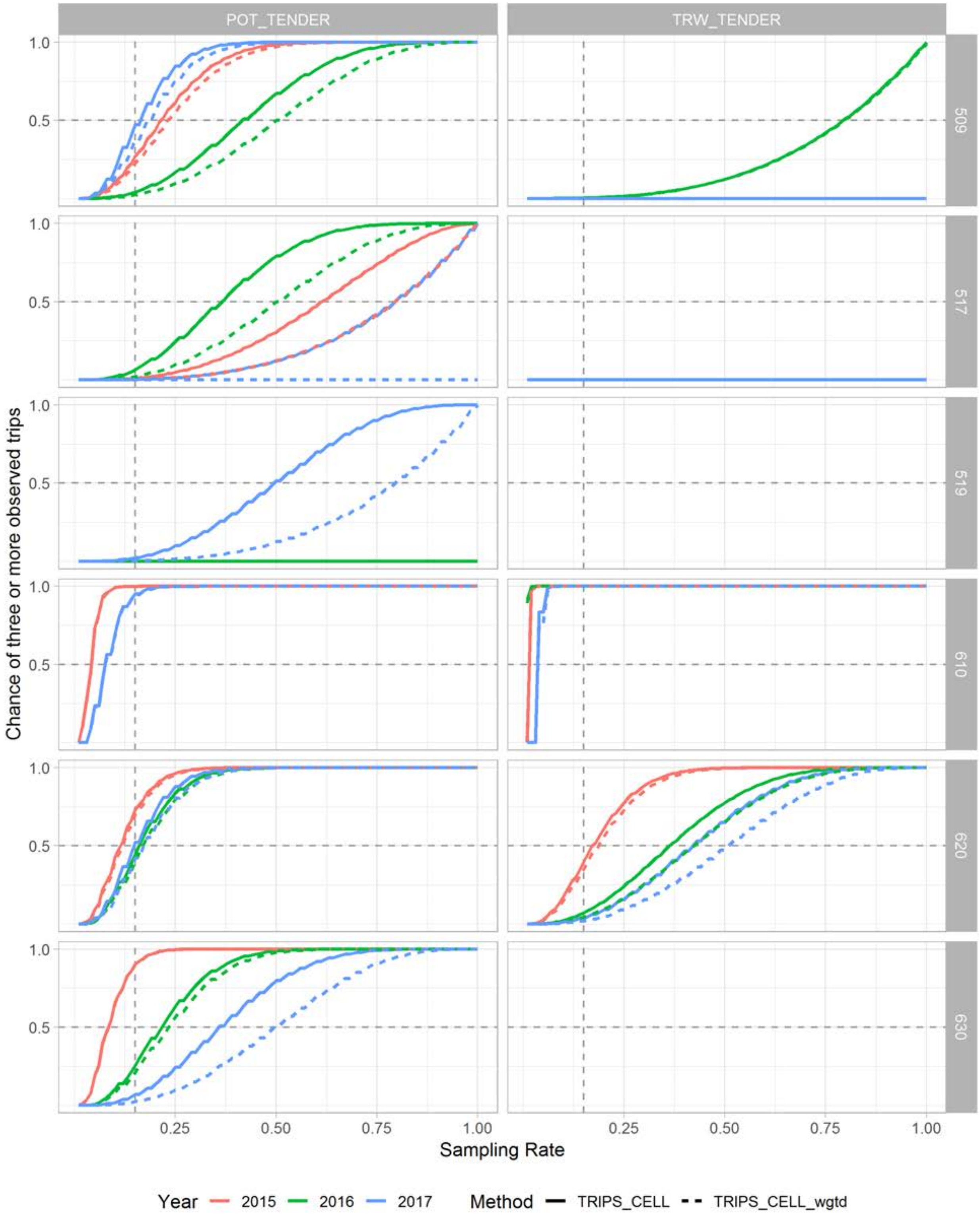


Figure 3. Chance of observing three or more trips in a NMFS Area presented by FMP and Year for the Pot and Tendering (POT_TENDER) and Hook and Trawl Tendering (TRW_TENDER) 2019 ADP stratum for two methods of accounting for split trips. Only areas with split trips are depicted.

Appendix E. Hypergeometric distribution and its use in evaluating the hurdle approach

Starting in 2018, NMFS implemented an observer allocation strategy of 15% plus optimization, which has been termed a “hurdle” approach. Under this allocation strategy, observer sea days are allocated equally across all strata up to 15% coverage rate. The remaining sea days are allocated using an allocation algorithm that maximizes precision for chosen metrics (such as discards or prohibited species catch). This appendix provides more information about the hurdle approach for allocation of sea days and the method used to evaluate the hurdle threshold.

Hurdle approach for allocation of observer sea days

In a well-designed sampling program, the observer coverage rate should be high enough to reasonably ensure that the range of fishing activities and characteristics that occur in a given year occur in the sample data. In addition to data needs for bycatch estimation for both in-season quota management and post-season variance estimation, observer data is critical to many other management and research efforts. These include stock assessment needs for high resolution data on biological characteristic of the catch (length and age distributions, halibut discard condition), estimating bycatch of, and monitoring fishery interactions with, marine mammals and seabirds (Endangered Species Act, Marine Mammal Protection Act), collection of data needed for ecosystem modeling and ecosystem-based fisheries management (Magnuson-Stevens Fishery Conservation Act), and providing data to support decision-making by the North Pacific Marine Fisheries Council, the International Pacific Halibut Commission, and the NMFS. This wide range of data collection responsibility is captured in the mission of the Observer Program to “collect data on catch and bycatch quantity, composition, and biological characteristics, document fishery interactions with marine mammals and birds, monitor compliance with federal fisheries regulations.” (https://www.st.nmfs.noaa.gov/observer-home/regions/northpacific/north-pacific-alaska accessed on 9 August 2018).

The Catch Accounting System (CAS) post-stratifies data coming into the system and groups observer data from fishing activities of similar character (gear, NMFS Area, trip targets) within weekly or running three-week periods. This post-stratification serves two purposes; 1) to decrease variance of the annual estimates of bycatch and catch and 2) to balance the sample so that discrepancies in the distribution of the sample due to the randomization process do not negatively impact the estimates by over-representing a particular NMFS area or time period. While post-stratification can be used to control variance and to balance the sample, it does not address estimation issues resulting from a lack data for a given area or time period. At low sample sizes, the probability of the sample data containing no observations for a particular post-stratum is increased. If this occurs, post-strata are combined and estimates are generated based on these larger post-strata; this pooling results in lower resolution estimates, such as estimates being made with FMP-area wide data. In addition to the lower resolution of the estimates, pooling post-strata may result in expansions of bycatch rates from one type of fishing activity against landings for a different type of fishing activity, increasing the variability of the estimates. For this reason it is important to have a large enough sample to have reasonable expectation of observing all types of fishing (i.e., collecting a sample large enough that there is a high probability that the sample contains trips from each fishery for which management needs estimates of catch and bycatch and other data users need information).

Over the course of a year, some NMFS Areas have low fishing effort and as a result there is a relatively high probability that there will be no observed trips for that area. Since the ability of NMFS to estimate bycatch depends on having data from the fishery, the presence of empty post-strata will decrease the utility of data collected by the sampling program. Setting a minimum level of sampling with the hurdle approach is precautionary with respect to avoiding bias and increasing the chance of getting data across all gear types and areas. This method increases the chances that there will be sufficient data from areas with the most fishing effort; but it does not guarantee data from areas with low fishing effort. The degree to which observer data are available to inform fishery management decisions can be evaluated using the hypergeometric distribution to provide range of risk associated with varying observer coverage levels.

What is the hypergeometric distribution?

The hypergeometric distribution is a mathematical function that describes the probability of sampling a population of items and obtaining a given number of items that have a certain trait or characteristic. This distribution is used in many situations ranging from testing whether a jury is balanced with regard to ethnicity and/or gender, whether a batch of factory widgets meet specified standards, or to determine how large an animal population is based on a sample where a known number of animals had been previously marked. It is a well understood distribution documented in many statistical textbooks.

More specifically, the hypergeometric distribution can be used to determine the probability of a certain type of item being selected from a population containing multiple items. For example, suppose you have a jar with red and blue marbles and you want to determine the probability of drawing a red marble based on some number of draws The hypergeometric distribution can be used to answer questions about the probability of drawing specific number of red colored marbles, or the probability of drawing more or less than a specific number of red colored marbles.

These same concepts can be applied to determining whether realized observer coverage rates were unusual when compared with known sampling rates. For example, was the outcome of observed trips within a reporting area (analogous to a marble color) unusual. Other questions can also be explored such as if the sampling rate, total population size (i.e., total trips across all reporting areas), and number of trips within a reporting area are known, then what is the probabilities of obtaining (or not obtaining) samples within a reporting area.

How is the hypergeometric distribution used?

Does a sample result meet expectations?

The hypergeometric distribution has been used by the Observer Science Committee (OSC) in the Observer Program Annual Reports to evaluate how well our deployment goals have been met. The expected distribution of observed trips should arise from the same population of all trips (due to random sampling). This information allows us to measure the likelihood of a sampling outcome by comparing the outcome with our expected coverage level. For example, within each reporting area, a randomized sample should result in the proportion of observed trips being nearly equal to the proportion of all fishing trips (observer+unobserved)- e.g., if 630 contained 41% of all trawl trips, it should also contain approximately 41% of all observed trawl trips. However, given the differing levels of total effort in each area, our ability to detect important departures from the expected coverage level will be lowest for areas with low effort and highest for high effort areas.

Hence, for each deployment stratum, the probability that the sample (*n*) of observed trips contains the actual number of observed trips (*x*) that occurred in each area should be high, if observed trips are in fact geographically representative of fishing trips. A low probability that the sample of observed trips would contain the actual number of trips observed in an area is evidence that the underlying assumption of randomized deployments is not valid

How big of a sample is needed?

The hypergeometric distribution can also be used to determine how big a sample is needed in order to detect a particular event. For example, suppose an aquaculture company is interested in the growth rate of fish. They have a large net pen of fish and a percentage of those fish have been tagged. They want to collect a minimum number of tagged fish from which measurements and specimens will be collected as part of their study. Since they have an estimate of the population size (e.g. 60,000) and know how many fish were tagged (e.g. 3,000, 5%), they can use the hypergeometric distribution to estimate the how many fish to collect (sample size) in order to get enough tagged fish for their study (e.g. at least 5). On average, in a sample of 100 fish, 5 will be tagged (100 * 5%), however the sample may contain fewer or more than 5 tagged fish due to randomization of the sample selection. If the researchers want a 50% probability of getting 5 or more tagged fish, they will need to take a sample of 93 fish. If they want to be more certain of achieving their sampling goals and want to have a 90% probability of getting 5 or more fish, they need to take a sample of 157 fish.

This same logic can be used to evaluate how many observed trips to expect, with varying levels of certainty, in samples of various sizes (i.e. with different deployment rates). This approach was used in portions of the Supplemental Environmental Assessment conducted in 2015 to assess whether sample data (observer deployments) would contain observed trips be representative of most fishing activities over a range deployment rates (NMFS 2015).

In the SEA analysis, the CAS post-stratification was used to evaluate the probability that post-strata would have no data under different sampling rates. The evaluation criteria used in the SEA were based on post-strata having a greater than 50% chance of having no data and on the number of trips in the post-strata (the number of trips, or amount of catch, that would be impacted by having no data in the post-stratum). The SEA found that the impacts of estimation gaps were highest at deployment rates less than 15% (noting that CAS post-strata were defined by gear type, NMFS Reporting area, week or three week rolling period, and trip target). In Figure 21 of the SEA, at deployment rates above 15% the proportion of trips in post-strata with a 50% or greater chance of not having data (observer coverage) declined; however at rates above 15% post-strata with greater than 50% chance of not having data were still present. These remaining post-strata had fewer trips and thus were the ones expected to have a lower chance of having data collected (observed trips). This analysis was repeated using a less granular view of post-strata; specifically using FMP Areas in place of NMFS Reporting Areas. This second analysis also demonstrated that at deployment rates above 15%, the proportion of trips in post-strata with a 50% or greater chance of not having data (observer coverage) declined, although that at higher deployment rates, post-strata with greater than 50% chance of not having data were still present (Figures 27 and 18, large boat trip selection stratum).

Figure 1 presents fishing effort data from 2014 (same as SEA analysis) that have been stratified into the current three gear-based sampling strata and used to evaluate the probability of drawing a sample of trips and observing no trips in a NMFS Area, again based on the hypergeometric distribution. This evaluation was conducted over a range of sample sizes (number of trips) to illustrate the effect of sample rate on the probability of observing no trips from an Area. Similar to the SEA, the smaller the number of trips that occur in a post-stratum, the higher the probability that the trips from that post-stratum will not be included in the sample. Including additional factors in the post-stratification, such as weekly periods, tendering activity, or etc., will decrease post-stratum size (number of trips in the post-stratum) and subsequently decrease the ability to detect specific fishing activities. The post-strata examined here are much larger (annual, NMFS reporting area only) than the CAS post-strata examined in the SEA.[9] Tendering activity, and specifically, the gear-specific tender strata used in recent ADPs were not included due to the small numbers of trips in the post-strata cells.

As seen in Figure 1, the sample (deployment) rate needed to achieve a specific management goal changes depends on the amount of risk for no data (of few data) that can be tolerated and the desire to detect certain fishing activities (e.g. having some fishing in a particular NMFS Reporting Area or time period in the dataset). As with the SEA analysis, NMFS reporting areas with less effort are less likely to have observed trips with any degree of certainty. The recommendation of a 15% minimum deployment rate for the hurdle analysis is based on most (*not all*) areas having observed trips with some degree of certainty (not guaranteed). In other words, these decisions give consideration to the probabilities of getting at least three trips in a post-strata with some degree of certainty, generally 50% (i.e. more likely than not of getting some data) and the size of the post-strata (i.e. getting data for many of the larger post-strata, but not all). **The 15% minimum deployment rate does not guarantee that all post-strata will have at least 3 observed trips. Instead, it represents the point at which many (*but not all*) post-strata have a greater than 50% chance of containing data (at least 3 observed trips) in a year**.

It is important to note that the post-strata discussed here are relatively large (NMFS Reporting Area) and are being evaluated for the entirety of the year. However, in-season quota managers monitor the accumulation of catch (estimates from the CAS) throughout the season and in-season bycatch estimates are based on the observer data collected to-date (near-real time estimation). It is to meet this management

[9] Note the analysis in the SEA was based on a different stratification scheme (trip and vessel selection strata) than is currently used in ADPs. The SEA evaluated the potential for empty (no data) post-strata at a much higher resolution (smaller in-season post-strata) than are used in ADPs. In addition, strata-specific (i.e. gear-specific) minimum thresholds may be better meet management needs than a one-size-fits-all approach to the minimum observer coverage rate.

need that observer data are post-stratified into weekly time periods and trip targets, in addition to NMFS Reporting Areas.

In planning for deployment of observers, the both in-season data availability needs and post-season annual variance estimation needs must be considered. The SEA evaluated the availability of data for in-season quota management (high resolution estimates) and concluded that deployment rates of 15% would increase the probability that some (not all) post-strata would contain at least some data. While pooling data across post-strata allows us to produce bycatch estimates in-season, these estimates suffer from lower resolution and variance estimates are not able to be produced. In the simplified evaluation presented here, deployment rates lower than the 15% suggested by the SEA would provide data from the larger post-strata with the same degree of certainty, allowing for annual estimates of bycatch (no variance). However, in-season management would be hampered by the lower quality in-season estimates (potentially no estimates for some fisheries and more pooling of in-season post-strata).

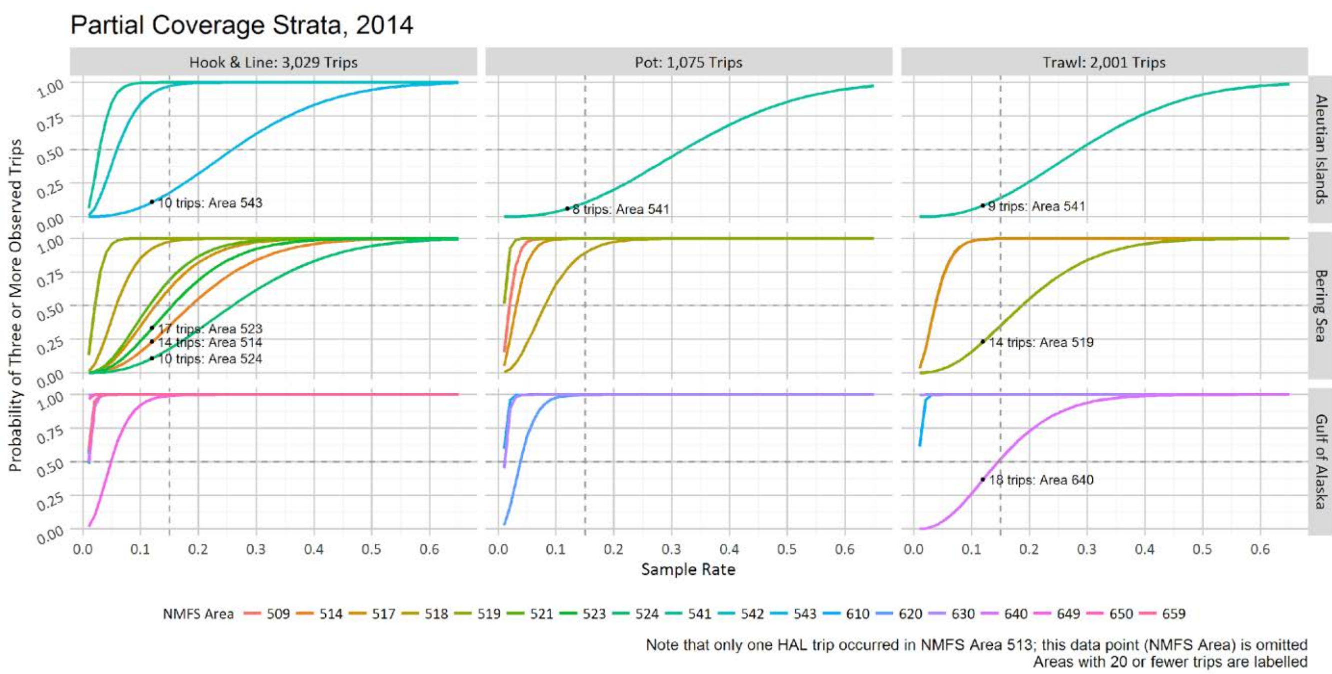


Figure 1. Probability that three or more observed trips are for each NMFS Reporting Area over a range of sampling rates. These are based on fishing effort patterns from 2014 (same data used in the SEA).

References

NMFS. 2015. Final Supplement to the Environmental Assessment For Restructuring the Program for Observer Procurement and Deployment in the North Pacific. September 2015. NMFS, Alaska Region. P.O. Box 21668, Juneau, AK 99802. Available at https://alaskafisheries.noaa.gov/sites/default/files/analyses/finalea_restructuring0915.pdf

Appendix F. 2019 EM Vessel Monitoring Plan Description

Introduction

A Vessel Monitoring Plan (VMP) describes how fishing operations on the vessel are conducted, including how gear is set, how catch is brought on board, and where catch is retained and discarded. It also describes how the EM system and associated equipment is configured to meet the data collection objectives and purpose of the EM program, including camera locations to cover all fishing activities, any sensors to detect fishing activities, and any special catch handling requirements to ensure the data collection objectives can be met. The VMP also includes methods to troubleshoot the EM system and instructions for ensuring the EM system is functioning properly.

Vessel operators will meet with the EM service provider to develop this VMP using a **VMP template that is available on the NMFS Website:** https://alaskafisheries.noaa.gov/fisheries/observer-program.

Here we provide an excerpt of the VMP so that vessel operators can preview the sections that describe vessel operator responsibilities and troubleshooting instructions.

Each VMP must be approved annually by NMFS. Once the VMP is complete and the vessel operator agrees to comply with the components of the VMP, the vessel operator must sign and submit the VMP to NMFS for approval. If changes are needed to the VMP after approval, vessel operators should work with EM service provider to make those changes and sign and submit those changes to NMFS. Once submitted the vessel operators may begin a fishing trip.

If a vessel operator has repeat problems with EM system reliability or video quality or are unable to comply with the requirements in this VMP, NMFS may disapprove a VMP for the following calendar year and the vessel may be removed from the EM pool the following calendar year.

Excerpt from VMP template Operator Responsibilities

When selected for coverage, you must comply with operator responsibilities listed below and in Appendix B – Guide for Vessel Operators.

Prior to Trip

- ✓ **Complete Function Test:** Prior to leaving port, you must turn the system on and conduct a system function test following the instructions provided in *Appendix B – Guide for Vessel Operators*. If the function test identifies a malfunction, you must follow the guidance in the malfunction matrix and the troubleshooting guidelines listed in *Appendix B – Guide for Vessel Operators.*

- ✓ **Confirm Hard Drive Storage Space:** Ensure that the system has enough storage to record the entire trip.

Each Trip

- ✓ **Power:** Maintain uninterrupted power to the EM unit while the vessel is underway.

- ✓ **Maintain Equipment:** Make certain that EM system components are not tampered with, disabled, destroyed, or operated or maintained improperly unless directed to make changes by NMFS, the EM service provider, or as directed in the troubleshooting guide of the VMP.

Each Day

- ✓ **Logbook:** You must complete ***one*** of the following:
  - o If you are required to complete a NMFS or IPHC logbook then you can use that logbook ***and add in the comments section:***
    - the ODDS trip number
    - whether the vessel fished at night during the trip
    - any EM malfunctions encountered during the trip
    - each set that marine mammals were observed feeding on the catch as it was brought aboard.
  - o If you ***are not*** required to complete a NMFS or IPHC logbook then you must complete the EM Effort Logbook found in either *Appendix E – 2018 Longline EM Effort Logbook* or *Appendix F – 2018 Pot EM Effort Logbook.*

Prior to each haul or set

- ✓ **Verify System Is Running Correctly**
  - o Verify that all cameras are recording and all sensors and other required EM system components are functioning as instructed in *Appendix B – Guide for Vessel Operators.*
  - o Check the monitor and verify that the camera views are consistent with the images provided in *Appendix A - Vessel Installation Details*.
- ✓ **Clear Camera Views**: Clean cameras to maintain video quality and make sure camera views are not blocked.

Catch Handling Requirements for LONGLINERS:

- ✓ All catch must be handled within view of the cameras as defined in the camera descriptions and deck diagram in *Appendix A - Vessel Installation Details*.
- ✓ All catch processing must be complete from the previous set prior to hauling the next set.
- ✓ **Seabirds**: Hold seabirds up to the camera for 2-3 seconds and show certain key parts of the animal, such as the beak, to the hauler view camera. When showing a seabird to the camera:
  - o Grasp by the outermost bend in wing, with wings out-stretched and show the bird to the hauler camera showing the ventral and dorsal sides;

  - For albatross, show a profile of the bill by holding the bird by the neck against the side of the boat. Ensure that the view is not obstructed; and
  - If possible, hold the bird beak near a scaled reference item (e.g., measurement board with large grid) to assist with identification.

- ✓ **Marine Mammal Depredation:** Note in the logbook each set where marine mammals were feeding on the catch.

Catch Handling for POT Gear:

- ✓ All catch must be handled within view of the cameras as defined in the camera descriptions and deck diagram in *Appendix A - Vessel Installation Details*.
- ✓ On retrieval of a pot, ALL catch must be emptied from the pot onto the sorting table. Any catch left in the pot or that land on the deck must be placed on the sorting table.
- ✓ Process all retained catch and leave discards on the sorting table until after the retained catch are placed in the fish hold.
- ✓ If there is no sorting table, all catch must be sorted in view of the cameras and discards left on deck in view of camera after retained fish are placed in the fish hold.
- ✓ Completely clear all catch, especially Pacific cod, off the table and deck before the next pot is dumped (so that catch from 2 pots is not mixed).
  - If the entire table is covered with catch, then Pacific cod should be cleared from the table a few at a time (to allow EM reviewer to count the retained catch).
  - If all of the snails and sea urchins cannot be not cleared off the table or deck before the next pot is dumped, they should be cleared by the next pot or as soon as feasible.

Owners of pot vessels may propose alternatives to these procedures by submitting plans to NMFS for approval. This alternative may not be used until approved by NMFS.

Trip End

- ✓ **Mail hard drive and logbook**
  - Mail hard drives and a copy of the trip's **logbook** (IPHC or NMFS logbook or EM effort logbook, as appropriate) and the ODDS trip number **within 2 business days** after the EM selected trip to the contact provided in *Appendix C – EM Program Contacts*.

- **EM selected trips ending in ports with limited postal service**: notify NMFS using the contacts on first page of the VMP to inform of the expected delay.

- ✓ **Close fishing trip in ODDS:** Prior to logging another trip or within 2 weeks of the end of the fishing trip selected for EM coverage, you must close the fishing trip in ODDS.

- ✓ **EM selected trips ending at a tender:**
  - You must manually turn on the EM system and trigger recording during the offload to allow the EM reviewer to verify the end of the trip
  - Record the location of the offload in your logbook.
  - Mail hard drives and a copy of the trip's **logbook** (IPHC or NMFS logbook or EM effort logbook, as appropriate) and the ODDS trip number **within 2 business days** after the tender's arrival in a port with regular postal service.

Vessels using the Exemption at §679.7(f)(4) to Fishing IFQ in Multiple Areas

You must still meet all the requirements for use of an EM system on every trip when fishing using the exemption at §679.7(f)(4) to fishing IFQ in multiple areas.

- ✓ The EM system must be powered continuously during the fishing trip. If the EM system is powered down during periods of non-fishing, you must describe alternate methods, such as VMS, to make sure the vessel's location information is available for the entire trip in *Appendix A - Vessel Installation Details*.
- ✓ If an EM system malfunction identified as "high" priority in the malfunction matrix occurs during a fishing trip, ***you must cease fishing immediately***; follow the troubleshooting guidelines listed in *Appendix B – Guide for Vessel Operators*, and contact NOAA OLE immediately.
  - If a "high" priority malfunction occurs, every effort should be made to contact OLE while at sea, but if you are unable to contact OLE while at sea, you is not required to abandon fishing gear. You should also contact the EM service provider to facilitate the repair.
  - You may contact OLE using a cell phone or satellite phone, or you may contact the U.S. Coast Guard via VHF or single side band radio to request the Coast Guard contact OLE.
  - You **must not set additional gear** once a "high" priority malfunction is detected and must return to port immediately if unable to contact OLE at sea.
- ✓ You may purchase additional equipment, such as cameras or control centers, at you own expense to reduce lost fishing time. This additional equipment and its purpose must be described in *Appendix A - Vessel Installation Details*.

Equipment Malfunctions

Equipment Malfunction Discovered During Pre-Departure EM System Function Test

If the function test identifies a malfunction, follow the troubleshooting guidelines listed in *Appendix B – Guide for Vessel Operators*.

Malfunction Type	High/Low Priority	Potential Solution	Action if Malfunction Not Resolved
Monitor	***High***	Connect a different monitor	Must remain in port up to 72 hours to allow for repairs. After 72 hours, may depart on trip and the next trip for EM coverage. Repair must occur prior to departing on the next trip.
GPS	***High***	Restart system	Must remain in port up to 72 hours to allow for repairs. After 72 hours, may depart on trip and the next trip for EM coverage. Repair must occur prior to departing on the next trip.
Insufficient Storage	***High***	Replace with spare data drive[1]	Must remain in port up to 72 hours to allow for repairs. After 72 hours, may depart on trip and the next trip for EM coverage. Repair must occur prior to departing on the next trip.
Control Center	***High***	Restart system	Must remain in port up to 72 hours to allow for repairs. After 72 hours, may depart on trip and the next trip for EM coverage. Repair must occur prior to departing on the next trip.
Insufficient Lighting	***High***	Replace lights	May fish but cannot retrieve gear at night.
Hauling Camera(s)	***High***	Restart system; replace with spare camera[1]	Must remain in port up to 72 hours to allow for repairs. After 72 hours, may depart on trip and the next trip for EM coverage. Repair must occur prior to departing on the next trip.
Discard Camera(s)	***High***	Restart system; replace with spare camera[1]	Must remain in port up to 72 hours to allow for repairs. After 72 hours, may depart on trip and the next trip for EM coverage. Repair must occur prior to departing on the next trip.
Streamer line Camera	Low	Restart system; replace with spare camera[1]	May depart on trip. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Rotation Sensor	Low	Carry spare rotation equipment[10]	May depart on trip, but must trigger video manually. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.

[10] Vessels may choose to purchase additional spare parts, such as cameras or sensors but these items will not be provided by NMFS

Malfunction Type	High/Low Priority	Potential Solution	Action if Malfunction Not Resolved
Hydraulic Sensor	Low	Restart system	May depart on trip, but must trigger video manually. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Keyboard/Mouse	Low	Replace with another keyboard/mouse[1]	May continue fishing provided that the sensors are properly triggering automatic recording. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.

Equipment Malfunction at Sea

- If the system passed the function test, and remains continuously powered during the trip, you are NOT required to return to port in the event of a breakdown. Follow the instructions provided in *Appendix B – Guide for Vessel Operators*.
- If the malfunction cannot be resolved following the troubleshooting guide and/or with remote support, continue to run the system with all functional parts, and contact the service provider immediately (from sea if possible) to assist with scheduling service at the time of landing.

Malfunction Type	High/Low Priority	Potential Solution	Action if Malfunction Not Resolved
Monitor	***High***	Connect a different monitor	Attempt to repair prior to retrieving gear. If cannot repair must contact EM service provider at end of trip. Repair must occur prior to departing on the next EM selected trip.
GPS	***High***	Restart system	Attempt to troubleshoot issue prior to retrieving gear. If cannot repair must contact EM service provider at end of trip. Repair must occur prior to departing on the next EM selected trip.
Insufficient Storage	***High***	Replace with spare data drive	Perform a data retrieval and swap data drive with a new blank data drive. If cannot repair must contact EM service provider at end of trip. Repair must occur prior to departing on the next EM selected trip.
Control Center	***High***	Restart system	Attempt to repair prior to retrieving gear. If cannot repair must contact EM service provider at end of trip. Repair must occur prior to departing on the next EM selected trip.
Insufficient Lighting	***High***	Replace lights	May fish but cannot retrieve gear at night.
Hauling Camera(s)	***High***	Restart system; replace with spare camera[2]	Attempt to repair prior to retrieving gear. If cannot repair must contact EM service provider at end of trip. Repair must occur prior to departing on the next EM selected trip.

Malfunction Type	High/Low Priority	Potential Solution	Action if Malfunction Not Resolved
Deck/Discard Camera(s)	***High***	Restart system; replace with spare camera[2]	Attempt to repair prior to retrieving gear. If cannot repair must contact EM service provider at end of trip. Repair must occur prior to departing on the next EM selected trip.
Streamer line Camera	Low	Restart system; replace with spare camera[2]	May continue on trip. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Rotation Sensor	Low	Carry spare rotation equipment.[11]	May continue trip, but must trigger video manually. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Keyboard/Mouse	Low	Replace with another keyboard/mouse[2]	May continue fishing provided sensors are triggering automatic recording properly. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Hydraulic Sensor	Low	Restart system	May continue trip, but must trigger video manually. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.

Equipment Malfunctions for Vessels Fishing IFQ in Multiple Areas using the Exemption at §679.7(f)(4)

For any malfunction identified as "High" priority, the vessel operator must cease fishing immediately, follow the troubleshooting guidelines listed in *Appendix B – Guide for Vessel Operators*, and contact NOAA OLE immediately.

Malfunction Type	High/Low Priority	Potential Solution	Action if Malfunction Not Resolved
Continuous Power to System	***High***	Check power supply to system	Cease fishing and contact OLE or you may not embark on trip using exemption. If system powered down during non-fishing, VMP must describe alternative methods to record location information
Monitor	***High***	Connect a different monitor[12]	Cease fishing and contact OLE or you may not embark on trip using exemption.

[11] Vessels may choose to purchase additional spare parts, such as cameras or sensors but these items will not be provided by NMFS

[12] Vessel owners may choose to purchase additional spare parts, such as cameras or sensors but these items will not be provided by NMFS

Malfunction Type	High/Low Priority	Potential Solution	Action if Malfunction Not Resolved
GPS	***High***	Restart system	Cease fishing and contact OLE or you may not embark on trip using exemption unless vessel has operating VMS and hauling and discard cameras are functioning.
Insufficient Storage	***High***	Replace with spare data drive	If vessel does not have a spare data drive, cease fishing and contact OLE or you may not embark on trip using exemption.
Control Center	***High***	Restart system	Cease fishing and contact OLE or you may not embark on trip using exemption.
Insufficient Lighting	***High***	Replace lights	May fish but cannot retrieve gear at night
Hauling Camera(s)	***High***	Restart system; replace with spare camera[3]	Cease fishing and contact OLE or you may not embark on trip using exemption.
Deck/Discard Camera(s)	***High***	Restart system; replace with spare camera[3]	Cease fishing and contact OLE or you may not embark on trip using exemption.
Streamer line Camera	Low	Restart system; replace with spare camera[3]	May depart on trip or continue trip. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Rotation Sensor	Low	Restart system. Carry spare sensor[3]	May depart on trip or continue trip, but must trigger video manually. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.
Hydraulic Sensor	Low	Restart system. Carry spare sensor[3]	May depart on trip or continue trip, but must trigger video manually. Must contact EM service provider to schedule repair before departing on another trip where EM is required.
Keyboard/Mouse	Low	Replace with another keyboard/mouse[3]	May continue fishing provided sensors are triggering automatic recording properly. Before departing on another trip selected for EM coverage, must contact EM service provider to schedule repair.