Report on the National Observer Program Vessel Selection Bias Workshop
Woods Hole, May 17-19, 2006

by

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2nd Draft, Revised September 26, 2006

ACKNOWLEDGMENTS

We thank Dennis Hansford (NOAA Fisheries Service, Office of Science and Technology) for project leadership and the following members of the NOAA Fisheries Service National Observer Program Advisory Team (NOPAT), who served as points of contact for Versar, Inc., and made indispensable contributions: Dr. Bill Karp - NOAA Fisheries Service, Alaska Fisheries Science Center; Dr. James Nance - NOAA Fisheries Service, Southeast Fisheries Science Center; David Potter - NOAA Fisheries Service, Northeast Fisheries Science Center. We thank David Potter and the staff of the Northeast Fisheries Observer Program for hosting the workshop. The NOPAT helped to plan and conduct the workshop and, together with Dr. Lisa Desfosse (NOAA Office of Science and Technology), provided helpful comments on the workshop report. The input of regional analysts during both the planning phase and the workshop was critical to its success. We thank Dr. Ed Weber for serving as rapporteur during the workshop, Dr. William Richkus and Carol DeLisle for significant editorial contributions, and Sherian George and Gail Lucas for document production support.

EXECUTIVE SUMMARY

This report summarizes key findings and recommendations of the Vessel Selection Bias Workshop held in Woods Hole, MA, from May 17-19, 2006. The report identifies procedures employed in observer programs to select vessels for observation and other factors that could cause bias in estimates of catch and bycatch, and provides recommendations for improved designs and procedures that could reduce such bias. The methodological approaches for evaluating and minimizing bias in observer programs were developed by reviewing a wide range of observed fisheries and through a series of meetings and conference calls with the National Observer Program Advisory Team (NOPAT) between August 2005 and May 2006. The workshop was facilitated by analyses provided by regional analysts in response to a questionnaire developed by NOPAT and Versar, Inc., presentations and discussions during the workshop, and internal and external reviews and responses.

Observer programs for 24 fisheries representing all regions were evaluated in this workshop. The fisheries considered were diverse, and equally diverse sources of potential bias were identified, providing a strong basis for drawing generally applicable conclusions about how to diagnose and reduce vessel selection bias when it occurs. Based on information from the questionnaire and workshop discussions, the causes of bias were classified into three broad categories: (1) errors in the sampling frame, (2) bias caused by how vessels within the sampling frame are selected for observation (i.e., observed vessels may not be representative of the general fleet), and (3) bias caused by changes in fishing behavior in the presence of observers. The latter form of bias is not directly related to the vessel selection method but was considered during the workshop because it applies to a sample of vessels.

Incomplete or inadequate sampling frames result from failing to identify and include all vessels within a fishery and from including vessels that are not actively fishing. Workshop participants established that sampling frames should be developed based on lists of active vessels in each fishery and that the lists should be as complete and current as possible. One means of

ensuring that the sampling frame is current would be to implement a call-in system. Call-in systems may be effective for keeping up-to-date lists of active vessels throughout the season in observer programs where the sampling frame is dynamic, (e.g., based on fishing permits that can be switched from one boat to another within a year).

Workshop participants identified six general methods for selecting vessels from the sampling frame in the observer programs we considered: (1) census (i.e., all trips from all vessels in the sampling frame are observed), (2) random sampling with replacement, (3) stratified random sampling with replacement, (4) stratified random sampling without replacement, (5) systematic random sampling, and (6) ad-hoc selection of vessels. Of these methods, ad-hoc selection of vessels was determined to be the most likely to produce bias. A census of all trips by all vessels in the sampling frame would eliminate vessel selection as a potential source of bias but could be prohibitively expensive and would not eliminate bias due to errors in the frame. Random or stratified random selection of vessels was determined to be the most cost-effective means of minimizing bias in general, but safety concerns and lack of accommodations may limit deployment of observers on randomly selected vessels. In this case, an ad-hoc selection of vessels from the frame, with full compliance, may cause no more systematic error than a random selection with poor compliance.

Several factors in addition to errors in the sampling frame and the method of selecting vessels could contribute to potential bias. Workshop participants discussed three situations that can produce a biased sample of vessels: (1) some selected vessels cannot be observed because operators refuse to take observers; (2) observers are unable to board some selected vessels because they are not certified as safe under current deployment rules; and, (3) some vessels within the sampling frame do not have accommodations for observers. Systematic errors in estimates of catch and bycatch resulting from these situations cannot be eliminated by increasing coverage of the observable fleet; however such errors are likely to be small if the characteristics and fishing behavior of the observed vessels and trips are similar to those of the general fleet. One regional program identified remote observation using digital video as a possible means of sampling the component of a fleet that is difficult to sample using on-board observers. Recent research involving collecting digital video data at sea indicates that this approach is promising for evaluating some types of bias. Vessels owned or leased by the government may be used to observe nearshore fisheries through a roving survey, particularly to cover small vessels that cannot accommodate observers.

Workshop participants considered an additional source of bias that is not directly related to the vessel selection method. Changes in fishing behavior when an observer is aboard may produce biased estimates of bycatch. For example, biased estimates are likely if fishers avoid areas where bycatch typically is high or change the duration of the trip, length of tow, or other aspects of fishing operations to reduce bycatch when observers are aboard. This form of bias is most likely to occur if fishing regulations, such as bycatch quotas, provide an incentive to change fishing behavior. This is the most difficult bias factor to address in all the programs. The only means of assessing the occurrence and potential magnitude of such a bias would be to compare trip and catch characteristics with observers aboard to characteristics of trips without observers. Diagnostics for identifying significant differences in fishing operations include the areas, times and catches of target species; however, sources of data for such comparisons are generally limited. Workshop participants considered outreach programs to improve vessel operators' understanding of the observer programs and their benefits to be the best means of reducing this potential source of bias.

The workshop documented several analytical methods and tools that could be used to assess the occurrence and magnitude of bias. These methods depend on the availability of appropriate data. Potential sources of data for such assessments include vessel trip reports, logbooks, port sampling, and dealer landing reports. Fishery parameters that could be compared to assess potential bias include proportion of sampled trips versus trips made by the general fleet by vessel class, area, and time; average trip length for observed vessels versus the general fleet, by vessel class, area, and time (e.g., paired t-test); average harvest (catch retained) per trip for observed vessels versus the general fleet, by vessel class, area, and time (e.g., quarter; paired t-test); average depth of observed tows/sets versus reported tows/sets by vessel class, area, and time (e.g., quarter); and extent of spatial overlap of observed tows/sets with reported fishing locations by the general fleet by vessel class, area, and time (e.g., quarter). Workshop participants recommended routinely performing analyses to diagnose bias and identified alternative selection methods that could reduce or eliminate sources of bias identified as a result of those analyses.

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APPENDICES

1. BACKGROUND

In a report released in March, 2004, by the Office of Inspector General ("NMFS Observer Programs Should Improve Data Quality, Performance Monitoring, and Outreach Efforts"), the first recommendation focused on the need for the Assistant Administrator to develop and implement statistically valid, unbiased vessel selection procedures for observer programs and to monitor implementation continually to ensure that the vessel selection process is applied properly. Versar, Inc., in collaboration with Dr. Michael Fogarty (Northeast Fisheries Science Center), supported the NOAA Fisheries Service, National Observer Program (NOP) and the National Observer Program Advisory Team (NOPAT) to develop an agenda and conduct a workshop to address the Office of Inspector General's recommendations. The primary goal of the workshop was to identify statistically valid, unbiased vessel selection procedures for observer programs and to recommend contractual provisions that would allow oversight and validation of vessel selection procedures.

We prepared for the workshop in close collaboration with the NOPAT, through a series of meetings and conference calls. Versar reviewed information about the NOP provided by Mr. Hansford, including all presentations from the 2003 "NMFS Fisheries Observer Coverage Level Workshop" and the National Marine Fisheries Services' (NMFS) 2004 report, "Evaluating Bycatch." We developed a request for information (questionnaire) with input from NOPAT; the questionnaire was submitted to the regions on October 31, 2005. The main goal of the questionnaire was to compile a comprehensive list of existing information (and its format) available for describing and evaluating each observer program. The information provided by regional managers and analysts in response to the questionnaire was used to guide the presentations for the workshop, including suggested analyses that could help evaluate the vessel selection procedures, and formed an important basis for the workshop discussions. Responses to the questionnaire and discussions at the workshop resulted in the identification of several factors in addition to the manner in which vessels are selected that could contribute to bias in observer data. The causes of those additional factors and possible means of minimizing their effects are discussed in this report.

This report documents findings and recommendations from the workshop, held in Woods Hole, Massachusetts, from May 17-18, 2006 (Agenda attached in Appendix A). Participants included NOPAT representatives; fisheries managers and scientists from National Marine Fisheries Service (NMFS) Regional Offices, Science Centers, and headquarters; and scientists from Versar (Appendix B). Observer programs for 24 fisheries representing all regions were evaluated in this workshop. These diverse fisheries represented a wide range of issues associated with potential selection bias and formed a firm basis for several generally applicable conclusions about and recommendations for minimizing vessel selection bias.

2. OBSERVER PROGRAMS ADDRESSED IN THE WORKSHOP

Most NMFS observer programs are fully funded by the government; exceptions include those for the North Pacific groundfish fishery, the at-sea Pacific whiting fishery, and the Atlantic scallop fishery operating in closed areas (NMFS 2004), which are partially funded by the fishing industry. Regardless of the source of funding, resources generally do not allow the deployment of observers on all vessels and trips for each sector. When only a fraction of the vessels or trips can be observed, it is important to ensure that the data collected are representative of the overall fishery; however, logistical and operational issues and other factors often constrain observer deployment such that representative sampling is compromised. Workshop participants evaluated a wide range of observer programs to assess the extent of this problem and, when appropriate, to recommend ways to resolve or mitigate the problem. Workshop participants reviewed information about a wide range of fisheries to identify approaches for evaluating vessel selection bias that are applicable to all programs with similar sources of bias. The workshop reviews focused on the following 24 observer programs:

Alaska Fisheries Science Center, North Pacific Groundfish Observer Program (NPGOP)

- NPGOP, 0% sector
- NPGOP, 30% sector
- NPGOP, 100% sector
- NPGOP, 200% sector

Northwest Fisheries Science Center (NWFSC)

- Shore-based hake
- At-sea hake
- Oregon near-shore rockfish
- Limited-entry sablefish - endorsed fixed-gear
- Limited-entry non-sablefish - endorsed fixed-gear
- California near-shore rockfish
- Limited-entry trawl

NOAA Pacific Islands Regional Office

- Hawaii bottomfish
- Hawaii longline

South West Fisheries Science Center (SWFSC)

- North Pacific albacore troll
- California/Oregon drift gillnet
- California Coastal pelagic species
- California pelagic longline

Northeast Fisheries Science Center (NEFSC)

- Northeast multispecies groundfish
- Mid-Atlantic gillnet
- Atlantic sea scallop dredge

Southeast Fisheries Science Center (SEFSC)

- Shrimp trawl
- Southeast shark gillnet
- Atlantic and Gulf of Mexico shark bottom longline
- Pelagic longline

NMFS oversees these programs, but private contractors are responsible for deploying observers. In the NPGOP and at-sea hake observer programs, the observers are contracted directly by the fishing industry, not through a contract with NMFS. Except for the shrimp trawl fishery in the South East region, all of these fisheries are subject to some level of mandatory observer coverage. NMFS is authorized to place observers on vessels that operate in these fisheries by the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), as well as other marine laws (NMFS 2004).

Science Centers, Regional Offices, and analysts familiar with the collection and uses of observer data provided detailed descriptions of each observer program in response to the workshop questionnaire (Appendix C). Tables 1a through 6a present the vessel selection methods and potential bias issues for each program documented during the workshop. The Alaska Region's responses about the Alaska Marine Mammal Observer Program (AMMOP) are included in Appendix C. This observer program was not addressed in detail at the workshop because representatives from the Alaska Region could not attend.

3. FRAMEWORK FOR EVALUATING BIAS

It is useful to evaluate vessel selection bias within the framework of "total survey design," which is defined as the attempt to control the total error in the estimates derived from survey data (Lessler and Kalsbeek 1992). In sampling theory, the total error is generally divided into variable errors and bias (e.g., Cochran 1977). Bias refers to systematic errors that cause the average survey value to deviate from the true population value for any sample selected under a specific survey design. For observer monitoring programs, the total error in estimates of catch and bycatch is linked to vessel selection and observer deployment procedures, field data collection procedures, and analytical methods for estimating catch and bycatch. Ideally, an overall design for observer programs is chosen to minimize the total error in the catch and bycatch estimates for the target fleet, within the resources available for the program and practical constraints. We follow Kish (1965) and describe the total survey error (accuracy) of a sample estimate $\overline{y}$ by the mean square error (MSE) as follows:

$$MSE(\bar{y}) = \sum_r (1 - f_r)\frac{S_r^2}{n_r} + \left(\sum_r B_r\right)^2, \quad (1.1)$$

where the first component on the right is the total variance of the estimate $\bar{y}$, with f_r denoting the sampling coverage (fraction of population units included in the sample), and the second term is the square of the biases. The variance may be reduced by increasing n_r, the effective sample size, by expanding sampling effort, improving the survey design, or both; increasing n_r generally does not reduce bias. The vessel selection bias workshop focused on vessel selection methods that could introduce bias, and had only limited discussions related to the variance component of the mean square error (eq. 1.1) and how it relates to survey design. We refer to the NMFS' (2004) "Bycatch Report" for a thorough discussion of survey methods and errors in catch and bycatch estimates, including errors related to field data collections and analysis methods.

At-sea sampling programs typically are designed to achieve a fixed level of precision for minimum observer effort, or to achieve maximum precision for a fixed observer effort, while attempting to minimize bias. It should be noted that, for a fixed overall observer effort, performing a census of one component of the fleet at the expense of reducing sampling effort for another component could result in larger total mean square errors (eq. 1.1) in estimates of catch and bycatch than a well-designed, probability-based sample survey across all sectors of an observed fishery.

A vessel selection procedure is considered biased if it results in catch and bycatch data that do not represent the fleet (and its fishing operations) on average (i.e., the procedure will tend to result in observer data that systematically deviates from data that would be representative of the true fleet and its fishery). Random selection is a safeguard against systematic bias in the selection procedure (i.e., on average, the samples will represent the total population of vessels in the list). A random selection of vessels, however, does not in itself eliminate systematic bias. If observers cannot be deployed on the vessels selected by a representative method such as random sampling, or if some of the vessels selected change fishing behavior, then the resulting sample is biased. Bias resulting from logistical problems and lack of compliance is particularly difficult to quantify and control and is not likely to be reduced by increasing sample sizes.

This workshop identified procedures used to select vessels for observation that could cause bias in estimates of catch and bycatch. Workshop participants classified the sources of bias in the 24 observer programs into three broad categories, closely following the general taxonomy promoted by Lessler and Kalsbeek (1992): (1) incomplete sampling frame, (2) sampling bias caused by procedures for selecting vessels from the sampling frame or by factors preventing the deployment of observers on all selected vessels, (3) and observer bias (i.e., measurement errors caused by changes in fishing behavior in the presence of observers).

3.1 INCOMPLETE SAMPLING FRAME

Bias related to errors in the sampling frame (list) from which vessels are selected for observation can occur when the list fails to include all active vessels in the fishery for which inferences about catch and bycatch are to be made (NMFS 2004). If the list omits an appreciable portion of vessels in the fleet for which estimates are required, then even a census (i.e., placing observers on all vessels and trips on the list) could yield poor (biased) estimates of catch and bycatch. Errors in the sampling frame can result when using lists of vessels that are not up-to-date, or if vessels are included that are not actively fishing. If the fraction of vessels not observed accounts for an appreciable portion of the total catch for a fishery, then the resulting bias in overall estimates of catch and bycatch based on observer data could be significant.

3.2 SAMPLE BIAS RELATED TO SELECTION OF VESSELS FROM THE FRAME AND DEPLOYMENT OF OBSERVERS

The goal of selecting vessels and deploying observers should be to obtain data from trips that are representative of actual fishing effort over the entire fishing season and the full geographic range of the fishery, as well as of vessel type, gear type, and targeting strategy (NMFS 2004). Six methods for selecting vessels were documented for the 24 observer programs evaluated during the workshop:

- census – every trip is observed for all vessels in the sampling frame
- random sampling with replacement (RS) – any vessel in the frame has a known probability (> 0) of being selected in each random sample, even if it has been previously selected (i.e., after a vessel has been chosen from the list, it is put back on the list before the next draw); this selection method includes “proportional to size” selection (i.e., selecting vessels with a probability that is proportional to their expected number of trips)
- stratified random sampling with replacement (STRS) – any vessel within a stratum has the same (known) chance of being selected, even if it has been previously selected
- stratified random sampling without replacement (STRWOR) – all vessels are covered within a selection cycle; each vessel is observed only once in each cycle (i.e., once a vessel in a stratum has been selected using RS, it is not available for subsequent draws)
- systematic random sampling - every k^{th} vessel from the list is selected, starting at a random location on the list
- ad hoc sampling – vessels are selected without known inclusion probability from all vessels in the frame

Performing a census would eliminate the potential for bias (assuming that the sample frame is complete and there is 100% compliance), but this approach usually is prohibitively expensive. Typically, available resources allow for observing only a fraction of the vessels in a given fleet. Precise estimates of catch and bycatch, nevertheless, can be achieved by sampling only a small fraction of vessels in the fleet if the sampled vessels are representative and the sample size is sufficient. Ad-hoc vessel selection has the greatest potential for generating bias because this method does not guarantee that repeated selections result in samples that, on average, represent the fleet. Conducting a probability-based survey with 100% compliance (i.e., all selected vessels agree to take an observer) would also eliminate sample bias. All the methods that involve randomization (i.e., selection of vessels with known inclusion probabilities) fall in the category of 'probability-based' sampling. Probability-based selection of vessels does not guarantee that observer data can be collected representatively because various constraints can limit NMFS' ability to place observers on all selected vessels. Concerns regarding safety of selected vessels or lack of accommodations may limit the pool of sampled vessels and reduce the ability to achieve a representative sample (NMFS 2004). Bias related to deployment can sometimes nullify the benefit of a well-planned survey. In effect, an inability to place observers on selected vessels is equivalent to implementing a program with an incomplete sampling frame because a portion of the fishery fleet is eliminated from observation.

Deployment bias is equivalent to nonresponse error and is most often caused by logistical constraints, for example when the operators of vessels in the sample refuse to take observers, when some of the vessels selected for observer deployment are unsafe[1], or when selected vessels do not have space for observers. In principle, an ad-hoc selection with full compliance may cause no more systematic error than a random selection procedure with poor compliance (equivalent to a low response rate). According to the Office of Federal Statistical Policy and Standards, the quality of survey data may be insufficient for reliable inferences about the target population if the response rate falls below 75% (http://www.casro.org/resprates.cfm). An acceptable proportion of observable vessels (response rate) for a given observer program cannot be stated in absolute terms (e.g., 75% or higher), but will depend on the mode of data collection, characteristics of the fleet and its fishery, and the similarity between catch and bycatch rates of the unobservable vessels and those of the fleet as a whole. For a general discussion of acceptable response rates we refer the reader to Lessler and Kalsbeek (1992). When the response rate is low, it is particularly important to evaluate what portion of the total catch is accounted for by vessels that cannot be observed and if these vessels have characteristics and fishing behavior that substantially deviate from the covered fleet. For example, if smaller vessels that cannot accommodate observers tend to operate closer to shore than the general fleet, then the catch and bycatch rates of observed vessels probably would not represent the rates of the unobserved vessels.

3.3 OBSERVER BIAS

The implication of observer bias is that data recorded on selected vessels is not representative of the fishery as a whole. Observer bias can occur when vessel operators systematically change their fishing behavior, effort, and location when observers are aboard. In this case, the catch and bycatch rates for observed trips would deviate from the true typical rates. This could occur if the fisher has an incentive to lower bycatch estimates (e.g., if the fisher believes that actual bycatch estimates could result in early closure of a fishery due to inseason

[1] An unsafe vessel is defined by the lack of a U.S. Coast Guard safety decal or other license certifying the presence of certain safety equipment onboard (NOAA 2004). In most programs, observers are instructed during training not to deploy on a vessel that does not have a current vessel safety decal.

management or changes in regulations that could restrict his future fishing opportunities). This form of sampling bias is the most difficult to evaluate and correct. Systematic errors in data collection and recording also fall into the category of observer bias, but these components were outside the scope of this workshop.

4. METHODS FOR EVALUATING THE OCCURRENCE OF BIAS

Systematic bias in estimates of catch and bycatch are likely to be small if the observed vessels and trips have similar characteristics and fishing behavior to those of the general fleet, but would clearly be greater if the catch and bycatch characteristics of the unobserved vessels deviate substantially from the norm. Workshop participants discussed analytical methods and tools that can be used to determine if such deviations between selected vessels and the fleet as a whole exist and to estimate their magnitude. Presentations during the workshop addressed means of evaluating bias related to each of the six methods of vessel selection listed above (Appendix D). Participants also discussed analyses that would provide a means of assessing the consequences of an incomplete sampling frame and possible observer effects. Table 7 is a list of auxiliary data required for these analyses. Potential sources of useful data would include self-reporting programs, vessel monitoring systems (VMS), or other types of electronic monitoring.

Self-reporting programs include fishing logbooks completed by fishermen; landings reports completed by fishermen, dealers (i.e., buyers or processors), or both; and interviews of fishermen. Determining the accuracy of observer data can be difficult unless there are methods for validating these data (NMFS 2004). Self-reporting programs may provide reliable data on effort, length of trips, and landed catch that can be compared with estimates from observer programs to identify potential sources of bias (NMFS 2004; Lee and Sampson 2000). These programs are less likely to be accurate for data about bycatch and total catch, including discard. State resource agencies generally require dealers to report the amount of fish bought and sold by vessel and species; however, dealer's reports and information reported by fishermen generally do not include data on at-sea discards and may be unreliable due to low rates of compliance with reporting requirements (NMFS 2004). Data on catch may be obtained by port-sampling, but there are significant concerns about the completeness and accuracy of these reports, particularly for discards, which are not observed by the port sampler (NMFS 2004). Table 8 presents the methods for evaluating bias recommended by workshop participants. Readers should also refer to discussions of bias in bycatch estimates in the "Bycatch Report" (NMFS 2004). A general description of diagnostic methods follows.

4.1 ADEQUACY OF SAMPLING FRAME

To minimize the potential for bias, the frame used for vessel selection must cover all vessels participating in the fishery and should be based on the most current list of active vessels. When a significant number of active vessels is excluded from the frame, the vessels in the frame should have characteristics similar to those of the overall fleet (i.e. be representative). Workshop participants identified the following "diagnostics" for evaluating the representativeness of the sampling frame:

- a comparison of the characteristics of vessels included in the sampling frame with those of vessels known to be part of a fishery, but that are not included in the sampling frame (e.g., length distributions of vessel, gear type)

- an analysis of the proportion of the total catch for the fleet that was landed by vessels in the sampling frame (by area and time)

4.2 ADEQUACY OF VESSEL SELECTION AND OBSERVER DEPLOYMENT

To diagnose selection or deployment bias, it is important, when feasible, to compare the observed vessels and trips with the general fleet using (1) self-reported data obtained from logbooks, trip reports, and dealer's reports, or (2) at-sea observations, including observers' reports and remote VMS (NMFS 2004). Comparisons can be made between vessel characteristics, areas fished, spatial distribution of effort, gears used, trip lengths, average landed harvest, and depths fished using both statistical and graphical methods. Such comparisons are particularly important in programs using ad-hoc selection of vessels because this method is the most likely to produce biased estimates. When appropriate self-reported data or at-sea observations are available, diagnostics of bias may include comparisons of the areas and times of trips and landed catch of target species to determine significant differences in fishing operations between the observed vessels and the fleet as a whole (e.g., Liggens et al. 1997; Sampson 2002; Walsh et al. 2002; NMFS 2004; Rago et al. 2005). An evaluation of the extent to which observed trips are representative of the general fishery may also be based on comparisons of

- average trip length for observed vessels versus general fleet, by vessel class, area and time (e.g., paired t-test);
- average harvest (catch retained) for observed vessels versus general fleet, by vessel class, area, and time (e.g., quarter; paired t-test);
- average depth of observed tows/sets versus reported tows/sets by vessel class, area, and time (e.g., quarter);
- the spatial and temporal overlap of observed tows/sets with fishing locations reported by the general fleet by vessel class, area, and time (e.g., quarter).

When VMS information is available, it is also useful to compare the spatial distribution of fishing effort for vessels with VMS with the distribution of tows on observed trips by area and time (see Murawski et al. 2005 for analytical methods).

4.3 OBSERVER BIAS

Although observer bias is not strictly a vessel selection issue, we also recommend evaluating potential observer effects on estimates of catch and bycatch, when feasible. Comparing landed catch per trip for observed vessels with those values for unobserved vessels or trips can identify changes in fishing behavior. If fishers avoid areas where bycatch typically is high or change trip duration, length of tow, or other aspects of fishing operations to reduce bycatch when observers are aboard, then estimates of bycatch are likely to be biased (NMFS 2004). Regulations such as those associated with individual fishing quotas (IFQ), in-season bycatch quotas, and marine protected areas may encourage different behavior for unobserved vessels. VMS reports show a concentration of 10% to 20% of effort within 5 km of marine closures in New England waters, indicating that fleets reallocate effort away from closed areas; however, effort appears to increase in the vicinity of protected areas because operators expect higher catch rates (Murawski et al. 2005).

A change in fishing behavior aboard observed vessels is the most difficult source of bias to evaluate and correct. This observer bias can be eliminated only through a census (i.e., by observing all hauls or sets accurately throughout the fishery). Increasing the coverage of trips, as recommended by Babcock et al. (2003), will not necessarily reduce such bias. Observer bias is usually diagnosed and quantified by comparing the behavior of vessels during observed trips or hauls/sets with the behavior of the general fleet, or by comparing the fishing operations of individual vessels during observed and during unobserved trips. Comparisons of trip or haul duration, fishing location, and catch-per-unit-effort and other metrics that characterize fishing behavior can help diagnose if the observed vessels and trips are representative of the fishery as a whole. Such comparisons generally can be made against only self-reported information from the fishing fleet; consequently, they must be interpreted with care (NMFS 2004).

4.4 RECOMMENDATIONS FOR IDENTIFYING BIASED VESSEL SELECTION

Based on their review of 24 diverse observer programs, workshop participants suggested the following recommendations for evaluating if vessel selection procedures are biased:

- Apply diagnostic tests to check for potential vessel selection bias on a routine basis.
  - Compare observer information on metrics that characterize a fishery with data derived from logbooks, trip tickets, VMS and other sources. Emphasis should be given to data on trip duration and average haul duration (see Table 7), which can be collected objectively (through enhanced VMS if possible) and are less likely to be misreported to avoid regulations.
  - Determine the magnitude and direction (effect size) of any differences between observer data and objectively determined data from other sources (e.g., VMS).

- Prior to using a particular data set for evaluating the likelihood of bias, assess the accuracy of estimated metrics used to compare observed vessels with the general fleet. Self-reported information on fishing positions from vessels that do not carry observers, for example, is likely to be less accurate than data collected by VMS. When estimates of metrics that are used to compare observed and unobserved trips have large variances, it may not be possible to detect differences between the two groups.

- When feasible, select vessels and trips with equal probability within the sector for which catch and bycatch are to be estimated. Such allocation will ensure that representative catch and bycatch estimates can be derived without weighting. Disproportionate "optimal allocations" result in observer samples that require weighting to yield accurate estimates of catch and bycatch. For complex fisheries, it can be very difficult to derive appropriate weighting factors to adjust for non-proportional sampling across strata.

- Categorize observer programs by their goals (e.g., bycatch of protected resources, inseason management). Evaluate the likelihood of bias and its implications for each goal.

- Identify fishing regulations and other factors that may encourage vessel operators to alter fishing behavior when observers are present as well as possible solutions for this source of bias. Implement measures such as outreach programs to improve compliance.

- Evaluate the effectiveness of mandatory programs for components of a fishery with respect to the mean square errors in catch and bycatch estimates for the fleet as a whole. For example, mandating 100% coverage of a subset of vessels in a fleet may require reducing coverage of other important components of the fleet because of budget and staff limitations. Such disproportional allocation of sampling effort across components of the fleet could reduce the precision in fleet-wide estimates of catch and bycatch and could cause substantial bias in these estimates unless appropriate weighting is employed.

Regional analysts presented examples of analytical methods to diagnose bycatch for a wide range of observer programs during the workshop (Appendix D).

4.5 RECOMMENDATIONS FOR REDUCING OR ELIMINATING VESSEL SELECTION BIAS

Workshop participants concurred on the following general recommendations for minimizing vessel selection bias.

4.5.1 Sampling Frame

- Develop sampling frames based on lists of actively participating vessels in each fishery. Ensure that these frames are complete and as current as possible, for example by implementing a call-in system to ensure the inclusion of all vessels that are actively fishing.
- Increase the coverage of the fleet by reducing the number of vessels that are unsafe. This could be achieved by implementing regulations (in the process of being revised) to require that all vessels in the fishery display a current and valid safety decal, submit to and pass a pre-trip safety check, and maintain safe conditions at all times an observer is aboard (NMFS 2004).

4.5.2 Selection of Vessels and Deployment

- Use random selection schemes to select vessels for observation. When a selected vessel cannot accommodate an observer for a particular trip, select a replacement from a list of randomly selected vessels (i.e., a random replacement list).

- Determine stratification criteria as appropriate for each fishery/program and select vessels with equal probability within strata. To reduce overall variance we recommend higher sampling effort in strata that account for larger portions of overall bycatch, and where the bycatch is most variable.

- Consider using formal adaptive sampling designs to account for dynamic fisheries and patterns of vessel participation. When the sampling frame is based on permits that can be switched from one boat to another within a year, the number of vessels operating within spatial and temporal strata may change accordingly. Adaptive sampling schemes provide the means to reallocate sampling effort in response to changes in the fleet and its fishing patterns over the season.

- Develop outreach programs and other incentives to increase the number of vessels in the sampling frame on which operators will agree to take observers when their vessels are selected. Potential biases introduced by uncooperative vessel owners or captains may be reduced by reminding the fishermen of requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Marine Mammal Protection Act (MMPA) to accommodate observers when requested unless justifiable extenuating circumstances exist (NMFS 2004).

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Table 1a. Alaska Fisheries Science Center, North Pacific Groundfish Observer Program (NPGOP). Catch and bycatch in all North Pacific Groundfish fisheries is monitored inseason to support quota management, but the fleet is divided into four sectors by vessel size and processing mode (Catcher Processors (CPs) or Catcher Vessels (CVs delivering to processing plants), each with different requirements for observer coverage. Changes in strategies for deployment of observers cannot be accomplished without changes in statutory authority to support collection of fees from industry (this was understood by the OIG and is reflected in the OIG report recommendations).

Program	**Coverage, sample size, or precision target**	**Mandatory**	**Sampling Frame**	**Vessel Selection Method**	**Vessel Selection Bias Issues**	**Potential outside data sources for bias detection**
NPGOP, 0%,, Catcher Vessels <60 ft LOA	0%	N	None Vessels < 60 ft not included in sampling frame for logistical reasons	No vessel selection No list of vessels or permits but information about landings from tickets	Important; landings are estimated from fish tickets, bycatch rates are estimated from the observed fleet ($\geq$60 ft).	Logbooks (not keypunched at present), fish tickets completed by processing plans but not catcher/processor vessels. Part of the fleet is equipped with VMS.
NPGOP, 30% Sector Fleet: Catcher Vessels and Catcher/Processors (C/Ps) Vessels, 60-124 ft LOA: ~ 46 bottom trawl vessels ~ 58 pelagic trawl vessels ~ 32 longline vessels Vessels, 70-176 ft LOA: 75 pot vessels Vessels < 60 ft: No record (see above)	30% per quarter	Y	Listed in column 1	Ad hoc; fleet is responsible for obtaining observer coverage.	Important; ad hoc selection; no spatial coverage requirements for trips (Bering Sea/Aleutian Island and Gulf of Alaska Regions). Vessel operators choose when to take observer and may select low-bycatch areas.	Logbooks (not keypunched at present), fish tickets completed by processing plans but not catcher/processor vessels. Part of the fleet is equipped with VMS.

Table 1a. Alaska Fisheries Science Center, North Pacific Groundfish Observer Program (NPGOP), continued.

Program	Coverage, sample size, or precision target	Mandatory	Sampling Frame	Vessel Selection Method	Vessel Selection Bias Issues	Potential outside data sources for bias detection
NPGOP, 100% Sector Fleet: Vessels ≥125 ft LOA; 79 bottom trawl catcher vessels; 55 longline vessels; variable trip length	100% 1 observer per trip	Y	Listed in column 1	Census	None; however, note the potential for observer bias in data collected within vessels if fishing behavior for observed hauls or sets differs from non-observed hauls or sets, particularly for prohibited species.	Logbooks (not keypunched at present), fish tickets completed by processing plans but not catcher/processor vessels. Part of the fleet is equipped with VMS.
NPGOP, 200% Sector Fleet: Vessels ≥125 ft LOA; 26-32 C/P bottom trawl and longline vessels; ~12 C/P vessels in the Atka mackerel fishery; 2 week + trip length	100%, 2 observers per trip	Y	Listed in column 1	Census	None; all vessels and almost all tows or sets observed	Logbooks (not keypunched at present), fish tickets completed by processing plans but not catcher/processor vessels. Part of the fleet is equipped with VMS.

Table 2a. Northwest Fisheries Science Center (NWFSC)

Program	Coverage, sample size, or precision target	Mandatory	Sampling Frame	Vessel Selection method	Vessel Selection Bias Issues	Potential outside data sources for bias detection
Shore-based Hake Fleet: 28 active vessels; mid-water trawl; EFP	100% , Electronic monitoring, 0% observer coverage	Y	Experimental fishing permit list	Census	Minimal. Equipment malfunction could result in less than 100% coverage. Addresses discard compliance but not species composition and quantity. Canadian shore-based fishery coverage is 10% and believed to be about 30% of the fishing effort.	
At-Sea Hake Observer Program, 200% Sector limited-entry non-endorsed fleet	100%, 2 observers per trip	Y	65 active federal permits	Census Fleet is responsible for obtaining coverage	None; all vessels and ~ all tows or sets observed. No	No data currently available but fish-ticket data may be available from California.
Oregon Near-shore Rockfish Fleet: 143 permits (89 active) Longline, pots, hook&line, pole	All vessels sampled once per cycle (currently 1 year cycles); This fishery occurs throughout the year with no defined seasons, so WCGOP has defined 'cycles' a sampling event that has a distinct beginning and end in lieu of a fishing season or year. Currently, the length of the selection cycles have been defined by the amount of time it will take to observe the entire fleet, typically 4-6 2-month periods. For each cycle, a list of permits is generated, the permits are assigned to port groups, and then selected for coverage. The cycles occur back-to-back, so observing is an ongoing process.	Y	89 active permits of 143 state permits issued	Stratified random sampling without replacement; Port-groups form strata State permit list	Moderate; possible changes in fishing behavior for vessels with observers; pooling of data across ports without weighting by relative strata sizes (e.g., fraction of trips or landings); spatial/temporal coverage may not overlap with general fleet.	Fish tickets (some limitations because of interaction with state fishery)

Table 2a. Northwest Fisheries Science Center (NWFSC), continued						
Program	**Coverage, sample size, or precision target**	**Mandatory**	**Sampling Frame**	**Vessel Selection method**	**Vessel Selection Bias Issues**	**Potential outside data sources for bias detection**
<u>Limited-Entry Sablefish-Endorsed Fixed-Gear</u> [2] Fleet: 97 active permits; vessels can have > 1 permit; longline and fish pots	All vessels sampled once per cycle (currently 2 year cycles) The selection cycle is defined by the amount of time it will take to observe the entire fleet, currently 2 fishing seasons. For each cycle, a list of permits is generated; the permits are assigned to port groups, and then selected for coverage.	Y	97 active federal permits, vessels can have more than one permit	Stratified random sampling without replacement; Port-groups form strata Federal permit list	Moderate; possible changes in fishing behavior for vessels with observers; pooling of data across ports without weighting by relative strata sizes (e.g., fraction of trips or landings); This fishery is a subset of the limited entry fixed-gear fleet.	Fish tickets, VMS
<u>Limited-Entry Non-Sablefish-Endorsed Fixed-Gear</u> [1] Fleet: 65 active permits; multiple fixed gears	All vessels sampled once per cycle (currently 2-4 year cycles). This fishery occurs throughout the year with no defined seasons, so WCGOP has defined 'cycles' a sampling event that has a distinct beginning and end in lieu of a fishing season or year. Currently, the length of the selection cycles have been defined by the amount of time it will take to observe the entire fleet, typically 4-6 2-month periods. For each cycle, a list of permits is generated, the permits are assigned to port groups, and then selected for coverage. The cycles occur back-to-back, so observing is an ongoing process.	Y	65 vessels with active federal permits	Stratified random sampling without replacement; Port-groups form strata Federal permit list	Moderate; Possible changes in fishing behavior for vessels with observers; pooling of data across ports without weighting by relative strata sizes (e.g., fraction of trips or landings); This fishery is a subset of the limited-entry fixed-gear fleet.	Fish tickets, VMS

[2] For the limited-entry fixed gear fishery, permits are either endorsed for sablefish or not. Thus an endorsed vessel cannot be a subset of the non-endorsed vessels. Both endorsed and non-endorsed vessel are distinct subsets of the limited-entry fixed-gear fishery (Jonathan Cusick, personal communication)

Table 2a. Northwest Fisheries Science Center (NWFSC), continued

Program	Coverage, sample size, or precision target	Mandatory	Sampling Frame	Vessel Selection method	Vessel Selection Bias Issues	Potential outside data sources for bias detection
California Nearshore Rockfish Fleet: 330 permits (fishermen); 129 active fishers in frame; daytrips; multiple fixed gears	All vessels sampled once per cycle (currently ½ -1 year cycles) This fishery occurs throughout the year with no defined seasons, so WCGOP has defined 'cycles' a sampling event that has a distinct beginning and end in lieu of a fishing season or year. Currently, the length of the selection cycles have been defined by the amount of time it will take to observe the entire fleet, typically 4-6 2-month periods. For each cycle, a list of permits is generated, the permits are assigned to port groups, and then selected for coverage. The cycles occur back-to-back, so observing is an ongoing process.	Y	129 active fishers during the last period of 330 state permits	Stratified random sampling without replacement; Port-groups form strata State permit list	Moderate; Possible changes in fishing behavior for vessels with observers; pooling of data across ports without weighting by relative strata sizes (e.g., fraction of trips or landings) Fishers are permitted instead of vessels.	Fish tickets
Limited-Entry Trawl Fleet: 180 permits; 127 deemed active included if frame; Groundfish trawls; flatfish net	All vessels sampled once per cycle (currently 8-month cycles) This fishery occurs throughout the year with no defined seasons, so WCGOP has defined 'cycles' a sampling event that has a distinct beginning and end in lieu of a fishing season or year. Currently, the length of the selection cycles have been defined by the amount of time it will take to observe the entire fleet, typically 4-6 2-month periods. For each cycle, a list of permits is generated, the permits are assigned to port groups, and then selected for coverage. The cycles occur back-to-back, so observing is an ongoing process.	Y	127 vessels with active federal permits of 180 issued.	Stratified random sampling without replacement; Port-groups form strata Federal permit list	Moderate; Possible changes in fishing behavior for vessels with observers; pooling of data across ports without weighting by relative strata sizes (e.g., fraction of trips or landings)	Fish tickets, log books, VMS

Table 3a. NOAA Pacific Islands Regional Office

Program	**Coverage, sample size, or precision target**	**Mandatory**	**Sampling Frame**	**Vessel Selection method**	**Vessel Selection Bias Issues**	**Potential outside data sources for bias detection**
<u>Hawaii Bottomfish</u> Fleet: 9 vessels, LOA 40-50 ft; hook & line; trolling; short (8-12 day) and long (20-30 day) trips	~ 20% per vessel	Y	Fleet listed; based on federal permits	Sampling is proportional to expected number of trips	Limited-moderate; spatiotemporal coverage is inconsistent; 1 vessel was excluded from the sampling frame because it is small and considered unsafe for observer sampling.	Logbook data, fish auction data may be available.
<u>Hawaii Longline</u> Fleet: 123 tuna, 32 sword; 28 tuna and swordfish; pelagic line; 15-25 day trips (tuna); 25-35 day trips (swordfish)	100% (swordfish)	Y	Fleet listed; based on federal permits	Census	None	Logbook data, VMS, fish auction data may be available.
	~20% (tuna)	Y	Fleet listed; based on federal permits	Systematic, Random start	Limited-Moderate; conflict with swordfish effort limits observer availability in some periods; spatiotemporal coverage; change in fishing practices for observed trips	Logbook data, VMS, fish auction data may be available.

Table 4a. South West Fisheries Science Center (SWFSC)

Program	Coverage, sample size, or precision target	Mandatory	Sampling Frame	Vessel Selection Method	Vessel Selection Bias Issues	Potential outside data sources for bias detection
North Pacific Albacore Troll Fleet: 800 vessels; troll lines; 1week – 1 month trips;	1% of days fished	Y	Fleet listed; based on federal permits?	Ad hoc, opportunistic	Important; temporal and spatial overlap not controlled; small vessels cannot be observed; volunteer program although authority to place observers exists.	Logbooks, fish tickets
California/Oregon Drift Gillnet Fishery Fleet: 40 active vessels; 7-10 day trips;	~20% of sets	Y	Fleet listed; based on federal permits	Ad-hoc; ~ 20% trips per vessel	Moderate; change in fishing behavior for observed trips possible; temporal and spatial overlap to explicitly controlled for; proportion of small boats that fish inshore and cannot be observed is increasing.	Video monitoring proposed, logbooks, fish tickets.
California Coastal Pelagic Species Fleet: 70 active vessels; purse seine; 1-2 day trips;	100% of tuna trips; otherwise 10% of trips per vessel	Y	Fleet listed; based on federal permits	Vessels selected proportional to effort	None for tuna trips; moderate-important for non-tuna trips; low call-in compliance Fish tickets, logbooks?	Logbooks, fish tickets
California Pelagic Longline Fishery Fleet: 1 active vessel	100% of trips	Y	One active vessel	Census	Minimal	Logbooks, fish tickets

Table 5a. Northeast Fisheries Science Center (NEFSC)

Program	Coverage, sample size, or precision target	Mandatory	Sampling Frame	Vessel Selection method	Vessel Selection Bias Issues	Potential outside data sources
Northeast Multispecies Groundfish Fleet: ~1500 vessels; multiple gears: otter trawls, gillnet, longline; 1-7 day trips typical 64,000 days available in FY05	Target 30% RSE for protected species catch ; 5% A-Days 50% B days 6291 days in Fy05	Y	Fleet lists determined by Vessel Trip Reports from the previous year and opportunistic selection	Stratified random sample; fleet sectors form strata.	Minor-Moderate; change in fishing behavior for observed vessels; sampling frame exclude small vessels for logistical reasons. Very skewed allocation of effort between quota monitoring and non-quota monitoring might lead to bias if catch cannot be attributed to the correct strata.	Fish tickets, log books, VMS except for smaller boats, days-at-sea call in.
Mid Atlantic Gillnet Fleet: 1,200+ vessels; LOA 21 ft -48 ft; gillnets: anchored, drift, float, sink; 1-2 day trips; Federal and state permits	Coverage typically < 5% ~600 sea-days FY05	Y	Fleet lists determined by Vessel Trip Reports from the previous year and opportunistic selection	Stratified random sample for a portion of the fleet; Fleet sectors form strata;	Moderate-Important; change in fishing behavior for observed vessels; sampling frame exclude substantial fleet of small vessels for logistical reasons and because they are trailerable; only a portion of the mid-Atlantic gillnet fleet benefits indirectly by the algorithm for stratified random sampling used in the Northeast multispecies fishery.	Fish tickets, log books, VMS data for some vessels.
Atlantic Sea Scallop Dredge Fishery Fleet: 525 vessels with permit; scallop dredge, scallop trawl; variable trip duration; VMS implemented	Fixed % of trips <5% 800 Days	Y	Opportunistic selection	Stratified random sample	Minor-Moderate; sampling frame is complete.	Fish tickets, log books, VMS, days-at-sea call ins

Table 6a. Southeast Fisheries Science Center (SEFSC)						
Program	**Coverage, sample size, or precision target**	**Mandatory**	**Sampling Frame**	**Vessel Selection method**	**Vessel Selection Bias Issues**	**Potential outside data sources for bias detection**
Shrimp Trawl Fleet: ~2,800 federally permitted vessels; LOA ~ 75 ft; ~ 25 day trips GOM target 80% of total sea days; year-around; ~3 day trips on the east coast target 20% of total sea days.	Target sample of 1,300 sea-days variable depending on funding;	N[1]	Federally-Permitted Vessels	Stratified random sample by effort, area, season, depth strata	Moderate-Important; low compliance for selected vessels; vessel operators who volunteered to participate are sampled if vessels selected under the randomized process refused; characteristics of sampled vessels vs. the general fleet; spatial and temporal distribution of trips/tows vs. general fleet	Trip tickets reported jointly by federal and state, VMS on east coast, limited electronic log books GOM.
Southeast Shark Gillnet Fleet: 6-30 vessels; multiple gill net types	100% coverage (Nov 15 - Apr 1) for drift and strike boats; Otherwise target of 30% RSE for turtle or mammal interaction estimates	Y[2]	Fleet	Census; stratified random sample	Moderate for drift and strike, moderate to important for others; change in fishing practices for observed trips in the season with < 100 % coverage; note that bias can be introduced at the secondary sampling stage (sets within vessels) if fishing behavior changes for observed sets within vessels during the season with 100% coverage of vessels. Program is being expanded to cover other vessels.	

[1] participants are paid
[2] Yes for drift and strike boats but not for others.

Table 6a. Southeast Fisheries Science Center (SEFSC), continued

Program	Coverage, sample size, or precision target	Mandatory	Sampling Frame	Vessel Selection method	Vessel Selection Bias Issues	Potential outside data sources for bias detection
Atlantic and Gulf of Mexico Shark Bottom Longline Fishery Fleet: 250 vessels, approximately 100 active; LOA < 50 ft; 500-1,500 hooks per line;	4% of all sets	Y	Fleet listed as determined by federal permits from the previous year	Stratified random sample by area and season based on previous years activity	Moderate; unobserved vessels because of safety and space issues. Potential problem with time series because of shift from voluntary program to mandatory program.	
Pelagic Longline Fleet: 80-100 active vessel w/ swordfish, tuna, and shark permits; 3-14 day trips 150-200 mi off-shore typical; some 20-40 day trips 200-1000 mi from port	8% of sets target, ~6% mean actual coverage	Y	Fleet listed as determined by federal permits from the previous year	Stratified random sample by statistical area and quarter based on previous years activity	Moderate-Important; changes in fishing behavior for observed trips; only 50-60 percent of vessels selected on any given calendar quarter are actually covered.	Dealer reports, log books, VMS

Table 1b. Alaska Fisheries Science Center, North Pacific Groundfish Observer Program (NPGOP)

Program	**Rationale for Current Design**	**Special concerns/implications**	**Alternative Selection Schemes Suggested**	**Applicable Diagnostic Tools**
NPGOP, 30% Sector Fleet: Catcher Vessels and C/P Vessels, LOA 60-124 ft: 46 bottom trawl vessels 58 pelagic trawl vessels 32 longline Vessels, LOA 70-176 ft: 75 pot vessels Vessels < 60 ft: No record	Fishery Management Council set coverage levels based on cost. Primarily designed to monitor catch/bycatch but also supports stock assessment. Designed as an interim solution.	Direct bias – Selection process can lead to uneven spatial and temporal coverage and difficulties in monitoring quota.	Divide coverage into smaller units of time (i.e., 30% per month). This would be difficult under current regulation structure.	Log books and fish tickets can be compared with observer data. Similar data needed for <60' fleet. Compare total catch estimates, trip length, etc. by spatial and temporal blocks. Electronic log books and complete VMS data are becoming available.
NPGOP, 100% Sector Fleet: Vessels LOA $\geq$125 ft; 79 bottom trawl catcher vessels; 55 longline vessels; variable trip length	Same as Above. Some coverage is mandatory to monitor ITQs.	Observer effects described above, particularly for prohibited species	Evaluate the cost/benefit implications of conducting a survey versus census in this sector.	Data from this sector could be used to simulate the effects of missing data in the 30%-coverage sector.
NPGOP, 200% Sector Fleet: Vessels LOA $\geq$125 ft; 26-32 C/P bottom trawl and longline vessels; ~12 C/P vessels in the Atka mackerel fishery; 2 week + trip length	Same as Above. Some coverage is mandatory to monitor ITQs.	Observer effects described above, particularly for prohibited species	Evaluate the cost/benefit implications of conducting a survey versus census in this sector.	Data from this sector could be used to simulate the effects of missing data in the 30%-coverage sector.

Table 2b. Northwest Fisheries Science Center (NWFSC)

Program	Rationale for Current Design	Special concerns/implications	Alternative Selection Schemes Suggested	Applicable Diagnostic Tools
Shore-based Hake Fleet: 28 active vessels; mid-water trawl; EFP	Compliance monitoring for discard events.	Design only allows for estimation of proportion of tows with discard, and not reliable quantification of the discard rates.	May be possible to augment the program with limited observer coverage to estimate discard rates.	Gear comparison tools
California nearshore rockfish Fleet: 330 permits (fishermen); 129 active fishers in frame; daytrips; multiple fixed gears	Coverage matches 2-month periods that catch limits are based on. Stratification by port groups covers spatial variation. Sampling without replacement is fair to all vessels and easy to implement.	Selection can result in strata with no coverage.	Explore sampling with replacement	No data currently available but fish-ticket data may be available from the state. Develop method of imputation for unsampled strata. Weight data by similar strata.
Limited-entry trawl Fleet: 180 permits; 127 deemed active included if frame; Groundfish trawls; flatfish net	Coverage matches 2-month periods that catch limits are based on. Stratification by port groups covers spatial variation. Sampling without replacement is fair to all vessels and easy to implement.	Selection can result in strata with no coverage.	Explore sampling with replacement	Develop method of imputation for unsampled strata. Weight data by similar strata.
Oregon near-shore rockfish Fleet: 143 permits (89 active) Longline, pots, hook&line, pole	Coverage matches 2-month periods that catch limits are based on. Stratification by port groups covers spatial variation. Sampling without replacement is fair to all vessels and easy to implement.	Selection can result in strata with no coverage.	Explore sampling with replacement	No data currently available but trying to obtain fish-ticket data from the state. Develop method of imputation for unsampled strata. Weight data by similar strata.

Table 2b. Northwest Fisheries Science Center (NWFSC), continued				
Program	**Rationale for Current Design**	**Special concerns/implications**	**Alternative Selection Schemes Suggested**	**Applicable Diagnostic Tools**
Limited-Entry Sablefish-Endorsed Fixed-Gear Fleet: 97 active permits; vessels can have > 1 permit; longline and fish pots	Coverage matches the season associated with the catch limit. The fishing season lasts from April to October. Sampling without replacement is fair to all vessels and easy to implement.	Representative sampling is complicated because permits may switch vessels once per year and vessels may carry multiple permits. When vessels carry multiple permits, all permits are observed because neither the fishing trip nor catch is associated with a single permit. Pooling of data across ports without weighting by relative strata sizes (fraction of total trips or landings accounted for by each stratum).	Change to 2-month strata.	Compare observer data to data from fish tickets to extrapolate to the whole fleet. Check the realization of the random-selection process against the fleet behavior as a whole. Develop method of imputation for unsampled strata. Weight data by similar strata.
Limited-Entry Non-Endorsed Fixed-Gear Fleet: 65 active permits; multiple fixed gears	Coverage matches 2-month periods that catch limits are based on. Stratification by port groups covers spatial variation. Sampling without replacement is fair to all vessels and easy to implement.	Selection can result in strata with no coverage.	Explore sampling with replacement	Develop method of imputation for unsampled strata. Weight data by similar strata.

Table 3b. NOAA Pacific Islands Regional Office

Program	Rationale for Current Design	Special concerns/implications	Alternative Selection Schemes Suggested	Applicable Diagnostic Tools
<u>Hawaii Bottomfish</u> Fleet: 9 vessels, LOA 40-50 ft; hook & line; trolling; short (8-12 day) and long (20-30 day) trips	Even distribution of sampling effort across trips.	Potential change in fishing behavior for observed trips.	None at this time, although with the Northwest Hawaiian Islands now being a national monument there could be mandatory changes to sampling requirements	Differences between observed and unobserved vessels using VMS, log books, etc.
<u>Hawaii Longline</u> Fleet: 123 tuna, 32 sword; 28 tuna and swordfish; pelagic line; 15-25 day trips (tuna); 25-35 day trips (swordfish)	Mandatory census (court order)	Potential change in fishing behavior for observed trips.	Not at this time due to the court order census	VMS and log book comparison.
	Mandatory 20% (court order)	Potential change in fishing behavior for observed trips.	Sword fishery: Not at this time due to the court order coverage requirement; Tuna fishery: Not at this time since the systematic random sample scheme includes all vessels and meets the 20% coverage	VMS and log book comparison.

Table 4b. South West Fisheries Science Center (SWFSC)				
Program	**Rationale for Current Design**	**Special concerns/implications**	**Alternative Selection Schemes Suggested**	**Applicable Diagnostic Tools**
North Pacific Albacore Troll Fleet: 800 vessels; troll lines; 1week – 1 month trips;	Observe fleet spatially and temporally for bycatch, finfish, and protected species.	Observed portion of the fleet may differ from the unobserved portion.	Stratify the fleet into near-shore and distant-water vessels; Implement probability-based sampling	Compare with logbooks and landings data
California/Oregon Drift Gillnet Fishery Fleet: 40 active vessels; 7-10 day trips;	20% coverage designed to capture marine mammal interactions	Proportion of small boats that fish inshore and cannot be observed is increasing.	Systematic random sampling (48 h call in required)	Compare with logbooks and landings data
California Coastal Pelagic Species Fleet: 70 active vessels; purse seine; 1-2 day trips;	Designed to quantify marine mammal interactions	Census of all tuna trips is costly, and requires reduced sampling in other sectors if budged is fixed	Systematic random sampling (48 h call in required)	Compare with logbooks and landings
California Pelagic Longline Fishery Fleet: 1 active vessel	In fishery management plan to address sea turtles	Census of all trips is costly, and requires reduced sampling in other sectors if budged is fixed	Stratified random sampling could achieve more even coverage across all sectors, with possible overall improvement in precision	N/A

Table 5b. Northeast Fisheries Science Center (NEFSC) Three example fisheries in the NE Region

Program	Rationale for Current Design	Special concerns/implications	Alternative Selection Schemes Possible	Applicable Diagnostic Tools
Northeast Multispecies Groundfish Fleet: ~1500 vessels; multiple gears: otter trawls, gillnet, longline; 1-7 day trips typical 64,000 days available in FY05	Multi-purpose including catch, bycatch, behavior, and marine mammals. Different allocation depending on fishery. Coverage level (5%) set by court order	Very skewed allocation of effort between quota monitoring and non-quota monitoring might lead to bias if catch cannot be attributed to the correct strata.	Optimize allocation between mammal and fisheries programs – an ancillary issue.	Comparison of: (1) kept pounds in dealer data and vessel trip report data; (2) vessel performance (kept pounds and trip duration) with and without an observer; (3) spatial coherence; (4) graphical comparisons of cumulative distribution functions fitted to a fleet's catch distribution by vessel with an overlay of observed vessels.
Mid Atlantic Gillnet Fleet: 1,200+ vessels; LOA 21 ft -48 ft; gillnets: anchored, drift, float, sink; 1-2 day trips; Federal and state permits	Multi-purpose including catch, bycatch, behavior, and marine mammals. Different allocation depending on fishery. Coverage level (5%) set by court order	Very skewed allocation of effort between quota monitoring and non-quota monitoring might lead to bias if catch cannot be attributed to the correct strata.	Optimize allocation between mammal and fisheries programs – an ancillary issue. Expand vessel list to include state permits.	Comparison of: (1) kept pounds in dealer data and vessel trip report data; (2) vessel performance (kept pounds and trip duration) with and without an observer; (3) spatial coherence; (4) graphical comparisons of cumulative distribution functions fitted to a fleet's catch distribution by vessel with an overlay of observed vessels.
Atlantic Sea Scallop Dredge Fishery Fleet: 525 vessels with permit; scallop dredge, scallop trawl; variable trip duration; VMS implemented	Multi-purpose including catch, bycatch, behavior, and protected species (turtles). Different allocation depending on fishery.	Very skewed allocation of effort between quota monitoring and non-quota monitoring might lead to bias if catch cannot be attributed to the correct strata.	Optimize allocation between turtles and fisheries programs – an ancillary issue	Comparison of: (1) kept pounds in dealer data and vessel trip report data; (2) vessel performance (kept pounds and trip duration) with and without an observer; (3) spatial coherence; (4) graphical comparisons of cumulative distribution functions fitted to a fleet's catch distribution by vessel with an overlay of observed vessels.

Table 6b. Southeast Fisheries Science Center (SEFSC)

Program	Rationale for Current Design	Special concerns/implications	Alternative Selection Schemes Suggested	Applicable Diagnostic Tools
Shrimp Trawl GOM Fleet: ~2,800 vessels; LOA ~ 70 ft; ~ 25 day trips; year-around; East Coast ~3 day trips, typically seasonal.	Bycatch estimation and gear development to reduce bycatch. Magnuson-Stevens Act ESA	Voluntary Program – low response rate for randomly-selected vessels.	Implement a mandatory selection program, pending. Stratified random sampling by effort, area, season, and depth.	Compare with electronic log books, trip tickets. Mimic the prior, voluntary program after the mandatory program is implemented to quantify the effect of the change on the time-series. VMS may be available in the future.
Southeast Shark Gillnet Fleet: 6-30 vessels; multiple gillnet types	MMPA and ESA enforcement	Complete coverage of a portion of the fleet at the expense of coverage for other gear types may cause major bias.	Drop 100% coverage of some gear types and implement a stratified random sample across all times, gears, and areas fished. Monitor compliance with closed areas using VMS.	Changing from 100% coverage to stratified random sample would allow for coverage of more of the fleet, a bias issue, as well as improve cost/benefit. This is supported by current analysis.

Table 6b. Southeast Fisheries Science Center (SEFSC), continued

Program	Rationale for Current Design	Special concerns/implications	Alternative Selection Schemes Possible	Applicable Diagnostic Tools
Atlantic and Gulf of Mexico Shark Bottom Longline Fishery Fleet: 250 vessels, approximately 100 active; LOA < 50 ft; 500-1,500 hooks per line	FMP for highly migratory species, ESA. The coverage is targeted to achieve a 30% RSE for protected resources.			Analyze time series for change from voluntary program to mandatory.
Pelagic Longline Fleet: 80-100 active vessel w/ swordfish, tuna, and shark permits; 3-14 day trips 150-200 mi off-shore typical; some 20-40 day trips 200- 1000 mi from port	Bycatch estimation, 8% coverage specified in BO for sea turtles.		Change vessel-selection procedure to random selection based on call in rather than last years effort. Improve enforcement to reduce number of unobserved boats.	

Table 7. Sources of data for diagnosing vessel selection bias and their assessed reliability

	Trip duration	**Catch**	**Bycatch Information**	**Fishing location**	**Gear**	**Operation Characteristics**	**Haul duration**
Logbook	High	Variable	Low	Variable	High	Variable	Variable
Trip ticket	High	High	Low	Poor-Moderate	-	-	-
VMS	High	-	-	High	-	Variable	High
Survey information	-	-	Variable	-	-	-	-
Days at sea report	High	-	-	-	-	-	-
Fishermen daily report	-	Variable	Low	Low	-	Low	-
MMAP[3]	-	-	Low	Low	-	-	-
Video/Electronic Monitoring	-	Possible	Possible	-		Possible	

Table 8. Methods for diagnosing vessel selection bias recommended by workshop participants.

Classification	**Tests**
Comparison of observed vessels versus entire fleet – magnitude and significance of difference	t-test, concordance correlation and other agreement methods, linear models, randomization tests, cumulative distributions, likelihood ratio test, appropriate graphics, multivariate characterization of catch characteristics (cf, Sampson) , comparison of behavior of individual vessels between observed and unobserved trips
Spatial distribution of the fishery	Graphic analysis, qualitative assessments, Jim Ianelli's presentation (Appendix D)
Realized sample versus actual sampling frame	Evaluate the composition and characteristics of the observed component of the fleet as compared to the entire fleet, including

[3] Marine Mammal Authorization Program, Mortality/Injury Reporting Forms (http://www.nmfs.noaa.gov/pr/interactions/mmap)

APPENDIX A

AGENDA

AGENDA
National Observer Program
Vessel Selection Bias Workshop
Woods Hole, MA, May 17-18, 2006

Wednesday, May 17th

8:30 – 8:45 am	Welcome and Logistics - Dr. John Boreman; Dave Potter (NEFSC)
8:45 – 9:00 am	Workshop Objectives - Dr. Bill Karp
9:00 – 10:00	Topic Presentations: Dr. John Carlson - NOAA NMFS, Southeast Fisheries Science Center, Panama City Laboratory, *"Potential Biases When Management Decides the Sampling Universe"* David Ackley - NOAA NMFS, Alaska Region, *"Observer Deployment Pilot Project – a 2003 Gulf of Alaska Trawl Fishery"*
10:00 – 10:15	***Coffee Break***
10:15 – 12:00	Topic Presentations: Susan Wigley - NOAA NMFS, Northeast Fisheries Science Center, *"Techniques used to Identify Potential Vessel Selection Bias in the Northeast Region"* Nancy Gove - NOAA NMFS, Northwest Fisheries Science Center, *"Analysis of Vessel Selection Bias – Examples using Limited-Entry Trawl Data from the West Coast"* Dr. James Ianelli - NOAA NMFS, Alaska Fisheries Science Center, *"An Evaluation of Observer Data for Salmon Bycatch Characteristics: Are There Vessel Selection Effects?"*

LUNCH

1:00 – 1:15 pm	Charge to Group - Dr. Michael Fogarty
1:15 – 5:00 pm	Group discussion (Conveners: Drs. Michael Fogarty and Jon Vølstad)

The group discussion will focus on appropriate criteria and methods to evaluate bias related to:

1. The completeness of the sampling frame (list) from which vessels are selected for observer deployment
   - Does the list include all vessels in the fishery for which inferences about catch and bycatch are to be made?

2. Procedures for selecting vessels from the sampling frame (attempted census, probability-based, ad-hoc)

3. The sample of vessels on which observers are actually deployed.

4. Changes in fishing behavior when observers are deployed.

Results of analysis across programs will be used to guide the development of a robust protocol for the diagnostics of bias due to vessel selection procedures and deployment.

6:30 pm	Dinner at Liam Maguire's Restaurant

Thursday, May 18

8:30 - 10:00 Plenary Session: Report-outs of Break-out groups and charge for today's break-out sessions

10:00 - 10:15 Coffee Break

10:15 - noon Continued break-out group discussions to identify commonality across programs, and possible improvements that have general applications with focus on:

- Criteria for identifying potential sources and levels of bias
- Procedures for selecting vessels and deploying observers that minimize bias under different logistical constraints;
- Effective methods for continually monitoring that the vessel selection and observer deployment process is properly implemented to ensure that observed vessels represent the fishery and fleet for which inferences are to be made

1 – 5 pm Plenary Discussion to develop consensus recommendations

APPENDIX B

LIST OF ATTENDEES

List of Attendees
Vessel Selection Bias Workshop
Woods Hole, MA
May 17 & 18, 2006

Last Name	First Name	Affiliation	E-mail
Ackley	Dave	AKRO	David.ackley@noaa.gov
Barkas	Jessica	NOP	Jessica.Barkas@noaa.gov
Beerkiche	Larry	SEFSC	Lawrence.R.Beerkiche@noaa.gov
Brown	Craig	SEFSC	Craig.Brown@noaa.gov
Carlson	John	SEFSC	John.Carlson@noaa.gov
Desfosse	Lisa	NOP	Lisa.Desfosse@noaa.gov
Enriquez	Lyle	SWR	Lyle.Enriquez@noaa.gov
Fogarty	Mike	NEFSC	Michael.Fogarty@noaa.gov
Gove	Nancy	NWFSC	Nancy.Gove@noaa.gov
Hansford	Dennis	NOP	Dennis.Hansford@noaa.gov
Ianelli	Jim	AFSC	Jim.Ianelli@noaa.gov
Karp	Bill	AFSC	Bill.Karp@noaa.gov
Majewski	Janell	NWFSC	Janell.Majewski@noaa.gov
Palka	Debi	NEFSC	Debra.Palka@noaa.gov
Potter	Dave	NEFSC	David.Potter@noaa.gov
Scott-Denton	Elizabeth	SEFSC	Elizabeth.Scott-denton@noaa.gov
Tork	Peter	NEFSC	Peter.Tork@noaa.gov
Van Atten	Amy	NEFSC	Amy.van.Atten@noaa.gov
Vølstad	Jon	Versar	jVolstad@versar.com
Weber	Ed	Versar	eWeber@versar.com
Wigley	Susan	NEFSC	Susan.Wigley@noaa.gov
Willson	Jeremy	PIRO	Jeremy.Willson@noaa.gov
Yoos	Patricia	NEFSC	Patricia.Yoos.@noaa.gov

APPENDIX C

QUESTIONNAIRE

ALASKA FISHERIES SCIENCE CENTER

North Pacific Groundfish Observer Program (NPGOP) 30% Observed Sector
North Pacific Groundfish Observer Program (NPGOP) 100% Observed Sector
North Pacific Groundfish Observer Program (NPGOP) 200% Observed Sector

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs - Alaska Groundfish 30% Observed Sector

1. *Your name and title:*

Bill Karp
Director, Fisheries Monitoring and Analysis Division, AFSC

2. *What is the name of your Observer Program?*

North Pacific Groundfish Observer Program (NPGOP), 30% Observed Sector

The following information is for trawl and longline vessels requiring an observer aboard the vessel for 30% of their fishing days per fishery per calendar quarter, when the vessel participates in the fishery for more than three days and for pot vessels requiring an observer aboard for 30% of their pot lifts each calendar quarter. This fleet is typically referred to as the 30% observer coverage fleet.

Vessels under 60 ft. in length overall are not required to carry an observer, and the Observer Program has no authority to place observers aboard this fleet.

3. *In which NOAA Region is it implemented?*

Alaska (Bering Sea and Aleutian Islands [BSAI] and Gulf of Alaska [GOA])

4. *List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below)*

The primary objectives of the program include the provision of data to support in-season catch monitoring and stock assessment information needs. Observers also monitor for compliance with a myriad of federal fishing regulations and natural resource legislation including the Marine Mammal Protection Act, Endangered Species Act, and the Magnuson-Stevens Fishery Conservation and Management Act.

5. *Provide a general description of the fleet to which the program is applied*

5.1. *Gear type(s)*

Pelagic trawl
Bottom trawl
Longline
Pot (trap)

5.2. *Number of active vessels by gear and size category*

Observer coverage in the Alaska groundfish fishery is set by federal regulation and is based primarily on vessel length or gear type for this fleet. Trawl and longline vessels between 60 and 124 ft. in length overall (LOA) and vessels using pot gear, regardless of length, require 30% observer coverage. Some vessels use multiple gear types, so there is some overlap in the following numbers. In 2004, observers were deployed on:

46 bottom trawl vessels between 60 and 124 ft. in length overall

58 pelagic trawl vessels between 60 and 124 ft. in length overall

32 longline vessels between 60 and 124 ft. in length overall

75 pot vessels (coverage is not size specific, but these vessels ranged from 70-176 ft. LOA)

Note that we do not have an estimate of the number of vessels less than 60 ft LOA

5.3. *Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)*

Because this fleet is made up catcher vessels and C/Ps targeting a variety of fisheries, trip length is highly variable. We use fishing day or sea day as our most common metric for characterizing observer coverage of vessel activity.

Some component of the 30% coverage fleet is active all year. Catcher vessels which store catch in refrigerated sea water (RSW) tanks tend to make return to port every 3-7 days to offload catch. Catcher vessels using ice to retain catch tend to stay out longer, with trips lasting 2-3 weeks. Catcher processor vessels can stay at sea until their freezer holds are full, and these vessels may return to port only once every 20-40 days to offload product.

An average "trip" is particularly difficult to characterize on this fleet, because may cut their trips short if they no longer need observer coverage. Vessel operators pay independent contractors a daily rate for the provision of observer services. In many cases, the vessel operator returns to port even if the vessel is not yet full, just to end an observer trip.

5.4. *Number of ports and distribution of vessels and trips among ports*

There are two components of this fleet; the Bering Sea catcher vessel fleet, which operates out of the ports of Dutch Harbor and Akutan. The Kodiak based catcher vessel fleet operates predominantly from the ports of Kodiak, King Cove and Sand Point.

There are numerous small longliners that prosecute the sablefish fishery under an Individual Fishing Quota (IFQ) system. These vessels tend to carry observers in Southeast Alaska and the GOA, depending on where the vessel has IFQ shares. These vessels use many smaller ports through Alaska such as Seward, Homer, Juneau, Cordova, Alitak and Yakutat.

C/Ps are not affiliated with one specific port, and tend to go to any of the deep-water ports that can accommodate their size to offload product and purchase fuel, fiber (boxes and bags for product) and food. In addition to Dutch Harbor, the C/Ps will use the ports of St. Paul and Adak.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target species (or species assemblages) include:

Walleye pollock

Pacific cod

Sablefish

Yellowfin sole

Rock sole

Flathead sole

Deep water flatfish
Shallow water flatfish (GOA – includes yellowfin sole, rock soles, English sole, starry flounder, butter sole, Alaska plaice and sand sole)

Greenland turbot

Arrowtooth flounder

Skates

Pacific Ocean perch

Demersal shelf rockfish (canary, china, copper, quillback, rosethorn, tiger and yellow-eye)

Pelagic shelf rockfish ((dusky, yellowtail and widow)
Slope rockfish (aurora, blackgill, Bocaccio, chilipepper, darkblotch, green-striped, harlequin, pygmy, redbanded, redstripe, sharpchin, shortbelly, silvergray, splitnose, stripetail, vermillion,and yellowmouth)

Major bycatch species include: Pacific halibut, salmonids (especially chum salmon and Chinook salmon) and Tanner crab species. These are regulatory prohibited species which groundfish harvesters are required to discard. Maximum retention allowances (MRAs) are also in affect for all groundfish species if their target fishery is closed. It must be noted that discarded bycatch is still attributed to the TAC and counted against the appropriate catch quota.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

These programs operate under primarily MSA authority.

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied

must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

The C/P portion of this fleet is required to submit weekly production reports to the Alaska Regional Office's (ARO) Sustainable Fisheries Division. Logbooks are required to be completed and submitted for all vessels over 60 ft. but are not keypunched.

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Logbooks in one form or another have existed prior to the Americanization of the fishery in 1991.

Landings information for the catcher vessel component of this fleet is captured by shoreside processing reports and through landings receipts (Alaska Department of Fish and Game (ADF&G) "fish tickets".) These receipts include gear type, NMFS and/or ADF&G area fished, a breakdown of species delivered, the fishing start date and the delivery date. Delivering vessels are supposed to report at-sea discard to the processing facility, but this is done in an incomplete manner.

For the catcher processor component portion of the fleet, the vessels submit weekly production reports to the Alaska Regional office. Production reports focus on production numbers and discards are not well reported.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Detailed vessel and haul specific information is available in the observer database for observed trips, and in the unkeypunched vessel logbooks. Landing data are reported as fish tickets to the State of Alaska. Overall estimates of catch and bycatch, by target fishery, time, area, and gear type are maintained by ARO.

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

Observer data is maintained in an ORACLE database and is confidential. Aggregate catch information is maintained separately by ARO and is posted on the WWW.

9. Describe the Design of Your Observer Program

The following information is for the 30% observer coverage program.

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

The primary sampling unit is the vessel (determined by size), secondary is trip (determined by vessel operator) and tertiary is haul or set (determined by observer)

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

All data is collected and recorded at the haul level.

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Vessel operators, in coordination with their observer service provider companies, arrange for the quarterly coverage required by regulation.

9.3.2 Secondary Sampling Level (trips)

(See above)
For this fleet, haul sampling would be the tertiary level. Observers use the Program issued random sample and/or random break tables to determine hauls to sample for composition and biological data.

9.3.3 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Vessel operators choose when to take an observer, and they do so based on many factors. First, an observer has to be available. Observers may be deployed on up to four vessels prior to retuning to NOAA Fisheries for debriefing. Observer provider companies want to maximize their observer deployments prior to pulling them from the field. Secondly, the vessel operator can control when they decide to take an observer. Operators can choose to take an observer when they know they'll be fishing in a low-bycatch area or when they will be fishing near to port, so they can return the observer to port as soon as their coverage level is reached.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

No. Vessels are required only to meet overall coverage requirements described above.

9.7. Number of observers per trip?

These trawl and longline vessels carry one observer for 30% of their fishing days in each fishery per calendar quarter when they operate in the fishery for more than 3 days.

Observer coverage aboard pot vessels is dependent upon the number of pots retrieved. These vessels must carry an observer for 30% of their pot retrievals each quarter.

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

For each haul, observers complete the following tasks (listed in order of priority):

1) Record incidental takes of short-tailed albatross and collect specimens. Record takes of marine mammals. Collect canine teeth from pinnipeds (except walrus), and tissue samples from cetaceans. Rehabilitate live endangered seabirds.
2) Record fishing effort and catch information and make an independent total catch estimate for as many hauls as possible. Record all calculations for independent catch estimates in an observer logbook.
3) Sample randomly selected hauls for species composition (if all hauls cannot be sampled).
4) Submit data on a trip-by-trip basis to the Observer Program.
5) Document compliance infractions and suspected violations in an observer logbook and complete affidavits.
6) Collect biological data on prohibited species.
7) Collect sexed length frequency from predominant species in each haul and collect otoliths or other age structures from the required subset of hauls.
8) Maintain the observer logbook, including: Vessel Safety Checklist, Daily Notes, all calculations and formulas, sampling techniques, seabird interactions and banded bird information, scale tests and sample station diagrams.
9) Collect data and specimens for standard projects as assigned.
10) Log sightings of seabird "species of interest" and marine mammals.
11) Complete special projects as assigned.

9.9. *Provide details of primary and secondary sample selection guidelines*

9.9.1 *Target sample sizes (vessels, trips) by stratum (if applicable)*

The target sample size is 30% of the fishing days each calendar quarter in each fishery for trawl and longline vessels. For pot vessels, the target sample size is 30% of pot lifts in each calendar quarter.

9.9.2 *Coverage (proportion of vessels & trips observed) by stratum (if applicable)*

Not applicable

9.9.3 *Sample allocation of vessels and trips by gear/size group*

Not applicable

9.9.4 *Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)*

Observers use a “random” sample table and random break table to select hauls for sampling when all hauls cannot be sampled. The Program has three random sample tables to accommodate the different harvest strategies of this fleet.

The “random” sample table is not entirely unpredictable, and the Program has had anecdotal reports of the fleet manipulating their fishing behavior to take advantage of the table’s design. For example, the random sample table never requires an observer to sample more than 4 hauls in a row. Some observers have felt that the vessel operator can manipulate the sample data by pulling four short hauls quickly, then moving to another area for the fifth (and possibly unsampled) haul.

Observers have the option of using a random break table in addition to, or instead of, the random sample tables. The break table designates a random 6 hour break every 24 hour period.

9.9.5 *Sample allocation of trips in time and space*

Observer coverage is required on a quarterly basis in each fishery in which a vessel operates for more than three days. There are no spatial distribution requirements.

9.9.6 *Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)*

See 9.9.4 above

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

The random sample and random break tables spread sampling effort among night and day hauls.

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

The target sample size concept is not applicable to this sampling design. Overall sample size is largely determined by the target fishery and gear type. Observers aboard trawlers are given the choice of three sample types, and these sample types can be used in combination depending on catch composition and haul size. These targets are based on pragmatic considerations, but not on any statistical measure.

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Catch and bycatch estimates are calculated by ARO according to target fishery, area, time, and gear type criteria. In general, available observer catch composition provides the basis for characterizing overall catch composition in each stratum. Delivery and production reports provide additional data necessary for these expansions. This approach does not take into account estimation uncertainty or sampling bias.

Fishery stock assessments incorporate fishing mortality estimates derived as described above, together with size and age composition provided from observer samples. Size- and age-composition measurement error is taken account by stock assessment scientists using a range of approaches.

Takes of marine mammals and seabirds are estimated from observer data by several AFSC scientists, but no standardized methodology has been developed.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Estimates derived from observer program data are used to account against quotas of target and bycatch species.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

ARO maintains a complete list of fishery participants granted federal fishing permits. This list is maintained annually. The list includes vessel size and gear types. This database could be used to characterize the 30% covered fleet and the uncovered fleet (those vessels less than 60 ft. LOA).

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Vessels less than 60 ft LOA are not observed at present.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

The basic sampling design, described above, precludes random selection of vessels or trips.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

Generally, compliance of the 30% coverage requirements is high.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

N/A

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

No – see previous information

12.6. Is there any basis for believing that the estimators employed may result in a bias?

N/A

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be

appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Trip and dealer reports are available for the catcher vessel component of this fleet on an annual basis. The Alaska Department of Fish and Game (ADF&G) fish tickets are receipts of sale issued by processing facilities which list the delivered quantities of at least commercially important species. Fish tickets are not perfect data sources. For example, discarded species may be missing and non-managed species may not be recorded even if it they account for a significant portion of the delivery. Recording to the species level is not always reliable because plant personnel are not familiar with all species, or species may appear similar to sorters. Despite these limitations, fish tickets are likely the best data source for some fisheries to use in these analyses.

  Port sampling in the AK groundfish fisheries is conducted by observers, primarily for biological data. Although processing plant observers record some delivery data, the level of detail is insufficient to allow comparison with other sources.

  Although this fleet is required to carry and submit catch logs, these data are not keyed into a database. The fleet submits weekly production reports to the ARO. Which report only the production of the processor. Discards are not well reported and much of the tonnage data is identical to that reported by observers.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  We have conducted some preliminary work evaluating the capability of video systems to monitor and account for discard at sea. The project was not designed to identify potential vessel coverage biases, and would likely not be directly applicable.

- ***Vessel Monitoring Systems (VMS)***

  Vessels harvesting Pacific cod, Atka mackerel or walleye pollock are required to carry a VMS. These systems would be very valuable to characterize spatial and temporal biases in these fisheries.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  Survey gear is designed to be consistent, and not to mimic commercial gear. Seasonal and area overlap is poor.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  N/A

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  This would require keypunching of a large amount of archived data. Only applicable for vessels >= 60ft LOA.

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  Limited comparisons would be possible for vessels >= 60ft LOA, but accurate temporal and spatial information from unsampled vessels would be difficult and time consuming to obtain.

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  Limited comparisons would be possible for vessels >= 60ft LOA, but accurate temporal and spatial information from unsampled vessels would be difficult and time consuming to obtain.

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  (See the temporal overlap response above.)

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

  Logbook data could be used to address this question for vessels >= 60ft LOA, but these data are not readily available.

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs - Alaska Groundfish 100% Observed Sector

1. *Your name and title:*

Bill Karp
Director, Fisheries Monitoring and Analysis Division, AFSC

2. *What is the name of your Observer Program?*

North Pacific Groundfish Observer Program (NPGOP), 100% Observed Sector

The following information is for vessels requiring an observer aboard the vessel at all times (100% observer coverage).

3. *In which NOAA Region is it implemented?*

Alaska Region
These vessels fish primarily in the Bering Sea and Aleutian Islands (BSAI), with some activity in the Gulf of Alaska (GOA).

4. *List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).*

The primary objective of the program includes the provision of data to support in-season catch monitoring and stock assessment information needs. Observers also monitor for compliance with a myriad of federal fishing regulations and natural resource legislation including the Marine Mammal Protection Act, Endangered Species Act, the American Fisheries Act and the Magnuson-Stevens Fishery Conservation and Management Act.

5. *Provide a general description of the fleet to which the program is applied*

5.1. *Gear type(s)*

Pelagic trawl
Bottom trawl
Longline

This fleet is comprised of both catcher vessels, which deliver unfrozen catch to shoreside or floating processor facilities, and catcher processor (C/P) vessels, which make a preliminary or finished product, and store it in large freezer holds. For our purposes, it is the ability to freeze fish that differentiates C/Ps from catcher boats.

5.2. *Number of active vessels by gear and size category*

All vessels requiring 100% observer coverage are 125 ft. or greater in length overall (LOA). Observer coverage in the Alaska groundfish fishery is set by federal regulation and is based primarily on vessel length, gear type and fishery. Some vessels use multiple gear types, so there is some overlap in the following numbers. In 2004, observers were deployed on:

79 bottom trawl vessels

27 pelagic trawl vessels (these are catcher vessels which generally participate in the walleye pollock fishery; pollock C/P vessels have higher coverage requirements and are included in the 200% coverage questionnaire)

53 longline vessels greater or equal to 125 ft. LOA

5.3. *Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)*

Because this fleet is made up catcher vessels and C/Ps targeting a variety of fisheries, trip length is highly variable. We use fishing day or sea day as our most common metric for characterizing observer coverage of vessel activity.

Some component of the 100% coverage fleet is active all year. Catcher vessels which store catch in refrigerated sea water (RSW) tanks tend to make return to port every 3-7 days to offload catch. C/P vessels can stay at sea until their freezer holds are full, and these vessels may return to port only once every 30-40 days to offload product.

5.4. *Number of ports and distribution of vessels and trips among ports*

The vast majority of this fleet operates out of the ports of Dutch Harbor and Akutan. C/Ps are not affiliated with one specific port, and tend to go to any of the deep-water ports that can accommodate their size to offload product and purchase fuel, fiber (boxes and bags for product) and food. In addition to Dutch Harbor, the C/Ps will use the ports of St. Paul and Adak.

6. *What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?*

Target species (or species assemblages) include:

Walleye pollock

Pacific cod

Sablefish

Yellowfin sole

Rock sole

Flathead sole

Deep water flatfish
Shallow water flatfish (GOA – includes yellowfin sole, rock soles, English sole, starry flounder, butter sole, Alaska plaice and sand sole)

Greenland turbot

Arrowtooth flounder

Pacific Ocean perch

Major bycatch species include: Pacific halibut, salmonids (especially chum salmon and Chinook salmon) and Tanner crab species. These are regulatory prohibited species which groundfish harvesters are required to discard. Maximum retention allowances (MRAs) are also in affect for all groundfish species if their target fishery is closed. It must be noted that discarded bycatch is still attributed to the TAC and counted against the appropriate catch quota.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

These programs operate under primarily MSA authority.

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

The C/P portion of this fleet is required to submit weekly production reports to the Alaska Regional Office's (ARO). Logbooks are required to be completed and submitted but these records are not keypunched.

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Logbooks in one form or another have existed since before the Americanization of the fishery in 1991. Many years of production reports are also available.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Detailed vessel and haul specific information is available in the observer database for observed trips (all trips for this fleet), and in the unkeypunched vessel logbooks. Landing data are reported as fish tickets to the Sate of Alaska. Overall estimates of catch and bycatch, by target fishery, time, area, and gear type are maintained by ARO.

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

Observer data is maintained in an ORACLE database and is confidential. Aggregate catch information is maintained separately by ARO and is posted on the WWW.

9. Describe the Design of Your Observer Program

The following information is for the 100% observer coverage program.

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Vessel (primary, 100%), trip (secondary, 100%), haul (tertiary <100%)

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

All data is collected and record at the haul level.

9.3. How were the sampling frames established?

9.3.4 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

All vessels are observed.

9.3.5 Secondary Sampling Level (trips)

See above

9.3.6 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

All vessels and trips made by these vessels in these fisheries are observed.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

All vessels and trips made by these vessels in these fisheries are observed.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

It is mandatory that all vessels in this fleet carry an observer at all times.

9.7. Number of observers per trip?

These vessels carry one observer any time they are active in the groundfish fishery.

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

For each haul, observers complete the following tasks (listed in order of priority):

1) Record incidental takes of short-tailed albatross and collect specimens. Record takes of marine mammals. Collect canine teeth from pinnipeds (except walrus), and tissue samples from cetaceans. Rehabilitate live endangered seabirds.
2) Record fishing effort and catch information and make an independent total catch estimate for as many hauls as possible. Record all calculations for independent catch estimates in an observer logbook.
3) Sample randomly selected hauls for species composition (if all hauls cannot be sampled).
4) Electronically submit data daily to the Observer Program.
5) Document compliance infractions and suspected violations in an observer logbook and complete affidavits.
6) Collect biological data on prohibited species.
7) Collect sexed length frequency from predominant species in each haul and collect otoliths or other age structures from the required subset of hauls.
8) Maintain the observer logbook, including: Vessel Safety Checklist, Daily Notes, all calculations and formulas, sampling techniques, seabird interactions and banded bird information, scale tests and sample station diagrams.
9) Collect data and specimens for standard projects as assigned.
10) Log sightings of seabird “species of interest” and marine mammals.
11) Complete special projects as assigned.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Observers use a “random” sample table and random break table to select hauls for sampling when all hauls cannot be sampled. The Program has three random sample tables to accommodate the different harvest strategies of this fleet.

The ”random” sample table is not entirely unpredictable, and the Program has had anecdotal reports of the fleet manipulating their fishing behavior to take advantage of the table’s design. For example, the random sample table never requires an observer to sample more than 4 hauls in a row. Some observers have felt that the vessel operator can manipulate the sample data by pulling four short hauls quickly, then moving to another area for the fifth (and possibly unsampled) haul.

Observers have the option of using a random break table in addition to, or instead of, the random sample tables. The break table designates a random 6 hour break every 24 hour period.

9.9.5 Sample allocation of trips in time and space

N/A

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

See 9.9.4 above

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

The random sample and random break tables allocate sampling effort among night and day hauls.

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

Catch and bycatch estimation is deterministic in nature, and overall sample sizes are determined by regulation. A very high proportion of hauls/sets are sampled in these fisheries.

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of

effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Catch and bycatch estimates are calculated by ARO according to target fishery, area, time, and gear type criteria. In general, available observer catch composition provides the basis for characterizing overall catch composition in each stratum. Delivery and production reports provide additional data necessary for these expansions. This approach does not take into account estimation uncertainty or sampling bias.

Fishery stock assessments incorporate fishing mortality estimates derived as described above, together with size and age composition provided from observer samples. Size- and age-composition measurement error is taken account by stock assessment scientists using a range of approaches.

Takes of marine mammals and seabirds are estimated from observer data by several AFSC scientists, but no standardized methodology has been developed.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Estimates derived from observer program data are used to account against quotas of target and bycatch species.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1 Is the list of active vessels complete and up-to-date?

Yes

12.1.2 Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

None of this fleet is unobserved.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

There are no logistical constraints to placing observers aboard these vessels. An observer is required, and vessels cannot fish without their required observer coverage.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

N/A

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

N/A

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  N/A

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  We have conducted some preliminary work evaluating the capability of video systems to monitor and account for discard at sea. The project was not designed to identify potential vessel coverage biases, and would likely not be directly applicable.

- ***Vessel Monitoring Systems (VMS)***

  Vessels prosecuting Pacific cod, Atka mackerel or walleye pollock are required to carry a VMS. These systems would be very valuable to characterize spatial and temporal biases in these fisheries.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  N/A

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  N/A

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  N/A

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  It would be possible to analyze the temporal and spatial distribution of unsampled and sampled hauls relative to fishing effort by this fleet. But all trips are sampled, and most hauls within each trip are also sampled.

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  See above

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  N/A

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

  N/A

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs – Alaska Groundfish 200% Observed Sector

1. Your name and title:

Bill Karp
Director, Fisheries Monitoring and Analysis Division, AFSC

2. What is the name of your Observer Program?

North Pacific Groundfish Observer Program (NPGOP), 200% Fleet

The following information is for vessels requiring two observers aboard the vessel anytime they participate in a specific fishery (commonly referred to as 200% coverage).

3. In which NOAA Region is it implemented?

Alaska Region
These vessels fish primarily in the Bering Sea and Aleutian Islands (BSAI), with some activity in the Gulf of Alaska (GOA).

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

The primary objective of the program is the provision of data to support in-season catch monitoring and stock assessment information needs. Vessels participating in fisheries requiring two observers operate under quota-monitoring intense programs, such as fishery cooperatives allowed under the American Fisheries Act (AFA) or Multi-Species Community Development Quotas (MSCDQ). These quota systems rely entirely upon observer data for fine-scale management of individual cooperative quotas.

Observers also monitor for compliance with a myriad of federal fishing regulations and natural resource legislation including the Marine Mammal Protection Act, Endangered Species Act, American Fisheries Act and the Magnuson-Stevens Fishery Conservation and Management Act.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Pelagic trawl
Bottom trawl
Longline

The fleet on which two observers are deployed is comprised of catcher processor (C/P) vessels. These vessels make a preliminary or finished product, and store it in large freezer holds. For our purposes, it is the ability to freeze fish that differentiates C/Ps from catcher boats, and a vessel which freezes whole fish is still considered a C/P.

5.2. Number of active vessels by gear and size category

There are 21 catcher processor pelagic trawl vessels allowed to harvest walleye pollock under the AFA. These vessels produce a variety of products including surimi, fillets, fish oil and fish meal. An additional three mothership vessels participate in the AFA pollock fishery. Motherships are processing vessels which receive unsorted codends from smaller trawlers. The delivering vessels do not carry observers, but the mothership observers are able to sample these catches. One of the three mothership vessels actually carries three observers because the quantity of catch coming aboard exceeds the work time limits set by regulation for AFA observers.

The number of C/P vessels that participated in MSCDQ fisheries fluctuates from year to year, but generally there are between 26-32 participants. These C/Ps include bottom trawl and longline vessels.

There are approximately 12 vessels that participate in the Atka mackerel fishery.

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Because this fleet is made up entirely of C/Ps, the trip length is entirely dependent on how long it takes to fill the vessels' freezers. A typical trip on a pollock C/P is approximately 2 ½ to 3 weeks. A bottom trawler or longliner fishing in the MSCDQ fisheries could take closer to a month to fill up.

5.4. Number of ports and distribution of vessels and trips among ports

Because this fleet is made up entirely of C/Ps, they are not affiliated with one specific port. The vessels will go to any of the deep-water ports that can accommodate their size to offload product and purchase fuel, fiber (boxes and bags for product) and food. The major ports in Alaska frequented by these vessels include Dutch Harbor (where most observers embark these vessels), St. Paul and Adak.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Current regulations and legislation require two observers aboard vessels participating in the offshore walleye pollock fishery, Atka mackerel fishery and the MSCDQ fisheries.

MSCDQ include the following additional target species (or species assemblages): Pacific cod, yellowfin sole, rock soles, flathead sole, Greenland turbot, arrowtooth flounder, and Pacific Ocean perch.

Major bycatch species include: Pacific halibut, salmonids (especially chum salmon and Chinook salmon) and Tanner crab species. These are regulatory prohibited species which groundfish harvesters are required to discard. Maximum retention allowances (MRAs) are also in affect for all groundfish species if their target fishery is closed. It must be noted that discarded bycatch is still attributed to the TAC and counted against the appropriate catch quota.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

These programs operate under primarily MSA authority, with more stringent coverage requirements prescribed under the AFA (American Fisheries Act) and MSCDQ (Multi Species Community Development Program – under MSA regulations.

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

This fleet is required to submit weekly production reports to the Alaska Regional Office's (ARO) Sustainable Fisheries Division. Logbook data are available as paper records, but are not keypunched.

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Logbooks in one form or another have existed since before the Americanization of the fishery in 1991. Many years of production reports are also available.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Detailed vessel and haul specific information is available in the observer database for observed trips (all trips for this fleet), and in the unkeypunched vessel logbooks. Landing data are reported as fish tickets to the Sate of Alaska. Overall estimates of catch and bycatch, by target fishery, time, area, and gear type are maintained by ARO.

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

Observer data is maintained in an ORACLE database and is confidential. Aggregate catch information is maintained separately by ARO and is posted on the WWW.

9. Describe the Design of Your Observer Program

The following information is for the 100% observer coverage program.

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Vessel (primary, 100%), trip (secondary, 100%), haul (tertiary <100%)

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

All data is collected and record at the haul level.

9.3. How were the sampling frames established?

9.3.7 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

All vessels are observed.

9.3.8 Secondary Sampling Level (trips)

See above

9.3.9 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

All vessels and trips made by these vessels in these fisheries are observed.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

All vessels and trips made by these vessels in these fisheries are observed.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

It is mandatory that all vessels in this fleet carry an observer at all times.

9.7. Number of observers per trip?

These vessels carry one observer any time they are active in the groundfish fishery.

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

For each haul, observers complete the following tasks (listed in order of priority):

1) Record incidental takes of short-tailed albatross and collect specimens. Record takes of marine mammals. Collect canine teeth from pinnipeds (except walrus), and tissue samples from cetaceans. Rehabilitate live endangered seabirds.
2) Record fishing effort and catch information and make an independent total catch estimate for as many hauls as possible. Record all calculations for independent catch estimates in an observer logbook.
3) Sample randomly selected hauls for species composition (if all hauls cannot be sampled).
4) Electronically submit data daily to the Observer Program.
5) Document compliance infractions and suspected violations in an observer logbook and complete affidavits.
6) Collect biological data on prohibited species.
7) Collect sexed length frequency from predominant species in each haul and collect otoliths or other age structures from the required subset of hauls.
8) Maintain the observer logbook, including: Vessel Safety Checklist, Daily Notes, all calculations and formulas, sampling techniques, seabird interactions and banded bird information, scale tests and sample station diagrams.
9) Collect data and specimens for standard projects as assigned.
10) Log sightings of seabird “species of interest” and marine mammals.
11) Complete special projects as assigned.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Observers use a “random” sample table and random break table to select hauls for sampling when all hauls cannot be sampled. The Program has three random sample tables to accommodate the different harvest strategies of this fleet.

The “random” sample table is not entirely unpredictable, and the Program has had anecdotal reports of the fleet manipulating their fishing behavior to take advantage of the table’s design. For example, the random sample table never requires an observer to sample more than 4 hauls in a row. Some observers have felt that the vessel operator can manipulate the sample data by pulling four short hauls quickly, then moving to another area for the fifth (and possibly unsampled) haul.

Observers have the option of using a random break table in addition to, or instead of, the random sample tables. The break table designates a random 6 hour break every 24 hour period.

9.9.5 Sample allocation of trips in time and space

N/A

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

See 9.9.4 above

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

The random sample and random break tables allocate sampling effort among night and day hauls.

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

Catch and bycatch estimation is deterministic in nature, and overall sample sizes are determined by regulation. A very high proportion of hauls/sets are sampled in these fisheries.

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Catch and bycatch estimates are calculated by ARO according to target fishery, area, time, and gear type criteria. In general, available observer catch composition provides the basis for characterizing overall catch composition in each stratum. Delivery and production reports provide additional data necessary for these expansions. This approach does not take into account estimation uncertainty or sampling bias.

Fishery stock assessments incorporate fishing mortality estimates derived as described above, together with size and age composition provided from observer samples. Size- and age-composition measurement error is taken account by stock assessment scientists using a range of approaches.

Takes of marine mammals and seabirds are estimated from observer data by several AFSC scientists, but no standardized methodology has been developed.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Estimates derived from observer program data are used to account against quotas of target and bycatch species.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

None of this fleet is unobserved.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

There are no logistical constraints to placing observers aboard these vessels. An observer is required, and vessels cannot fish without their required observer coverage.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

N/A

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

N/A

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  N/A

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  We have conducted some preliminary work evaluating the capability of video systems to monitor and account for discard at sea. The project was not designed to identify potential vessel coverage biases, and would likely not be directly applicable.

- ***Vessel Monitoring Systems (VMS)***

  Vessels prosecuting Pacific cod, Atka mackerel or walleye pollock are required to carry a VMS. These systems would be very valuable to characterize spatial and temporal biases in these fisheries.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  N/A

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  N/A

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  N/A

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  It would be possible to analyze the temporal and spatial distribution of unsampled and sampled hauls relative to fishing effort by this fleet. But all trips are sampled, and most hauls within each trip are also sampled.

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  See above

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  N/A

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

  N/A

ALASKAN REGIONAL OFFICE

Alaska Marine Mammal Observer Program (AMMOP)

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title: *Bridget Mansfield, AMMOP Coordinator*

2. What is the name of your Observer Program? *Alaska Marine Mammal Observer Program (AMMOP)*

3. In which NOAA Region is it implemented? *Alaska Region*

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below): *see attached*

5. Provide a general description of the fleet to which the program is applied:

    5.1. Gear type(s*) see table below*

    5.2. Number of active vessels by gear and size category: *see table below*

    5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips) *see attached description*

    5.4. Number of ports and distribution of vessels and trips among ports. *Not relevant for set gillnet fisheries*

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues? *Salmon - see table*

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

    MMPA

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data:

    8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling) *Fishing effort and catch statistics – ADFG fish tickets, ADFG data on fishery openers; marine mammal incidental takes – logbook data prior to 1995, stranding/entanglement reports*

    8.2. Number of years of catch, landings, and effort data, and the consistency of data among years. > 10 yrs*. Data are very consistent among years*

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other. *This info is generally determined by a feasibility study conducted by AMMOP during the season prior to commencement of AMMOP observation. Other info is available from ADFG.*

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability *n/a*

9. Describe the Design of Your Observer Program – *see attached description*

9.1 What are the primary and secondary sampling units (e.g., vessels; trips) *net day – 24 hour period in which at least one set is observed*;

9.2 What is the ultimate sampling unit (e.g., tow/set) from which observers collects data? *set*

9.3 How were the sampling frames established? *See attached description*
- 9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)
- 9.3.2 Secondary Sampling Level (trips)
- 9.3.3 Other pertinent details

9.4 Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])? *Yes, see attached description*

9.5 How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures) *see attached description*

9.6 Is it mandatory that selected vessels accept observers for the selected trips? *yes*

9.7 Number of observers per trip? *Generally one per permit sampled; for coops or joint ventures, see attached description*

9.8 Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)? *Observers collect information on characteristics of gear that is used to fish while observer is observing operations. Observations of "picks" or "hauls " occurs while fishermen are actively taking fish from the net. The primary data to be collected are records of all marine mammals found to be entangled in the net, even if the self-release or are released before the net is removed from the water. Photos and biological samples are taken from each marine mammal found in the net, as feasible. Environmental data are collected for each haul observed. Information on catch and other bycatch, particularly seabirds, are collected and recorded for each haul* *observed. Additionally, observers conduct sighting watches to record marine mammals sighted in the vicinity of the fishing operations. See attached description for more information on observer trip logisitics.*

9.9 Provide details of primary and secondary sample selection guidelines: *see attached description*

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)
9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)
9.9.3 Sample allocation of vessels and trips by gear/size group
9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random);
9.9.5 Sample allocation of trips in time and space
9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)
9.9.7 Allocation of sampling effort within trips between night and day (if applicable)
9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest) *They are included in marine mammal stock assessment reports, used for determination of the annual MMPA List of Fisheries categorization, and informing periodic management decisions, such as authorizing incidental takes of ESA-listed species under MMPA Section 101a5E, potential use in Take Reduction Plan formation, if warranted, etc.*

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection:

12.1. Regarding completeness of sampling frames:

12.1.1. Is the list of active vessels complete and up-to-date? *yes*
12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)? *No.*

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g, factors that constrains representative sampling)? *See attached description*

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)? 100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels? *On a weekly basis, target levels achieved might vary from about 4.3% to about 6%; overall for each month and area as well as the season, observed levels are pretty close to the target levels.*

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery? *yes*

12.6. Is there any basis for believing that the estimators employed may result in a bias? No.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate:

    Potential data sources:

    - Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling ,
    - At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners
    - Vessel Monitoring Systems (VMS)
    - Fisheries-independent survey data (((How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)
    - Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)

    Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

    - Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum) – *this is done inseason to inform best observer distribution*.
    - Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one

particular portion of the season?) *also done in-season*.

- Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit· *There is no other reliable source of marine mammal incidental take.*
- Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling) *Target catch is not used as an effort estimator for this program. Fisher self reports of marine mammals known to be unreliable*
- Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])

Alaska Marine Mammal Observer Program
Mission/Goals/Objectives

I. **Mission**:
Provide the highest quality data to promote stewardship of marine mammal stocks found in the North Pacific and waters off Alaska for the benefit of the nation.

II. **Goal**:
Provide reliable information on interactions between marine mammals and inshore Category I and II Alaska fisheries, essential for the management of marine mammals in the North Pacific and waters off Alaska, to meet the mandates of the Marine Mammal Protection Act (MMPA), and, where feasible, to provide reliable information on incidental mortality and injury of non-marine mammal species including seabirds, sea turtles, and other marine species that may be taken in commercial fisheries.

III. **Objectives**:

a. *Provide accurate and precise incidental take, serious injury and mortality, interaction, and biological information for conservation and management of marine mammals, seabirds, and other marine species.*

Tasks:

1. Provide timely, reliable information on marine mammal interactions with commercial fishing operations, particularly serious injuries and mortalities, for management of marine mammal stocks. Data must provide information to assist in the following MMPA requirements:

   A. Annual determination that marine mammal mortalities or serious injuries do/ do not occur in conjunction with fishing operations.
   B. Annual determination that the Potential Biological Removal level for each marine mammal stock is/ is not exceeded by fisheries that interact with each stock.
   C. Annual List of Fisheries categorization based on marine mammal incidental take.
   D. Annual assessment of achievement toward a zero mortality rate goal for each marine mammal stock.

2. Provide information to document and reduce commercial fishery/marine mammal interactions, particularly serious injury and mortalities.

3. Collect biological data and samples required for marine mammal stock assessment analyses.

4. Collect observations and samples as appropriate for marine ecosystem research.

b. *Support NMFS policy development and decision-making.*

Tasks:

1. Provide information, analyses, and other support in the development of proposed management measures.

c. *Conduct research to support the mission of the Alaska Marine Mammal Observer Program*.

Tasks:
1. Conduct scientific analyses to assess current and proposed sampling protocols and coverage levels.

d. Provide information to monitor and promote compliance with NOAA regulations.

Tasks:
1. Work with NMFS Enforcement to monitor compliance with NOAA regulations.

e. *Foster and maintain effective communications*.

Tasks:
1. Enhance awareness of the benefits of the collection of quality observer data.
2. Promote two-way communication between NMFS and interested parties.

AMMOP Category II Fisheries

Fishery			Permits issued 2003	Permits fished 2003	Year Observed	Marine Mammal Stock of Interest	Vessel Size
Target	Gear	Location					
salmon	Drift gillnet	**Prince William Sound**	540	510	**1990-1991**	**Steller sea lion**	**30 – 40 ft**
		Southeast AK	477	376	**--**	**humpback whale** **harbor porpoise**	**30-40 ft**
		Cook Inlet	572	418	1999-2000	harbor porpoise	25-40 ft
		AK Peninsula/ Aleutian Is	160	109	--	Steller sea lion	< 33 ft
		Bristol Bay	1867	1424	--	beluga	< 33 ft
	Set gillnet	**Yakutat**	167	104	**2007-2008**	**harbor seal**	**14- 20 ft**
		Kodiak	188	161	2002, 2005	harbor porpoise sea otter	18-24 ft
		AK Peninsula/Aleutian Is	113	86	1991	Steller sea lion	18- 24 ft
		Bristol Bay	1001	761	--	beluga	18-24 ft
	Purse seine	**Southeast AK**	416	236	**--**	**humpback whale**	**40-58 ft**

AMMOP Category II Fishery Operations Details

Fishery	**Soak Time**	**Landings / Deliveries Per Day**	**Sets Per Day**	**Season Duration**	**Fishery Trends**
Bristol Bay Set Gillnet	Continuous during opener but net dry during low tide; day and night.	1	Two or continuous	June 2 to August 13 in 2003	Catch variable, apparently declining
Bristol Bay Drift Gillnet	Continuous soak part of the net while other part picked; day & night.	2	Continuous	June 2 to August 13 in 2003	Catch variable, apparently declining
Alaska Peninsula Set Gillnet	Continuous during opener; day and night.	1	Every two hours	June 9 to October 10 in 2003	Catch variable, apparently declining
Alaska Peninsula Drift Gillnet	109 Day and night, 2-5 hours	1	3-8	June 9 to October 10 in 2003	Catch variable, apparently declining
Cook Inlet Drift Gillnet	Day only, 15 minutes to 3 hours or continuous.	1	6-18	June 26 to August 7 in 2003	Number of vessels stable, catch variable
Kodiak Island Set Gillnet	Day only, continuous during opener.	1 or 2	2 or more	June 5 to September 19 in 2003	Number of sites declining slightly, catch variable
Prince W illiam Sound Drift Gillnet	Day and night, 15 minutes to 3 hours	1 or 2	10-14	May 16 to September 15 in 2003	Number of vessels stable; catch stable
Yakutat Set Gillnet	Day and night, continuous soak during openers	1	Every 2 – 4 hrs/day; continuous during peak	June 1 to October 24 in 2003	Number of sites declining slightly, catch variable
Southeast Alaska Drift Gillnet	Day and night, 20 minutes to 3 hours	1	6-20	June 15 to October 16 in 2003	Number of vessels and catch declining slightly
Southeast Alaska Purse Seine	Mostly daylight fishing except at peak, 20-45 minutes	1	6-20	22 Jun - 30 Sep in 2003	Number of vessels and catch declining slightly

Alaska Marine Mammal Observer Program

Background
The Marine Mammal Protection Act requires the Secretary of Commerce to publish an annual Stock Assessment Report for marine mammals, which includes mortality estimates from commercial fisheries, and to annually categorize commercial fishing relative to each fishery's impact on marine mammal stocks. The Alaska Marine Mammal Observer Program (AMMOP) collects information annually and rotationally on over a dozen fisheries that have observed or suspected interactions with marine mammals. The majority of the fisheries observed by this program are inshore, coastal, small-boat salmon fisheries, such as the Kodiak salmon set gillnet fishery. AMMOP's main objectives are to 1) obtain reliable estimates of incidental serious injury and mortality of marine mammals, 2) determine the reliability of reports submitted by vessel owners and operators, 3) identify changes in fishing methods or technology that may increase or decrease incidental serious injury or mortality if necessary, 4) collect biological samples for scientific studies that may otherwise be unobtainable, and 5) record data on by-catch and discard levels of all species.

The program is supported by an observer contractor with 15 to 40 observers in the field and is coordinated by the Program Coordinator from the NMFS Alaska Regional Office, Protected Resources Division. Marine mammal and seabird incidental take data are collected through a statistically-based sampling strategy. Additional information is collected on fishing gear characteristics, effort, and operations, as well as on environmental conditions and biological samples on target and by-catch species. The observer coverage is approximately 5% of the fishing effort and is scheduled by area and month, totaling between 500 to 2000 permit samples annually, depending on the fishery or fisheries observed.

Observer effort is to be distributed proportionally according to fishing effort throughout the fishery in time and area to obtain statistically reliable information, while not over-burdening any individual permit holder. Observers sample proportionally relative to the time the fishery is open and the number of active permits within each area. A sampling protocol has been developed for selecting permits to be observed and for collecting the data during observation of fishing operations. The observers are debriefed weekly to rigid standards to ensure proper sampling and data recording. Lead observers review the trip for completeness and accuracy. The trip data is forwarded to NMFS where staff enter the data into an Oracle database, where there are audits and restraints on data fields to limit possible data entry errors. The AMMOP database is managed by the AMMOP Program Coordinator and the Alaska Regional Database Management Administrator. Database development and upgrades are completed by a contracted database programmer.

Based on the data collected during the season on fishing effort and observations, a by-catch analysis is completed to determine the level of marine mammal mortality in a particular fishery. The results are summarized in reports and forwarded to the AFSC stock assessment staff and the Alaska Scientific Review Group for review.

During the fishing season prior to the first season of observation, a small scale feasibility study is conducted to assess the level and distribution of typical fishing effort and determine the feasibility of observer logistics. This is done both in the field and from data available from Alaska Department of Fish and Game (ADF&G). Fishing operations are observed for several days to better understand the actual fishing operations unique to the fishery or area to be observed. Observer sampling techniques are developed or fine tuned for this particular fishery and observer data forms and the manual are updated as needed. The characteristic fishing effort distribution over time and area is noted and statistical areas for sampling stratification are confirmed or identified. Many factors influence fishing effort (i.e. fish market value, run strength, cannery sales, weather) and observer effort (i.e. logistic constraints, funding, visibility). It is important to document what these factors are within and between seasons and how they would relate to by-catch analysis. Sampling design is adjusted as feasible to reduce possible effects of biases.

During the fishing season observed, subject to program coverage needs and the vagaries of the salmon fisheries, the distribution of observers and port assignments may change as the fishing season progresses. Optimal observer coverage effort of a "permit sample", is considered to be all retrievals observed, with a minimum of one retrieval or "pick" observed, in a 24 hour period during which the fishing gear of one permit holder is submerged and fishing during an ADF&G fishing opener. It is understood that factors such as weather, changes to fishing operations, and other unforeseen circumstances may interfere with observer effort and is taken into consideration in program design and data analysis. The Contractor determines the number of observers needed per region to meet the 5% target coverage rate and maintains an accurate real-time assessment of fishing effort through direct contact with permit holders and in coordination with the ADF&G. The contractor adjusts observer coverage as fishing effort changes throughout the fishing season, maintaining a 5% coverage level in each region of the covered fishery, based on the number of permits fished during open fishing periods in all regions of the fishery over the course of the season. Observers are resident in the area, either on land or on a chartered vessel and travel to set gillnet sites to meet the coverage needs. In set gillnet fisheries, observers sample alongside fishing skiffs in independent skiffs.

The AMMOP has not observed a drift gillnet fishery since 2000 and the overall approach to sampling design has been radically improved and updated since then. Only set gillnet fisheries have been observed since 2003 and will be observed through 2008. Therefore, for purposes of describing the AMMOP sampling design and approaches, only set gillnet fisheries will be addressed here.

Description of Alaska salmon set gillnet fishery operations

Set gillnetters set curtain-like nets in the water suspended from a float line at the surface and a weighted lead line along the submerged bottom edge. Fish returning to rivers gather in bays and inlets before entering the waterways, and fishermen position their nets to intercept the fish as they prepare to enter the rivers. Set gillnets are deployed in an anchored system out from a beach, with nets positioned perpendicular to the shore to channel fish into the webbing of the net and entangle the salmon. The legal gear for the commercial set gillnet fishery is 150 fathoms in length. Mesh and net size for both fisheries are restricted by regulation. Set gillnet skiffs average between 14 – 20 feet and generally carry one person, sometimes two. A set gillnet site is generally established for the season and not moved during the fishing season. Although it rarely happens, a permit holders may move his or her site. However, this will happen only once or twice during a season for any individual permit holder. Sites are usually on private property, or have been established in a location for many years, which is respected by the fishing community as a culture. This makes the permit selection and sampling much easier than for mobile, vessel-based fisheries.

AMMOP Kodiak 2005
Sampling Plan and Protocols

The goal of the Alaska Marine Mammal Observer Program (AMMOP) is to observe and document interactions between commercial set gillnet gear and marine mammals during normal fishing operations. Data collected by observers will be used to extrapolate estimates of marine mammal interactions with fishing gear to assess the impact of the fishing operations on the affected marine mammal stocks. NOAA Fisheries has determined that a target coverage level of 5% of the total fishing effort is a minimum that will satisfy the statistical requirements for the reporting of bycatch numbers to be used for management purposes.

To achieve the coverage target of 5% of overall fishing effort across the fishery, projected coverage needs in permit sampling days were developed. However, these numbers are projections and will be adjusted by NMFS accordingly as the fishery progresses through the season and actual effort becomes known.

AMMOP Sampling Regions

The set gillnet fishing areas around Kodiak were stratified into regions to make distribution of observer effort more feasible and to obtain results that are statistically more accurate. Regions were defined by geography, traditional fishing patterns and fish processor coverage. To allow observer coverage levels to be adjusted to most accurately reflect the actual fishing effort, the regions were also structured to encompass sites that start and stop fishing at similar times. Logistically, this allowed transit between all sites within a region within a 12-hour period. The contractor was responsible for determining where and when fishing effort in this fishery occurs.

ADF&G manages the fishery in two districts: the Northwest District, which includes Uyak, Uganik, and Viekoda Bays, Kupreanof Straits and the North Cape permits; and the Southwest District, which includes Alitak, Moser, and Olga Bays. The Northwest District typically is fished by 98 to 100 permit holders and constitutes 70% of the annual fishery effort. The Alitak District averages 72 participating permit holders and represents approximately 30% of the annual fishing effort.

The Northwest (NW) District will be comprised of the following four regions for the AMMOP study:

-*The Northern NW region (KI1A)* consisted of the permits in the North Cape section and Kupreanof Straits, including ADF&G statistical areas ADFG 259-35 thru 259-39. This region covers a large area, however, traditionally only 15 to 20 permit holders are active in this region. These sites typically start fishing later and stop fishing earlier than sites in other areas.

-*The Central NW region (KI1B)* consisted of Viekoda Bay. This region was comprised of all permits north of Cape Uganik and south of Kupreanof Straits. This includes ADF&G statistical area 253-31. The region consists of 15 to 20 active permits, ranging from exposed cape sites to sheltered sites in the back of the bay. Although some permit holders leave earlier in August, the majority of the permits holders are active until late August when the processor stops buying fish.

-*The Southern NW region (KI1C)* consisted of Uganik Bay and Uganik Passage. This region was comprised of all permits south of Cape Uganik to Cape Kuliuk. This includes ADF&G statistical areas 253-11 thru 253-14. The region consists of about 25 active permits, ranging from exposed cape sites to sheltered sites in Uganik Passage and Northeast Arm. Although some permit holders leave earlier in August, the majority of the permits holders are active until late August when the processor stops buying fish.

-*The Uyak Region (KI2)* included Uyak Bay. This was comprised of all permits south of the ADF&G line at Cape Kuliuk to Rocky Point and includes ADF&G statistical areas 254-10, 254-20, 254-30, and 254-40. Uyak Bay currently has 45 to 50 active permit holders, which concentrate on the southern shore of the bay and in the Larsen Bay area. A handful of permit holder operate sites on the north shore of Uyak Bay and in the back of the bay. Many of the sites in Uyak Bay are very productive and will fish as long as there is a market available, usually into September.

The Alitak District will be comprised of three regions for this AMMOP study:
-*Olga Bay Region (KI3)* included the waters of ADF&G stat area 257-40 with approximately 20 regular permit holders.
-*Inner Moser Bay Region (KI4)* was north of a line from the southernmost point of Moser Point west to the northernmost point of Amik Island, and west to the easternmost point of the Kodiak mainland north of the Little Narrows, with roughly 22 permit holders.
-*Outer Moser Bay Region (KI5)* was south of this line, with 30 permit holders.
Fishing gear in Inner Moser Bay can be placed in the water 12 hours after the scheduled fishery opener in Olga Bay. In Outer Moser Bay, fishing gear can be put in the water 24 hours after the Olga Bay opening. For example, the fishery in Olga Bay typically opens at noon. If, on the 14th of June, Olga Bays opens at noon, Inner Moser Bay sites can begin fishing at midnight, and Outer Moser Bay sites can begin fishing at noon on the 15th. Some permit holders in Outer Moser Bay move their nets into Olga Bay for 24-hours to maximize their fishing effort.
In the past several seasons the Alitak District has had several poor salmon returns. The fishery was not fished in 2002 and was restricted in 2003. The fishery is open for a maximum of four out of every seven days. This district is typically closed by early to mid August.

<u>Estimating Fishing Effort</u>
To distribute observer coverage in a manner that accurately reflects the distribution of fishing effort over time and area, the contractor establishes gross fishing effort through determination of the total time permits can fish and the individual effort of each permit. A list of all permit holders was obtained from the Alaska Department of Fish & Game (ADF&G), the management entity for this fishery. Direct observations of sites were the primary means of determining the beginning of fishery effort. The contractor flew an aerial survey on the first full-length opener, June 1st, to determine which sites are participating. The contractor then adjusted pre-season estimates of coverage to actual effort. The contractor obtained fishery opener announcements from ADF&G Kodiak Area Management Biologists, tracking openers to plan observer deployments and calculate fishing effort on an ongoing basis.
The contractor determines several variables of in-season effort for each Region: 1) ADF&G fishery opener hours; 2) Number of active permits; 3) Date each permit holder starts fishing for the season; and 4) Date each permit holder completes the current fishing season. Additionally, fishing effort was determined on a daily basis during all openers. Once a permit holder begins fishing for the season, their nets typically remain in the water for every open period, until the permit holder ceases fishing operations, unless a general fishing stand down or strike is in force, a permit holder must leave the grounds for an emergency, or the net, though left in the water, is rolled up and not actively fishing. Therefore, some verification of fishing effort must be made for each permit holder. Verification of daily fishing effort at each site in each Region was accomplished through two methods. The first method was in real time, although it was expected to cover only about 80-90% of the sites in a region. Observers on skiffs and R/Vs transiting throughout each region recorded all sites that have deployed nets, noted the presence or absence

of buoy sets, and indicated if weather or other circumstances have decreased effort at any sites. Identification of sites was made from a laminated, labeled site chart of the region. The second fishing effort verification method occurred periodically when a site was sampled. The observer asked the permit holder if he or she had had their net(s) in the water fishing every day during each opener since the last time the site was sampled.
Observer effort was tracked by area on a weekly basis to ensure the target coverage levels of 5% are met. Where discrepancies are noted, adjustments were made to observer distribution to ensure that monthly target levels of 5% per area are met.

Permit Sample
The "permit sample" is the basic unit of observation for analysis of the data, defined as the observation of all picks on a permitted standard length of gillnet (150 fathoms) in a 24 hour period, during which the net is submerged and fishing. If all picks in the 24-hour period cannot be observed, reasons for not observing all picks will be documented in comments on the Trip Form, and a percentage of total fishing effort observed within the 24-hour period for that permit will be determined. Any permit sample that achieves less than all picks in a 24-hour period will be considered a partial permit sample.
When and how often a permit holder picks the nets at their site is highly variable between sites and at the same site at different times in the season. However, most permit holders will pick nets multiple times during the day, starting early in the morning and ending late at night. Some permit holders pick their nets six or more times a day, others pick it only once. The majority of the permit holders pick their nets three times during the day: in the morning, afternoon, and evening. Patterns are common and certain permit holders have tendencies to pick more often. The most common reason permit holders pick their net more frequently is an increased number of fish in the net. Fluctuations in salmon runs, weather and tidal action, and location all contribute to the amount of fish moving past the net.
Lead observers contacted selected permit holders the day prior to the expected observation to determine the estimated picking schedule for the sample day. Observers deployed to the selected site on the designated sampling day in time to observe the initial pick. Observers collected data on the fishing operations, marine mammal incidental take, and seabird and other by-catch from independent skiffs. Observer skiffs are operated by full time drivers and observers are not expected to or allowed to drive the skiffs during sampling periods. Optimal observations will achieve a "permit sample" for each permit sampled each time the permit is selected for sampling and observed. Observers watch all the picks at the selected permit during the 24 hour sampling period, unless unforeseen circumstances prevent this. Observers stay at sites as long as possible allowing for sufficient light and reasonable weather for the trip back to base camp. This is more of an issue late in the season, but permit holders generally do not pick after dark. Operations are most often 5 or 6 am to about 9 pm, sometimes later, in this fishery. Observers take breaks during the day between picks, as circumstances allow, to keep total sampling duty time to 12 hours. Observers stay as late as possible at the site to observe all picks during the 24 hour period. To date, this strategy has been successful in obtaining full permit samples. Partial samples, when they have occurred, generally have been the result of factors other than observer sampling time constraints.
In some cases when the observer was not able to watch the last pick of the day at the sample site, the permit holder was contacted the following day to determine the final number of picks at the sample site. If certain permit holder's pick strategies are such that an observer consistently cannot observe all picks during the 24 hour sampling period, a random start time strategy would have been employed by observers for observing that site as long as the pick strategy remains the

same. (this strategy was never utilized in 2005)

Table 1. Projected permit sample totals by region 2005 .

FISHING AREA	JUNE permit samples 5%	JULY permit samples 5%	AUGUST permit samples 5%	SEPTEMBER permit samples 5%	TOTAL Permit samples
Inner Moser Bay (ADFG 257-41)	22	25	4	0	**51**
Outer Moser Bay (ADFG 257-43)	19	21	2	0	**42**
Olga Bay (ADFG 257-40)	17	19	2	0	**38**
Viekoda Bay (ADFG 253-31)	19	16	14	4	**53**
Kupreanof Strait/North Cape Section (ADFG 253-35, 259-35 thru 259-39)	13	8	10	1	**32**
Uyak Bay (ADFG 254-10 thru 254-40)	29	29	40	10	**108**
Uganik Bay (ADFG 253-11 thru 253-14)	24	20	23	4	**71**
Total Permit Samples Expected	**143**	**138**	**95**	**19**	**395**

Note: fishing effort unexpectedly increased during the 2005 season due to unexpected large salmon returns. Observer coverage was adjusted upward accordingly resulting in nearly twice the projected observer effort.

Permit Sample Selection

One of the primary challenges of this program is to distribute observer coverage proportionately across the fishing effort as it occurs, in a way that allows logistical flexibility and provides statistically valid samples of the overall fishing effort. Under this scheme, each permit has an equal opportunity to be sampled and bias will be reduced by not over-sampling individual permits. To achieve this, the contractor will coordinate the placement of observers at fishing sites based on a list of randomly-selected permits stratified by area. A lead or assistant lead observer will direct the placement of observers at the selected permits in each region in the order the permits appear on this list.

Each active permit number in a region will be written on an individual poker chip and placed in a bin. The permits will be placed on the sampling list in the order they are removed from the bin. Observers will be assigned to observe permits in the order the permits appear on the list. Permits holders that begin fishing after a sampling list has been generated will be added to unsampled portion of the list in a random position. A new list will be generated in the same manner as soon as all permits have been sampled from the previous list for that sampling region. If a permit on the top of the list is not able to be sampled on the day for which it was chosen (due to weather, mechanical failure, etc), the observer will sample the next name on the list. However, the original permit number stays at the top of the list and is the top priority for observation on the next open fishing day. Such permits will remain at the top of the list until sampled. All permits on the monthly sampling list will be sampled before the list is begun anew.
Lead observers will monitor weather reports and compile input from the field to determine weather projections in the vicinity of the sites to be observed. Based on these weather reports, lead observers will assess the probability of observations being able to be conducted in part or total. For safety and data quality reasons, the permit will be sampled according to the weather safety protocols, outlined in the Beaufort Scale Sampling Reduction Plan below. Lead observers will assign coverage to the next permit on the list if observation of the permit selected cannot occur.

Joint Ventures, Leased Nets, and Co-ops
In some areas, permit holders join together to fish as a co-op or joint venture. Joint ventures, leased nets, and co-ops will require distinct sampling protocols to avoid biasing the data.

Joint ventures (JVs) occur when two or more permit holders combine permits and share sites. Typically two permit holders set three 100-fathom nets made out of the two 150-fathoms of gear allotted to each permit. Both permit holders pick the nets from a single skiff, working the gear like one large permit.
During the random selection process, each permit number will be assigned a poker chip. Once a complete sampling list for the region is selected, the second of the two JV permit numbers will be marked off and combined with the first one on the list. The JV permits will be sampled together by one observer in most cases. One set of trip forms will be filled out, with both permit numbers included on the Trip Form. An Operation Type of "2 – Joint Venture" will be entered on the Trip Form. Two Permit Sample Days will be considered achieved where two standard lengths of nets were observed.

Leased Nets: Another form of combining gear is the use of leased nets, which occurs when a permit holder leases a section of gillnet to another permit holder. The most common example of this practice is for Permit holder "A" (lessor) to lease permit holder "B" (lessee) a 50-fathom section of gillnet. Permit holder "A" fishes one 100-fathom net and permit holder "B" fishes two 100-fathom nets. Leased nets are often in separate bays, the original permit holder (lessor) does not manage the leased net, and the lessee often does not distinguish the leased section of their fishing nets.

The leased portion will be sampled with the lessee's nets when the lesee's permit number comes up for sampling. In the example above, when permit holder "B" (lessee) is selected for observation, the observer will watch all 200-fathoms of gear. The permit holders are selected separately for placement on the sampling list and observed separately, and each permit is counted as one Permit Sample Day for record-keeping purposes. When the "lessee" permit holder is sampled, observers will mark an Operation Type of "4 - Leased Nets" on the Trip Form and indicate the length of leased net. When a "lessor" permit holder is sampled, and less than 150 fm of net is being fished, the length of net NOT present because it is currently leased to another permit holder will be recorded on the Trip Form. The observer will also make notes in the comment section detailing the lease arrangement, including the length of the leased portion of net, location of site, and permit number of the other party involved. If the information is available, the observer will denote the leased section of gear in the notes of the Gear Characteristics Form.

Co-operatives (Co-ops): Some permit holders operate several sites in cooperation with other permit holders, as a "Co-op". These are family groups, friends, or business associates using one or multiple skiffs working together to pick all co-op members' nets. Skiffs may pick two to four permits before returning to camp. Difficulty in observing these operations arises when two or more skiffs pick a series of Co-op nets as a team. More than one observer platform is required to watch the multiple skiffs pick the gear.

Co-ops range from two permit holders working four 75-fathom nets to twelve permit holders fishing 20 to 24 nets of varying lengths. In most cases, the nets are clearly marked and the permit number is obvious. However, some co-ops are more lax than others. When multiple fishing skiffs are used, typically two skiffs begin at the middle and work towards the ends of the net. Often a team of two skiffs will pick two to four co-op permits in a day. One Co-op uses three sets of three skiffs to tend 12 permits. In that case, one set of the three skiffs goes to a set of three to four permits (six to eight nets), where one skiff picks the trap (or hook), and while the other two skiffs start in the middle of the net and work out to the ends. The skiffs move on to the next net when they have finished their section of the net. The other two sets of skiffs do the same on the other 8 or 9 permits.

In a more typical example of a Co-op, three permit holders work together with permit numbers A, B, and C. In this example, each permit holder fishes two 75-fathom nets for a total of six 75-fathom nets. They use two skiffs to pick the nets, typically starting a net A1 and picking in the following order B1, C1, A2, B2, and C2. This order may change, however, due to amount of fish, gear damage, weather, etc.

The contractor will use cluster sampling to address the problems that arise due to multiple picking skiffs at Co-op sites. During the random selection process each permit number in a Co-op will be assigned a poker chip. Each permit number in a region will have an equal opportunity to be sampled. Once a Sampling List for the region is generated, observations will begin at the top of the list. When one permit in a Co-op comes up to the top of the list, all Co-op permits that are picked in conjunction with the selected permit on that day will be sampled as well. The lead observer will mark off the additional permits sampled from the list, and they will not be sampled again until that sampling list is completed (all permits on the list are sampled) and a new list is generated.

Example: On the sampling list for a region, the 4th, 17th and 30th permit numbers are fishing together in a co-op. All three would be sampled on the day the 4th permit is at the top of the sampling list, and all three permits would be removed from the list until list is re-randomized. The number of observers required to sample the three permits would be determined by the number of skiffs used by the fishermen to pick the nets. One observer skiff would be assigned to each fishing skiff for the day. A total of three Permit Samples would be completed for that one trip. One Trip Form will be completed by the observer assigned to the permit actually selected from the list, and would include on it all data from the permits sampled with the selected permit. An Operation Type of "3 – Co-op" will be entered on the Trip Summary Form. The other observer(s) would coordinate with the primary observer in completing all required data forms. Such cluster sampling of co-op nets will achieve: 1) *Increased program efficiency*. Multiple observation skiffs at a co-op will reduce the number of partial observations of such sites; and 2) *Improved relationships with co-op fishers*. This method would greatly reduce the number of sampling days at the larger co-ops. In 2002, observers were at the co-op with 12 permits almost every day. Under the new protocol, the effort should be concentrated into three or four sampling days in a rotation through the Monthly Sampling List.

Beaufort Scale Sampling Reduction Plan

Weather can potentially affect all observations and could bias observer coverage of more exposed sites. Many of the sites located on capes in Shelikof Strait will receive extreme weather. The contractor will ensure that observer coverage at exposed sites is in proportion to other sites in a region based on fishing effort. Weather will also reduce the quality of observations during soak watches due to wave action and sampling platform movement. Fifteen-foot seas are not uncommon at cape sites. Moderate weather will reduce visibility and obscure interactions, while strong winds and heavy seas will cause serious safety concerns.

Lead observers will use a combination of National Weather Service forecasts, USCG weather reports, RV captains' and skiff operators' evaluations, and information provided by area radio contacts. Lead observers will attempt to establish the weather at sites before deploying observers. If the weather begins to worsen, observers will relay information to the RV, lead observer, or other appropriate parties and a determination to change sampling protocols appropriately will be made. Avoidance of placing observer/skiff operator teams in danger during severe weather conditions is paramount. For these reasons, the contractor will deploy observers based on sea-state and implement a Beaufort Scale Sampling Reduction Plan as follows:

> *Beaufort 0-3 (wind 0-10 kts; seas 0 – 3.5 ft)*: All sampling will occur as scheduled.
>
> *Beaufort 4 (wind 11 to 16 kts; seas 3.5-5 ft*): All soak watches (for the marine mammal sighting form, which does not include the essential pick observation data) will be suspended. At Beaufort 4, frequent white caps and small waves begin to limit visibility, affecting the dependability of soak watch data. Anchoring a skiff to a buoy becomes quite dangerous in four-foot seas. Observer effort will focus on observing picks.
>
> *Beaufort 5 (wind 17-21 kts; seas 6-8 ft):* Lead observers may direct observer-skiff operator teams to use alternate sites. R/V captains will restrict deployment of skiffs during Beaufort 5 weather. R/Vs that would normally deploy two skiffs at two locations will select one of the two locations and determine if a single skiff can safely be deployed during picks only. The R/V will remain in position nearby to respond in case the skiff encounters trouble. Sampling distances from the R/V in rough weather would be no greater than 30 meters.

Beaufort 6 and higher (wind 22+ kts; seas 9.5 ft +): All observations will be suspended. Ten-foot white-capped waves with scattered spray will reduce visibility beyond acceptable observation levels. Some remote observations of sites from R/Vs may allow for verification of fishing effort only. R/Vs will establish if the net is fishing and try to contact the permit holder to determine if the site will be picked that day.

NORTHEAST FISHERIES SCIENCE CENTER

Northeast Fisheries Observer Program (NEFOP)
Northeast Fisheries Observer Program, Mid Atlantic Gillnet
Atlantic Sea Scallop Dredge Fishery (Access Areas)

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. *Your name and title:*

David Potter, Branch Chief

2. What is the name of your Observer Program?

Northeast Fisheries Observer Program (NEFOP), specifically for this questionnaire the Northeast Multispecies Groundfish Observer Program

3. In which NOAA Region is it implemented?

Northeast

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

To provide fisheries observer coverage to scientifically collect data on protected and endangered species issues; to provide scientific data on fish catch and discards for assessment purposes; to provide industry monitoring for quota and TAC caps; and to collect economic data for the NEFSC Social Sciences Branch for evaluation during the promulgation of regulations.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

otter trawl
gillnet
longline

5.2. Number of active vessels by gear and size category

Approx. 700 Vessels

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Parts of the fishery are open year round, with trips of 1 to 7 days most common.

5.4. Number of ports and distribution of vessels and trips among ports

There are approximately 30 primary ports for this fishery however, 5 of the ports supply 75 % of the effort.

6. ***What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?***

The target species are the Groundfish Multispecies complex, about 17 species. Bycatch of protected species, dolphin and seals are common, however probably the most critical issues are bycatch of specific groundfish stocks that are depleted and not recovering.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MSA, MMPA (I and II)

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

See Rago 2005, attached.

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

See Rago 2005, attached

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

See Rago 2005, attached

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

See Rago 2005, attached

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Oracle database tables.

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels and Trips

9.2. What is the ultimate sampling unit (e.g., tows/sets) from which observers collects data?

Individual hauls.

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

See Rago 2005, attached

9.3.2 Secondary Sampling Level (trips)

See Rago 2005, attached

9.3.3 Other pertinent details

See Rago 2005, attached

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

See Rago 2005, attached

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random)? (Please provide a detailed description of your procedures)

See Rago 2005, attached

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One, unless it is a training trip for a new observer.

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

The observer performs sampling on all hauls during a 12 hour watch, for every day of fishing.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

9.9.3 Sample allocation of vessels and trips by gear/size group

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

9.9.5 Sample allocation of trips in time and space

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

For all of 9.9 questions see Rago 2005, attached

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

See Rago 2005, attached, however incidental takes are also key outputs and ratio-estimators are used to calculate total rates, specific biological studies, as well as economic analyses are derived from the NEFOP data.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Primarily quota and TAC monitoring, however, protected and endangered species takes are a high priority.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames:

12.1.1. Is the list of active vessels complete and up-to-date?

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

See Rago 2005, attached

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

See Rago 2005, attached

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

See Rago 2005, attached

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels.

See Rago 2005, attached

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

See Rago 2005, attached

12.6. Is there any basis for believing that the estimators employed may result in a bias?

See Rago 2005, attached

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling ,***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Mike Tork, Fishery Biologist.

2. What is the name of your Observer Program?

Northeast Fisheries Observer Program, Mid Atlantic Gillnet

3. In which NOAA Region is it implemented?

Northeast

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

To fulfill specific responsibilities (MMPA, ESA) concerning marine mammal and sea turtle by-catch within Federal and state waters, and to provide fisheries managers with the data needed to ensure sustainable fisheries and healthy marine populations as outlined in the Magnuson-Stevens Fishery Conservation Act and the MMPA.

5. Provide a general description of the fleet to which the program is applied

Vessel size range is from 21' to 48'. Small skiffs can, at times, be carried on trailers. Nets can be pulled by hand, stern net drum, side hauled through a block, fished over or pulled up onto the beach using a vehicle. Vessels are spread throughout mid Atlantic ports (NY thru NC) and target a variety of fish species between 0 and 50 miles of the shore. Some vessels have only state permits while some have both Federal and state permits. The fishery is prosecuted in inshore waters, state waters and Federal waters.

5.1. Gear type(s)

Gillnet; anchored/drift, float/sink

5.2. Number of active vessels by gear and size category

1,200 +

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Majority are single day trips with a few 2 day trips. Trip frequency is often dictated by weather and target species abundance/presence. October thru January are the busiest months but there is considerable effort year round.

5.4. Number of ports and distribution of vessels and trips among ports

There are 50 + ports within mid Atlantic area. Number of vessels per port varies widely (1-50). Area of high effort concentrations would be Point Pleasant, Barnegat Light, Ocean City, Chincoteague, VA Beach, Wanchese and Hatteras.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Flounder, monkfish, cod, pollock, haddock, dogfish, croaker, weakfish, bluefish, mackerel, spot, shad, and striped bass. Critical by-catch issues would be marine mammals and marine turtles.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

MSA & MMPA category I

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

State/Federal landings reports (dealers) and mandatory vessel logbooks.

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Data goes back to 1977. In 1994 landings and effort data were split into 2 systems. Observations began in the mid Atlantic in July of 1993.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Data on Vessel and trip characteristics, landings by year, month, day, port and time. Some gear data but averaged over the trip. All gear and effort data are reported at the trip level, that is no haul/tow specific data. Position data is reported for trips (not haul/tow). The observed data is used for the finer resolution information on the fishery.

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

All data are stored in Oracle d-bases and are readily available following formal data request procedures.

9. *Describe the Design of Your Observer Program*

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

The vessel is the primary sampling unit. Sample vessels by gear type. Trips are translated to sea days.

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Per retrieval. Each net that is hauled is sampled within a trip.

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Population of vessels/trips by gear type is estimated based on previous year's data (one year lag). Sea days are allocated proportional to total landings. Observed landings are compared to total landings to derive % coverage.

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

The number of trips are estimated by isolating unique gear/vessel/port landed/year/month/day transactions from the dealer reported data. The dealer reported data are considered a census of fleet wide fishing activity. There are limitations with some of the state reported data as unique vessel data is not provided. Although, state reported data is reported at the trip level. That is, each state record is in theory supposed to represent one trip. The limitations are we can not estimate fleet size for individual states in the mid Atlantic region. Reporting requirements vary by state and vessel data is generally not submitted to the federal government due to confidentiality issues.

Percent coverage is variable and dependant on funding and analytical needs. Generally it is 5% or less. Since the number of active vessels, at a particular time/area, is often unknown, the contractor is instructed to cover all active vessels per port. Vessel selection is monitored by NEFOP and repeat trips on the same vessel, without justification, are discouraged. It is difficult to identify which vessels will be active because many fishermen will switch from one gear type to another based on seasonality and abundance of target species and market price. These factors make it difficult to predict when and where a particular vessel might be active so a list of randomly selected vessels is hard to develop.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Gear type/area/time

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

See above

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers will remain with the selected vessel until the trip is completed. A completed trip is defined as one that has offloaded all catch.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

Based on total landings by area and time and by availability of funds.

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Coverage is stratified by area/time based on presence and abundance of the particular marine mammal/marine turtle being assessed. Sea days are allocated proportional to fishing effort (landings) throughout the animal's ranges.

9.9.3 Sample allocation of vessels and trips by gear/size group

A portion of the mid-Atlantic gillnet fleet benefits indirectly by the sampling algorithm used in the Northeast multispecies fishery. This particular fishery utilizes a randomization procedure on a master list of vessels permitted in this particular fishery (stratified by port/month/vessel ton class/mesh size group). The gillnet vessels that carry a multispecies permit in the mid Atlantic region are part of this sampling procedure. At the present time, all other gillnet vessels that do not participate in the NE multispecies fishery (the majority of the mid Atlantic fleet) are not sampled by a vessel randomization procedure.

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random);

Since these are primarily single day trips all retrievals/hauls are observed for the entire trip. Data and samples are collected for each retrieval.

9.9.5 Sample allocation of trips in time and space.

For protected species (marine mammals and sea turtles) sampling, all the trips from #9.3.3 are stratified to state/county-port/month. The total number of sea days available are allocated proportional to trips by the given strata after trips have been converted to sea days.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

All retrievals, per trip, are observed (sampled).

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

For protected species sampling. The target sampling (in trips) is estimated based on the target precision (CV <=30%) of species specific by-catch mortality estimates.

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

For protected species. By-catch rates (ratio estimators) are either directly estimated or predicted using regression techniques via GLM's or GAMS. Any number of fields collected by observers (i.e., environmental, habitat, gear, fishing practices, etc.) have been investigated and/or used to estimate parameters to predict by-catch of protected species. In the case of the mid Atlantic gillnets the metric tons of fish landed are used as the unit of effort to estimate total mortality.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

By-catch documentation, mortality estimation. Take Reduction Plan (TRP) development and Stock Assessments. TRPs may include time/area closures and/or gear restrictions or modifications.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

No, see 9.3.3

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes, small or unsafe vessels.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g, factors that constrains representative sampling)?

See 9.3.3. A substantial fleet of small vessels in some states is a major logistical constraint.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

Once a vessel is selected they are required by law to carry the observer. Out of ~ 1,600 mid-Atlantic gillnet days assigned during 2005, less than 6 vessels refused to carry the observer. Those vessels were reported to NMFS OLE.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

In some cases (some species) observed incidental mortality is a rare event. It can be cost prohibitive in some cases to achieve the desired target precision. 2. Allocated sea days for sampling and realized sea days can be quite far apart. This can be attributed to several different factors (a) weather (b) market/economics and (c) fluctuations in the number of observers available to meet shifting agency priorities (that can occur without any advanced warning).

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes. Days are allocated based on both fishing effort and presence/abundance of the marine mammal being analyzed.

12.6. *Is there any basis for believing that the estimators employed may result in a bias?*

For protected species, we may not be accounting for unobserved heterogeneity but this can be addressed with appropriate modeling techniques. There is always going to be an element of observer bias, to what degree is unknown. In some cases the effort data used for expansion may not be accurate. It is variable and must be evaluated case by case. On an average this may not result in a large bias. For the most part most issues surrounding bias can be addressed. Other possible biases: Observer bias (fisherman changes/alters fishing practice while observer is onboard and vessel selection biases (vessels that are cooperative, comfortable, large, etc. may be selected over other vessels).

13. *In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.*

Potential data sources

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Yes

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  Yes

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Patricia Yoos, Fishery Biologist

2. What is the name of your Observer Program?

Atlantic Sea Scallop Dredge Fishery (Access Areas)

3. In which NOAA Region is it implemented?

Northeast

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Provide observer coverage as required in the Atlantic Sea Scallop Fishery Management Plan. The percentage of vessel coverage required varies by area.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Scallop dredge and scallop trawl

5.2. Number of active vessels by gear and size category

In 2005, 525 vessels hold General Category Permits.

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

This fishery occurs year round, with the fishing year running from 1 March through 28 February. Trip durations are variable.

5.4. Number of ports and distribution of vessels and trips among ports

The number of active ports is variable. Ports range from North Carolina to Maine.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

The targeted species is sea scallops. The major bycatch species in current Access Areas are yellowtail flounder and monkfish.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

The program operates under the Atlantic Sea Scallop Fishery Management Plan (FMP).

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

This fishery utilizes a Vessel Monitoring System (VMS), vessel logbooks, dealer logbooks and NMFS Port Sampling, in addition to observer coverage.

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Data have been collected, by observers, in all Area Access locations since initiation of the fishery in 1999. Data collection protocols have remained consistent since 2000. Data are also collected by methods listed in 8.1.

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Observers collect data for each on-watch tow (see 9.9.6).

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Format of the data is consistent with all NEFSC observer data. All are available to authorized users.

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Each Access Area has specific percentage sampling requirements, set by the Regional Office. Individual vessels are the second sampling unit.

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Hauls

9.3. How were the sampling frames established?

See 9.4 and 9.5

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

The coverage requirement from the Regional Office is based on fixed percentages of vessels going into each of the Access Areas.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

As part of the FMP regulations, vessels fishing in the Access Areas are required to call the Observer Program 72 hours prior to each trip. The list is compiled and used to randomly select vessels for coverage.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers remain on the vessel until the catch is offloaded. They work the captain's 12 hour watch for the first half of the trip and switch mid-trip to work the mate's watch. Scallops are sampled for each tow of their watch. Finfish are sampled on one tow of each watch.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1. *Target sample sizes (vessels, trips) by stratum (if applicable)*

Coverage is based on percentage requirement from the Regional Office.

9.9.2. Coverage (proportion of vessels & trips observed) by stratum (if applicable)

See 9.9.1

9.9.3. Sample allocation of vessels and trips by gear/size group

See 9.9.1

9.9.4. Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

See 9.9.6

9.9.5. Sample allocation of trips in time and space

See 9.9.1

9.9.6. Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Observers collect data from, and sample all tows on their watch of 12 hours. During the first half of the trip, the observer is on watch during the captain's watch. Mid-trip s/he switches to the mate's watch.

9.9.7. Allocation of sampling effort within trips between night and day (if applicable)

See 9.9.6

9.9.8. Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Data are used for TAC monitoring for certain species. Data collected from sea turtle takes are used for Protected Species Branch projections for the scallop fishery.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

In certain Access Areas, TACs are in place for specific species. Observer data are used to project total catches from these areas and monitor TAC activity.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection:

12.1. Regarding completeness of sampling frames

12.12.1. Is the list of active vessels complete and up-to-date?

Yes

12.12.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

There are none.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

Compliance is 100%.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

No

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling.***

  These methods are all currently being used in this fishery.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  This particular fishery does not currently lend itself to using video cameras or scanners.

- ***Vessel Monitoring Systems (VMS)***

  This is currently being used in this fishery.

- ***Fisheries-independent survey data ((How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  Survey data are used when determining which Access Areas to open to commercial fishing.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  This fishery occurs offshore. Vessels are generally larger and most can easily accommodate an observer.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  This is currently done in the Regional Office.
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Northeast Fisheries Science Center Reference Document 05-09

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by

Paul J. Rago, Susan E. Wigley, and Michael J. Fogarty

August 2005

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NEFSC Bycatch Estimation Methodology: Allocation, Precision, and Accuracy

by

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

August 2005

Northeast Fisheries Science Center Reference Documents

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This document's publication history is as follows: manuscript submitted for review -- July 28, 2005; manuscript accepted through technical review -- July 28, 2005; manuscript accepted through policy review -- August 2, 2005; and final copy submitted for publication -- August 11, 2005. This document may be cited as:

Rago, P.J.; Wigley, S.E.; Fogarty, M.J. 2005. NEFSC bycatch estimation methodology: allocation, precision, and accuracy. *U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc.* 05-09; 44 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

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Executive Summary

This report describes the standardized methodology used to estimate bycatch rates of finfish by commercial fisheries in the Northeast. In this report, bycatch is defined as the observed discarded catch, summed over from eleven different groundfish species. Estimates of unobserved discards are not considered. All retained catches are included whether or not the catches were incidental to the target species. Emphasis is placed on the methods used to define the sampling frame (i.e., the population of commercial fishing trips to be sampled), appropriate stratification, and efficient allocation of sampling effort to these strata. Efficient allocation of sampling effort within a stratified survey design improves the precision of the estimate of overall discard rates. Accuracy of sample estimates is evaluated by comparing various performance measures (e.g., landings, trip duration) between vessels with and without observers present. Although formal statistical distinctions between accuracy and bias of estimators and estimates can be made, in this report we use the terms interchangeably and less formally. A biased estimator is inaccurate; an accurate estimator is unbiased.

This report focuses on bycatch estimates based on discard to kept ratios. Use of this ratio is appropriate for trawl, gillnet and longline fisheries in the Northeast US. A formal assessment of bycatch estimates based on the ratio of discards to fishing effort is not considered in this report. Estimators based on ratios of total discard to fishing effort are more appropriate for fisheries that do not target groundfish, such as the sea scallop and herring fisheries. Evaluations of groundfish bycatch in these fisheries are being conducted by technical committees for their respective fishery management plans.

The Northeast Fisheries Science Center allocates observer sea days to monitor bycatch in commercial fisheries along the Northeast coast. These fisheries are diverse and therefore it is necessary to stratify commercial trips into fleet sectors (strata) with similar characteristics. Data from Northeast Fisheries Observer Program and the Fishing Vessel Trip Report are used together to define the size of the sample and the size of the strata, respectively. We define a total of 227 fisheries for 2005 observer coverage, consisting of three major gear types, four mesh sizes, two levels of trip durations, six port areas, and four seasonal quarters. The total fishing effort for April 2003 to March 2004 in the defined strata comprises 43,703 trips. Our examination of efficacy of observer coverage included results from 1,103 trips and 2,704 sea days. Every effort has been made to make the sampling program synoptic (i.e., cover all the major fisheries that discard commercially important species) and robust to sources of uncertainty. In particular, we utilize discard information at the trip level as opposed to the tow level. Sampling selection relies on observable properties of the strata, rather than desired outcomes (e.g., a targeted “cod” trip). Trips within strata are also assigned a probability of obtaining useful information relative to the species group of interest. The “usefulness” of a trip is conditional on the likelihood that a trip will catch one or more of the species within a predefined group of species.

Our analysis of sea-day allocations and use of optimization methods to improve allocations rest on two primary assumptions. First, the extant data are sufficient to obtain consistent estimates of the underlying variance of the discard ratio per stratum. Consistency is ensured if the samples are representative. Second, the relative size of the strata, i.e., the total number of trips, remains constant from year to year. This is a more tenuous assumption, as the balance of fishing effort can change in response to changes in resource abundance or regulations. Both of these assumptions are inherent in the use of retrospective data to improve a future sampling program.

The observer sea-day allocation model developed here represents an extension of Neyman optimal allocation (Cochran 1977). Observer trips are allocated to strata as a function of their contribution to the total variance, the expected number of observer days per trip, and the probability that a trip will provide information on one or more of the species groups of interest. The essential features of the sampling design and allocation process are summarized below.

- Strata are defined on the basis of observable properties of the fleet sector
- The sample unit within a stratum is a trip
- The primary response variables are total discards and kept weights of groups of species. Eleven groundfish species constitute one group, monkfish another group, and summer flounder-scup-sea bass, a third group
- The probability of obtaining information on one or more of the species groups from a future trip in a stratum is estimated from analysis of observer data
- An estimate of the probability of not obtaining any information about one of the three species groups is incorporated to allow appropriate increases in sample sizes commensurate with this risk
- Expected average trip durations are defined for each stratum
- Total observer days at sea serve as a constraint on the allocation process
- Additional constraints can be imposed on the minimum and maximum numbers of samples per stratum
- Unsampled strata use imputed (or borrowed) values from adjacent strata to ensure that some information is used for sample selection
- Imputation also identifies gaps in coverage and allows for updates of the population frame as new data are acquired
- Discard ratios and standard errors incorporate the approximate covariance of the ratio
- The precision of the overall discard/kept ratio is the primary performance measure in the allocation process.
- Total variance can be minimized subject to a total observer day constraint, or the number of observer days can be minimized subject to a desired level of precision

Results from the optimization model are used as a tool to improve observer coverage. Some post-processing of the optimized sea days is needed to fine-tune coverage across fleet sectors. Where feasible, the fine-tuning of sea-day allocation capitalizes on the multi-purpose attributes of observer coverage oriented toward assessment of non-finfish species (e.g., acquire data in the sea scallop fishery from trips designed to evaluate turtle bycatch rates.)

Presently the model is based on aggregate Discard/Kept (D/K) ratios. These ratios are relevant to most fisheries but, of course, the Discard/Effort (D/E) ratio is important in others. D/E ratio data have been prepared but not yet implemented in the model. D/E ratios are relevant for fisheries such as sea scallops, northern shrimp, and herring. It should be noted that one of the primary difficulties of implementing the D/E methodology is the selection of an appropriate unit of effort.

The “trip” level of effort may be the most useful but additional work will be necessary before extending the methodology to optimally allocate observer coverage to these fisheries.

The optimization methodology addresses the precision of the overall D/K ratio in the context of multiple objectives and limited resources. The issue of accuracy/bias is addressed by comparing various properties of vessels with and without observers onboard. Bias -- the systematic difference between the estimated and true value -- is addressed by first ensuring that the vessel trips are representative, and that a variety of quality assurance/control procedures are employed to accurately monitor vessel performance. Refusals to take an observer and other forms of non-response by industry are possible sources of bias. These sources are addressed via increased use of Enforcement personnel. For these concerns, the NEFSC observer program is consistent with the recommendations of the NMFS National Working Group on Bycatch (NMFS 2004).

Babcock et al. (2003) assert that increases in sampling effort are sufficient to reduce bias. If the presence of observers onboard alters the vessels fishing patterns, then it can be argued that all observed trips yield potentially biased results. If the unobserved vessel fishes with different methods in different areas and so forth, then the increases in sample size can only reduce but not eliminate the scope for bias. A variety of statistical techniques for inferring bias can be applied, but a review of the literature suggests that these techniques have been only moderately successful. Independent measures of vessel behavior may be possible from Vessel Monitoring System data, but such analyses can only detect gross changes from observed trips. Where possible, verification by independent data sources is encouraged, but one should be careful to avoid the problems of incorrectly assuming that a particular methodology is completely unbiased.

Several tests were conducted to address the potential sources of bias by comparing measures of performance for vessels with and without observers present. Bias can arise if the vessels with observers on board consistently catch more or less than other vessels, if the average trip durations change, or if vessels fish in different areas. Each of these hypotheses was tested by comparing observable properties in strata having vessels with and without observers.
Average catches (pounds landed) for observed and total trips compare favorably, following an expected linear relationship. The expected difference of the stratum specific means and standard deviations for both kept weight of groundfish and total trip duration was near zero. The frequency distribution of these differences provided no evidence of systematic bias. The mean difference between average catch rates of 238 pounds was not significantly different from zero ($p=0.59$, $df=84$). A paired t-test of the stratum specific standard deviations of pounds kept suggested no significant difference from zero ($p=0.08$). A similar analysis of average trip duration revealed a strong correlation between observed and unobserved trips (Figure 7) and a suggestion that the observed trips were about a half-day longer when the observer was on board ($p = 0.01$). A paired t-test of the difference in stratum specific standard deviations of trip length was not significantly different from zero ($p = 0.60$) (Figure 8B). Some skewing of the differences in mean trip durations was observed, with observed trips being slightly longer.

Two measures of spatial coherence suggest that the spatial distribution of fishing effort for trips having observers closely matches the spatial distribution of all trips. The null hypothesis of observer proportions equal to the VTR proportions was rejected ($P<0.05$) in 20 of 65 comparisons. Of these 20 cases, 10 involved ports in Southern New England and the Mid-Atlantic region where landings of New England groundfish are expected to be low. Of the remaining ten cases, five involved the large and extra-large gill net fisheries that mainly target monkfish. Thus, the null hypothesis of equivalent spatial distribution of sampling was rejected in only 5 of 50 fleet sectors, a rejection rate only slightly higher than due to chance alone.

A paper by Murawski et al. (2005 in press) presents information on the spatial distribution of otter trawl fishing effort for vessels with Vessel Monitoring Systems (VMS) with the distribution of tows on observed trips. Qualitatively, the spatial distributions match very well with high concentrations of effort near the boundaries of the existing closed areas on Georges Bank and within the Gulf of Maine. Moreover, the effort concentration profiles deduced from VMS data coincided almost exactly with the profiles derived from observed trips. Overall, these comparisons suggest strong coherency between the two independent measures of fishing locations.

An assessment of the sources of uncertainty in the design and data collected in the Northeast Fisheries Observer program indicates that the level of precision in the discard ratios (d/k) for the New England Groundfish fisheries as a whole is high and there is little evidence of bias. However, at finer temporal and spatial scales, precision of the discard ratios will generally be lower than the aggregate. Precision of the discards estimates will also be lower for individual species, age groups and size classes.

Introduction

Estimation of bycatch in any commercial fishery is a difficult task. At the level of an individual trip, bycatch occurs sporadically over wide geographical ranges. Proper quantification typically requires presence of trained observers. The commercial marine fisheries of the Northeastern US comprise many vessels of widely different sizes, targeting multiple species in a variety of habitats. Overlaying the complexity of the fleet and target species is a complex regulatory environment that constrains fleet behaviors. Since many stocks are in rebuilding phases, the effects of restrictions on landings per trip, and therefore revenue per trip, are difficult to predict. The Northeast Fisheries Observer Program (NEFOP) addresses this complexity by first ensuring that the data obtained from any trip are of the highest quality. This is achieved through a rigorous training program, standardized on-board data collection protocols, and thorough auditing of data. To allow for extrapolation from the sample data to the fleet as a whole, these procedures must be embedded in a statistical sampling design. This report provides a summary of the issues relevant to the design and analysis of the observer sampling program particularly with respect to the allocation of observer days to achieve desired levels of precision.

The NEFOP program incorporates the following important features:

1. Definition of a sampling frame across all relevant fisheries
2. Identification of strata based on observable properties
3. Development of rules for imputing variance estimates in unsampled strata (i.e., "borrowing" estimates from appropriate strata)
4. Use of a trip as the sample unit (rather than individual tow)
5. Definition of discards by species groups, corresponding to the major finfish species within the Northeast US.
6. Use of discard to kept ratios (d/k) for species groups as the primary response variable.
7. Estimation of approximate variances for d/k for groups of species, rather than individual species
8. Allocation of sampling effort based on reduction in total variance of the d/k estimate, subject to total cost constraints.
9. Allowance for observer coverage in remaining fisheries not included in the sampling frame, owing to other priorities (e.g., protected species concerns).
10. Where feasible, capitalize on the multi-purpose attributes of observer coverage oriented toward assessment of non-finfish species (e.g., acquire data in sea scallop fishery from trips designed to evaluate turtle bycatch rates.)

In this report we describe the foundations of our standardized approach for bycatch reporting methodologies and the primary sources of uncertainty.

Background

The Northeast Fisheries Science Center (NEFSC) routinely allocates observer coverage to monitor bycatch (fish, invertebrates, and protected species) in the commercial fisheries in the Mid-Atlantic and New England regions. The observer coverage is administered in units of 'sea days'.   Based on the daily cost of an observer at sea, the available funds determine the number of potential sea days. However, for the New England groundfish fishery, the number of sea days is presently mandated to be 5% coverage of the fishery. The projected fishing activity (in days) for the year is estimated by the available days-at-sea allowed under the Northeast Multispecies Fishery Management Plan. Thus, in a given year, the NEFSC has a mixture of mandated sea days and non-mandated sea days to monitor bycatch in the Northeast region (North Carolina to Maine) for various fisheries.

Allocation of sea days is guided by an optimization algorithm that is based on generalization of the well-known Neyman allocation principle in survey sampling. Precision of the overall estimate of the discard ratio is improved by allocating samples to strata with the greatest contribution to the total variance, subject to an overall constraint on available resources. In this application, "resources" refers to the total number of observer days available. Improvement of the allocation process requires an evaluation of the current sampling design and precision of estimators. The ability to improve the design is contingent on the reliability of the stratum-specific variances and the persistence of these estimates in the future (or at least the next sampling period).

The optimization algorithm can be used to (1) minimize the variance of the discard estimate subject to a given number of sea days, or (2) minimize the number of sea days subject to a desired level of precision. Results from the optimization model are used as a tool to improve the coverage. However, the model does not incorporate information regarding sampling for protected species, nor does it include information for fisheries where the discard ratio may be more appropriately measured by a discard to effort ratio (d/e). Thus the model predictions are conditioned to exploit the multipurpose utility of the protected species sampling, and coverage in important fisheries (like sea scallops) is ensured by reserving some additional days to "level out" sampling that may be required for either protected species or closed area trips.

This report will describe: 1) the fishery identification and data sources used; 2) imputation rules for unobserved fisheries; 3) sampling theory and optimization methods; 4) application of the model to observer coverage; and 5) address accuracy issues discussed by Babcock et al. (2003)

Definition of Strata -- Fishery Identification

Diverse commercial fisheries are prosecuted off the Northeastern coast of the USA. These fisheries vary in size (number of trips) and have varying bycatch rates.   To monitor these fisheries with at-sea observers, it is necessary to stratify the trips into fleet sectors with similar characteristics. For this report, fleet sectors are defined as strata within a survey design.

Commercial fishing trips are partitioned into fleet sectors using five classification variables: calendar quarter, gear type, mesh size, geographical region, and trip length.   These classification variables are selected because they are generally known *before* a trip occurs. Using these criteria it is possible to generate a list of candidate vessels for each stratum, which simultaneously enables a random selection process and reduces the number of repeat trips on vessels. This is a critical aspect for both strata definition and sample selection. One cannot base a sampling design on the outcome of a sample observation. In this exercise, it is not possible to select a sampling design that specifically improves the precision of cod discards, since that objective is dependent on the realization of the actual sample. However, it is possible to select samples that will improve the probability of obtaining improved discard estimates by estimating the expected proportion of trips that catch species groups of interest.

Calendar quarter was considered the most feasible temporal unit to capture seasonal variations in fishing activity and bycatch rates over the full range of fisheries. Although some management regulations operate at a finer scale (e.g. weekly), quarterly data can be further subdivided if finer resolution is needed. Otter trawl, gillnet and longline gear were defined as the three major gear types for finfish. Otter trawl and gillnet trips were classified into four mesh size groups: Small (less than 3.99 inch mesh); Medium (between 3.99 and 5.49 inch mesh); Large (between 5.5 and 7.99 inch mesh) and XLarge (8.0 inch mesh or greater). Additionally, trips are classified into six geographical regions based upon the port of departure: ports located within Maine and New Hampshire (ME_NH); Massachusetts (N_MA, excluding Bristol county); Connecticut, RI, and Bristol county, MA (SNE); New Jersey - New York (NJ/NY); Maryland and Delaware (MD/DE); Virginia and North Carolina (VA/NC). Trip length serves as a surrogate for spatial resolution (inshore vs. offshore). Otter trawl trips are further classified into two trip length categories: day trips and multi-day trips. Longline and gillnet gears are not partitioned by trip length.

Due to the mixture of species caught during a trip, it is not sufficient to classify trips with regard to target species because discard of target and non-target species may occur. To account for target and non-target discard, trips in each fleet sector are classified into one or more of three species groups: New England groundfish (NEGF); summer flounder, scup and black sea bass (FSB); and monkfish (MONK). There is often overlap between trips which catch NEGF, FSB and MONK. The estimated number of trips and sea days needed to cover these fleet sectors may be overestimated when the trips are assumed to be independent, therefore the overlapping nature of the fishing fleets are taken into account. Sampling fractions, and how the overlap is accounted for, are described in a later section.

Eleven species constitute the New England groundfish species group: cod, haddock, yellowtail flounder, American plaice, witch flounder, winter flounder, redfish, pollock, white hake, windowpane, and halibut. If a trip catches (retains or discards) at least 1 of the 11 large-mesh regulated species, the trip is categorized as NEGF trip and the hail weights of the 11 species are summed to form an aggregate species total for NEGF. Similarly, if a trip catches (retains or discards) either summer flounder, black sea bass or scup, the trip is categorized as a FSB trip and the hail weights of these species are summed to form an aggregate species total for FSB. If a trip catches (retains or discards) monkfish, then the trip is categorized as a MONK trip. A trip may be categorized to one or more of the three species groups.

Data Sources

Trip characteristics are recorded in both the NEFOP and Fishing Vessel Trip Reports (VTR) data sets. Together, these databases are used to define the size of the sample and the size of the strata, respectively. Data from each source are retrieved and prepared separately before the two sets are combined (Figure 1).

Fishing Vessel Trip Report Data

Beginning in June 1994, the Northeast Region's data collection system was changed from a voluntary to a mandatory reporting system for USA fishermen and dealers who catch and buy/sell groundfish species regulated by the Northeast Multi-species Fishery Management Plan. The mandatory reporting system consists of two components: 1) dealer reporting and 2) vessel trip reporting. Each component contains information needed for fishery management and stock assessment analyses: the dealer reports contain total landings by market category, while the vessel trip reports contain information on area fished, kept and discarded portions of the catch, and fishing effort. The VTR data has been routinely used in management analyses and peer reviewed stock assessments. Details on example applications of the VTR to stock assessments may be found in a large number of reports of the Stock Assessment Review Committee (SARC). Reports prepared since 2000 may be found at http://www.nefsc.noaa.gov/nefsc/saw/. Earlier reports are available by contacting saw_reports@noaa.gov.

In this report, the VTR data are used to: 1) define the sampling frame of the commercial fishing trips, and 2) evaluate the accuracy of the observer data with respect to area fished, kept pounds, and trip length. The VTR data are the only synoptic data source for vessel activity, area fished and fishing effort for commercial fisheries. The Vessel Monitoring System data and the Days-At-Sea data systems cover only portions of the fisheries and therefore are limited in use.

The VTR data can be used as a basis for defining the sampling frame, because all federally permitted vessels are required to file a VTR for each fishing trip (see NMFS-NERO *http://www.nero.noaa.gov/ro/fso/vtr_inst.pdf*). These self-reported data constitute the basis of the fishing activity of the commercial fleets. The VTR trip data are collapsed into fleet sectors and species groups as defined above. For each species group within a fleet sector, the number of trips that caught the species group, the average number of days absent, and the weight of the species in the species group are calculated.

The limitations of self-reported catch data are well known (e.g., Walsh et al. 2002, NMFS 2004). Limitations of the initial data VTR data sets were described by the SARC in 1996 (NMFS 1996). Since then, many of these limitations have been addressed. In particular, subsequent peer-reviews through numerous SARCs and a review by the National Research Council (1998) have identified the strengths, weaknesses, and appropriate uses of the VTR data from the Northeast.

The validity of VTR data as a basis for a sampling frame is supported by comparisons with total landings data from dealer records. All dealers which buy and sell groundfish regulated by federal

FMPs are required to report 100% of the landings. These data are generally thought to constitute a near census of landings of groundfish. The NRC (1998) noted that misreporting of landings is "usually a significant issue only when fisheries are managed by setting a total allowable catch." On this basis, the magnitude of misreporting by dealers would be low as Northeast groundfish stocks have been managed primarily through effort controls. A comparison of total groundfish landings from VTR and Dealer records for calendar year 2003 reveals close agreement between the two sources:

Species	VTR Landings (mt)	Dealer Landings (mt)	Difference (mt)	Pecent Difference
Cod	8240	8692	452	5.2%
Winter flounder	5321	5714	393	6.9%
Witch flounder	2971	3108	137	4.4%
Yellowtail flounder	5208	5530	322	5.8%
American Plaice	2204	2415	211	8.7%
Windowpane flounder	102	60	-42	-70%
Haddock	5778	5874	96	1.6%
White Hake	2268	3305	1037	31.4%
Halibut	11	13	2	15.4%
Redfish	338	360	22	6.1%
Pollock	3839	4188	349	8.3%
Total	36281	39258	2977	7.6%

For the three major species, cod, haddock and yellowtail flounder, the percentage differences range from 1.6% to 5.8%. Only windowpane flounder, white hake and halibut exhibit large percentage differences. Total landings of windowpane flounder and halibut represent small fractions of the total (0.3% of VTR and 0.2% Dealer) landings and these percentage differences are considered negligible. Large percentage differences for white hake may be attributable to confusion between white hake and red hake. White hake can be difficult to distinguish from red hake (sp) and may be identified simply as "hake" by both dealers and fishermen. The overall difference of 7.6% is dominated by large differences in the landings of white hake. Excluding white hake from the comparison reduces the overall percentage difference to 5.4%.

Other measures to ensure the validity of the VTR database include routine auditing procedures, standardized data entry protocols and compliance reviews (pers. comm. Greg Power, Chief, Fisheries Information Section, Northeast Regional Office, NMFS).

Northeast Fisheries Observer Program Data

The NEFOP employs trained, sea-going observers to collect catch data by species and disposition (retained and discarded). Biological samples, gear characteristics data, and economic information are also collected. For the optimization data set, only observed hauls from trips classified as 'standard sea sampling trips' are used. Observed trips that were aborted or which used a ‘limited’ fish sampling protocol (no discard data collected) are excluded.   Hail weight can be reported in round or dressed weights; if kept hail weights are reported as ‘dressed’, then the hail weight is converted to round (live) weight using Commercial Fisheries Database System (CFDBS) conversion factors for the species.   All discard hail weights are assumed to be round (live) weight.

The NEFOP data are collapsed into strata as defined above. For each stratum, the number of observed trips that caught one or more of the three species groups is calculated. For each fleet sector and species group, the number of observed trips, number of observed hauls, average trip length (in days), kept weight of all species in the species group, discarded weight of all species in species group, and the number of observed days are calculated. A discard ratio and the variance of the ratio are calculated for each stratum (fleet sector and species group).

Optimization Data Set

The VTR and NEFOP data sets are concatenated by fleet sector and species group. A list of variables and their definitions are presented in Table 1. Not all VTR fleet activity may have NEFOP coverage (Table 2). When fleet sectors do not have observer coverage, imputed values are used (Table 3). The imputed values are derived from NEFOP data from similar fleet sectors, thus providing an estimate for the non-observed fleets. Details of the imputation process are provided in the following section.

The optimization tool is flexible and allows the user to select the entire input data set, or a subset. To allocate sea days for an entire year, four calendar quarters of data are used. Using the most recent available data, given the time needed for data entry and auditing, the year consists of calendar quarter 3 and 4 from year -1 and calendar quarter 1 and 2 from the current year.

The three gear types (otter trawl, gillnet, and longline) used in the optimization data set are gear types for which fishing regulations allow finfish to be retained, thus a discard to kept ratio estimator (d/k) is used. Fisheries using other gear types where regulations may prohibit groundfish possession are excluded from the current optimization process because a d/k ratio is not appropriate for these cases.

Imputation rules for unobserved fisheries

Not all of the fishery strata had observed trips between April 2003 and March 2004. To account for the expected variance of the estimates in the missing cells, it was necessary to develop a standardized procedure to handle both missing and minimal levels (e.g., a single trip) of observer coverage. This procedure is referred to hereafter as ‘imputation’ and the estimates derived by the imputation are referred to ‘imputed values’. Imputed values are derived by sequentially relaxing the fleet sector classification. The fleet sectors for each species group (NEGF, FSB, and MONK) are imputed separately. The imputed values fill in missing values for the unobserved strata. Fishery strata are defined with respect to rigid definitions of categorical variables such as region or quarter. A stratum with missing data must be filled with data from similar strata. To identify suitable candidate strata as "donor" or "parent" cells, it is necessary to "relax" the definitions of the strata. For example, if no trips occur in the Jan.-Mar. quarter, one might relax the definition to include data from the Jan-Jun. half year. The objective process of relaxing strata definitions to impute data is described below.

A fleet sector was not imputed if:

> 1) VTR number of trips = 0 (no imputation needed when there is no fleet activity for the species group);
>
> 2) VTR number of trips > 0 and standard error was not missing (no imputation needed when there is fleet activity for the species group and there is a standard error of the observer d/k ratio); and
>
> 3) VTR number of trips > 0 and total observed kept pounds = 0 (no imputation needed when there is fleet activity for the species group and the standard error cannot be calculated); otherwise, the fleet sector was imputed.

The imputation uses three increasing levels of aggregated NEFOP data (using the same data and calculation methods as the original calculations of observed d/k ratio and associated statistics). Three of the five stratification factors are relaxed (region, mesh size and calendar quarter). Gear type and trip length are used, but their stratification is not relaxed. Trip length is not relaxed because the average trip length is used to determine the number of sea days needed to obtain the desired precision level. Gear type is not relaxed because of fundamental differences in catches (retained and discarded) occur using these gear types.

> Level 1: Calendar quarter is relaxed to half year and the six geographic regions are relaxed to two regions (NE region = ME/NH, N_MA, SNE; MA region = NY/NJ, DE/MD, NC/VA); gear, mesh size and trip length categories are maintained.
>
> Level 2: Calendar quarter is relaxed to an entire year, the six geographic regions are relaxed to two regions (as in Level 1), and the four mesh groups are relaxed to two mesh groups (SMALL = small and medium mesh groups; LARGE = none, large, and Xlarge mesh groups); gear and trip length categories are maintained.
>
> Level 3: Calendar quarter is relaxed to an entire year (as in Level 2), the six regions are relaxed to one region (all six regions combined), and the four mesh groups are relaxed into one mesh group. This level served as a 'catch-all' for all remaining fleets sectors that required imputation.

The VTR-NEFOP data set is merged with Level 1 NEFOP data; if a fleet sector needs imputed values, based on the criteria list above, then the imputed values from the observed trips in Level 1 are transferred to the corresponding VTR-NEFOP fleet sector and species group only if the trips in the Level 1 data set are greater than 1. Data from Level 2 and Level 3 are subsequently merged with the VTR-NEFOP. When imputed values are used in the VTR-NEFOP data set, the fleet sector and species group is ‘flagged’ with the imputation level used. All fleet sectors that need imputation obtain values at one of the three levels.

Below is a summary of the number of fleet sectors, by imputation level and species group used in the 2005 sea day allocation.

	Species group		
Imputation Level	NEGF	FSB	MONK
Level 0 (no imputation)	150	116	111
Level 1	30	51	44
Level 2	27	41	35
Level 3	20	19	37
Total	227	227	227

To include all fisheries using otter trawl, gillnet and longline gear in the optimization, approximately 33% to 50% of the mean discard rates and variances are imputed or ‘borrowed’.

When a fleet sector and species group is imputed, five variables (number of observed trips, observed d/k ratio, total observed kept pounds, standard error of the d/k ratio, and number of observed days) are estimated with imputed values. Because the aggregated NEFOP data at each level have more observations than the original VTR-NEFOP fleet sector, the imputed values need to be rescaled before they are used. Except for the imputed d/k ratio, the imputed values for the number of observed trips, the total observed kept pounds, the standard error and the number of observed days are re-scaled using a sampling fraction represented by the ratio of the total NEFOP trips for that level, fleet sector and species group to the total VTR trips for that level, fleet sector and species group. Equations used to re-scale imputed values within stratum h are:

T_{vtr} = total VTR trips of $Level_i$
T_{obs} = total NEFOP trips for $Level_i$
$T_{imp,h} = (T_{obs} / T_{vtr}) * Trips_{vtr,h}$;
$Kept_{imp} = (T_{imp,h} / T_{obs}) *$ NEFOP kept pounds sum in $Level_i$
$SE_{imp} = (T_{obs} / T_{imp,h})^{1/2} *$ NEFOP standard error in $Level_i$
$Days_{imp} = (T_{imp,h} / T_{obs}) *$ total number of NEFOP days in $Level_i$
$T_{imp,h}$ is rounded to a whole number, if $T_{imp,h} < 1$, then $T_{imp,h} = 1$;

where $Level_i$ denotes Imputation Level 1, Level 2 or Level 3.

Sampling Theory and Optimization Methods

Fishing trips are considered the primary sample unit in estimating d/k ratios. Fishing trips generally catch multiple species, some of which are not landed owing to various regulations or market conditions. We defined three major groups of species: (1) New England groundfish, (2) summer flounder, scup and sea bass, and (3) monkfish. Fishing trips in a given stratum may catch species from one or more of these groups. The degree of overlap among species groups has important implications for the efficacy of sampling within strata, i.e., the number of samples necessary to achieve a desired level of precision. Because some fraction of trips provide information on more than one species group, estimates of sample size based on the assumption of independence, will overestimate the number of required trips. Developing estimators that explicitly account for the magnitude of overlap can circumvent this potential inefficiency. There are two ways to approach this estimation. One is based on the pattern of overall trips from the vessel trip reports. The second is based on the pattern in observer sampled trips. In theory, if the observed trips are a representative sample, the proportions in the vessel trip reports and observer trips should be the same. In practice, the proportions in the observed trips will deviate from those in the VTRs due to sampling variability and other factors. The selection of observed trips reflects a practical mix of vessel availability, knowledge of vessel operations, familiarity, and safety considerations. These are, of course, important factors for program management, but it must be recognized that these factors introduce bias into estimates.

Both approaches follow the algorithm described below. Let I_{hij} be an indicator variable denoting the presence or absence of species group j within trip i in stratum h. Then I_{hij} =1 if species group j is present, else 0. A design matrix can be used to describe each unique trip within a stratum. The design matrix appends to each trip record a set of indicator variables that identify the presence/absence of species groups caught. The following table illustrates a hypothetical case with 7 trips in stratum h.

Example 1

Trip ID	I_{h_1} j=1 NEGF	I_{h_2} j=2 Monk	I_{h_3} j=3 FSB
1	1	0	0
2	1	1	0
3	1	1	1
4	1	0	1
5	0	1	1
6	0	1	0
7	0	0	1
Sum	4	4	4
n_h=7	n_{h1}	n_{h2}	n_{h3}

In this simple example, four of the seven trips caught New England groundfish, four trips caught monkfish, and four caught summer flounder, scup or sea bass. If all of these trips (or trip types) are equally likely, then the probability of obtaining a sample that yields information on NEGF is 4/7 and so forth. The probability of obtaining information on species j is the sum of the species group specific trips within the stratum (i.e., n_{hj}) divided by the total number of unique trips within the stratum (n_h). Note that

$$n_h \neq \sum_{j=1}^{3} n_{hj}$$

owing to the overlap in coverage for some trips. The probability that a random trip provides information on species group j is defined as

$$\hat{p}_{hj} = \frac{n_{hj}}{n_h} \qquad (1)$$

For each stratum, the probabilities can be computed that a random sample will contain information about species group j. The basis for the probability estimator can either be the observed set of trips within a stratum or the total set of trips represented in the VTRs. Applying the same set of indicator variables to the VTR data, one can obtain the population estimates of these quantities as

$$\hat{P}_{hj} = \frac{N_{hj}}{N_h} \qquad (2)$$

Eq. 1 establishes the basis for a random sample from the set of observed trips. Eq. 2 establishes the same basis from the VTR. On first principles, Eq. 2 is a better estimator if a representative sample can be taken in a stratum. Eq. 1 is more appropriate if the set of observed trips within a stratum is representative of those trips available for observation.

Using Eq. 1 or 2, it is now possible to examine the effects of altered sample sizes. Let n'_h represent the new total number of trips to be taken in stratum h. For the purpose of evaluating the expected change in variance in the component species groups, the n'_{hj} for each species group need to be redefined. This is accomplished using the equation

$$n'_{hj} = \hat{p}_{hj} n'_h \qquad (3)$$

if Eq. 1 is used , or

$$n'_{hj} = \hat{P}_{hj} n'_h \qquad (4)$$

if Eq. 2 (based on VTR) is used to estimate the expected probabilities that a trip in stratum h will capture fish from species group j.

Another worked example will reinforce the basic concept of the expected proportions of samples likely to sample species group j. Consider a stratum with 10 observed trips with Eq.1 used to estimate p'_{hj}.

Example 2

Trip ID	I_{h_1} j=1 NEGF	I_{h_2} j=2 Monk	I_{h_3} j=3 FSB
1	1	1	0
2	1	0	0
3	1	0	1
4	1	1	0
5	1	1	1
6	0	0	1
7	0	0	1
8	1	0	1
9	0	1	0
10	0	1	0
Sum	7	4	5
n_h=10	n_{h1}	n_{h2}	n_{h3}
p_{hj}	7/10	4/10	5/10

If the n_h were increased to n'_h=30 then the revised estimates of n'_{hj} would be

$$\hat{n}'_{h1} = \left(\frac{7}{10}\right)30 = 21$$

$$\hat{n}'_{h2} = \left(\frac{4}{10}\right)30 = 12$$

$$\hat{n}'_{h1} = \left(\frac{5}{10}\right)30 = 15$$

Thus, adding 20 trips to stratum h would translate into an expected increase of 14 trips for NEGF (i.e., 21-7), 8 trips for monkfish (i.e., 12-8) and 10 trips for FSB (i.e., 15-5). The increase in the total number of trips for a stratum differs with respect to the pattern of information in the sample. The allowance for non-integer numbers of trips is considered to have a negligible effect. In practice, the actual implementation of a sampling strategy would be based on rounding to the nearest integer, and subject to a lower bound constraint, say n_{hj}= 2.

Example 2 could be repeated for estimates derived from the VTR data. For such an example, the universe of trips would be much larger.

Measures of Overlap

Venn diagrams of the number of trips in the VTR and NEFOP depict the degree of overlap between the three species groups in the two data sets. In the April 2003-March 2004 VTR database, half of the trips (22,274 trips out of 43,703 trips) are unique to the species groups (Figure 2), while in the NEFOP database, a third of the trips (286 trips out of 1,103 trips) are unique to the species groups (Figure 3). The sampling fractions (NEFOP trips divided by VTR trips) are given in Figure 4. The numbers of trips (and days) in the Venn diagrams are based on whole trips, and therefore slight differences occur in the number of trips between the Venn diagram and d/k ratio analyses (e.g. there are trips in d/k ratio analysis which used two different mesh sizes during a trip).

Observers Days at Sea Constraints

While trips constitute the sampling unit, the total number of sampling units is constrained by the total number of days available during any interval. To consider this component of the sampling design, it is necessary to consider the average trip duration in stratum h. Let t_{hi} be the trip duration (days) for the i-th trip in stratum h. The total number of observed trips in stratum h is n_h and the total number of observed days is Σt_{hi} The average trip duration is estimated as

$$\bar{t}_h = \frac{\sum_{i=1}^{n_h} t_{hi}}{n_h} \qquad (5)$$

The actual number of future observer days that will be required under some new sampling intensity (n'_h) is proportional to n'_h / n_h . Eq. 5 can also be defined in terms of the durations of the trips in the VTR database. The expected total number of days allocated to stratum h is defined as

$$T_h = \bar{t}_h n_h = \sum_{i=1}^{n_h} t_{hi} \qquad (6)$$

regardless of whether observer or VTR data are used. The average trip duration in stratum h is not influenced by the number of trips allocated, as long as the trips selected are representative of the basis used to define the species composition of the trips. Recall that either the observer database or the VTR database can be used. Thus the total number of observer days allocated to stratum h under some new allocation is

$$T_h^{'} = \bar{t}_h n_h^{'} \qquad (7)$$

The grand total number of days at sea that would be allocated given some new set $\{n'_h\}$ would be

$$T^{'} = \sum_{h=1}^{H} \bar{t}_h n_h^{'} \qquad (8)$$

Some key points in this derivation are:

- It is not possible to derive any real-world sampling program without considering the key uncertainties related to the probability that the trip will be "successful" and that the cost of sea days may vary.
- The number of successful trips, relative to the objective of reducing the variance of the estimate, is a random variable, based on a probability estimate. The expected number of actual trips may not actually result in information necessary to improve the precision of the estimate.
- The "cost" per trip is expressed as the expected duration. Actual duration may also vary within strata, although the stratification is designed reduce the variation in this component.

Optimization is a technique for maximizing (or minimizing) some quantity of interest subject to one or more constraints. Constraints are the key concept. In this application, we consider upper and lower bounds on the size of the sample within a strata, a total constraint on the number of available days, and a constraints related to acceptable levels of precision. For problems that do not explicitly consider dynamic (i.e., time dependent) processes, a variety of optimization methods can be used including linear and nonlinear programming. For this project, the optimization program, Premium Solver Platform (Version 5.5) developed by Frontline Systems, Inc. (2003) was used.

To address the optimization problem, the overall variance of the discard to kept ratio must first be estimated. The discard ratio for species group j in stratum h is the sum of discard weight over all trips divided by sum of kept weights over all trips:

$$\hat{R}_{jh} = \frac{\sum_{i=1}^{n_h} d_{ijh}}{\sum_{i=1}^{n_h} k_{ijh}} \qquad (9)$$

where d_{ijh} is the discards for species group j within trip i in stratum h and k_{ijh} is the kept portion of the catch. R_{jh} is the discard rate for species group j in stratum h. The stratum weighted discard to kept ratio for species group j is obtained by weighted sum of discard ratios over all strata:

$$\hat{R}_j = \sum_{h=1}^{H} \left(\frac{N_h}{\sum_{h=1}^{H} N_h} \right) \hat{R}_{jh} I_h \qquad (10)$$

The variable I_h is a zero/one indicator of whether or not a stratum is included in the computation. The indicator variable can be considered as a composite measure of the suitability of stratum h in the estimator. The indicator variable allows a stratum to be filtered on the basis of one or more metrics. A more complete description of the various types of filtering is described in the next section.

The approximate variance of the estimate of R_{jh} is obtained from a first order Taylor series expansion about the mean:

$$V\left(\hat{R}_{jh}\right)=\frac{1}{(n_{jh}-1)n_{jh}\bar{k}_{jh}^{2}}\left[\left(\sum_{i=1}^{n_{jh}}d_{ijh}\right)^{2}+\hat{R}_{jh}^{2}\left(\sum_{i=1}^{n_{jh}}k_{ijh}\right)^{2}-2\hat{R}_{jh}\left(\sum_{i=1}^{n_{jh}}d_{ijh}\right)\left(\sum_{i=1}^{n_{jh}}k_{ijh}\right)\right] \tag{11}$$

where d_{ijh} is the total discard weight of species group j in trip i within stratum h, k_{ijh} is the total kept weight of species group j in trip i within stratum h, nj_h is the sample size (number of trips) that caught species group j in stratum h, and k_{jh} bar is the mean kept landing of species group j within stratum h. Note that in this formulation of the variance, the finite population correction factor (fpc), i.e., one minus the sampling fraction within the stratum, has been omitted. This has been done to improve readability. The fpc is included however, in Eq. 11 for the total variance of the d/k ratio.

The variance of the d/k ratio for species group j over the entire set of strata is estimated using standard sampling theory methodology for a stratified random design as

$$V\left(\hat{R}_{j}\right)=\sum_{h=1}^{H}\left(\frac{N_h-n_{jh}}{N_h}\right)\left(\frac{N_h}{\sum_{h=1}^{H}N_h}\right)^{2}V\left(\hat{R}_{jh}\right)I_h \tag{12}$$

The overall coefficient of variation for the discard/kept ratio is defined as

$$CV_j=\frac{\sqrt{V(\hat{R}_j)}}{\hat{R}_j} \tag{13}$$

It is now possible to define an overall estimate of the relative precision of the d/k ratio across all species groups as

$$CV = \sum_{j=1}^{3} \lambda_j CV_j \qquad (14)$$

where λ_j is an arbitrary weighting factor for species group j. In this formulation, the λ_j can be used as binary factors (0,1) to examine the allocations individually for species groups.

The optimization tool evaluates the potential improvements in the precision of the discard ratio through reallocation of the number of trips to individual strata. Equation 11 illustrates that the variance of the ratio decreases as the number of trips (n_h) increases. Assuming that the data yield representative estimates of the stratum specific variances, then the reduction in total variance can be examined as a function of alternative allocation schemes for each stratum. If n^*_h is defined as the optimal number of trips taken in stratum h, then the variance of the overall ratio is estimated as

$$V\left(\hat{R}_j^*\right) = \sum_{h=1}^{H} \left(\frac{N_h - n_{jh}}{N_h} \right) \left(\frac{N_h}{\sum_{h=1}^{H} N_h} \right)^2 \left(\frac{n_{jh}}{n_{jh}^*} \right) V\left(\hat{R}_{jh}\right) I_h \qquad (15)$$

The optimization problem can now be posed as the minimization of the CV of the composite ratio estimate, subject to a total days at sea constraint (T_C) and constraints on the number of trips per stratum.

$$\begin{aligned} &\min \sum_{j=1}^{3} \lambda_j CV_j \\ &\textit{subject to} \\ &2 \le n_{jh}^* \le N_h \qquad , \forall_h \\ &T_C^* \ge \sum_{h=1}^{H} \bar{t}_h n_h^* \end{aligned} \qquad (16)$$

Alternatively, the optimization problem can be defined with the objective of minimizing the total number of days at sea, subject to an acceptable coefficient of variation (CV_{CRIT}). This version of the model can be written as:

$$
\begin{aligned}
&\min \sum_{h=1}^{H} \bar{t}_h n_h^* \\
&\textit{subject to} \\
&2 \le n_{jh}^* \le N_h \qquad , \forall_h \\
&CV_{CRIT} \ge \sum_{j=1}^{3} \lambda_j CV_j
\end{aligned}
\tag{17}
$$

Another relevant consideration is that a trip may not yield information on any of the target species groups. In some strata, for example, a number of trips fail to capture groundfish, monkfish or the summer flounder, scup and sea bass mixture. To protect against this possibility, it is desirable to inflate the optimal number of trip estimates by the ratio of N_h to N'_h where N_h is the total number of trips in stratum h and N'_h is the number of trips that obtained information on one or more of the species groups.

Application of the Model

Using the optimization algorithm to minimize the variance of the discard estimates subject to a given number of sea days, the allocation of observer sea days for the Mid-Atlantic (M-A) and New England (NE) regions was optimized separately and the resulting allocated sea days combined. Separate analyses were conducted because of differential sea days constraints (mandated sea days for New England groundfish versus non-mandated sea days for the Mid-Atlantic region). Before the optimization began, a portion of the available sea days were set aside to cover fisheries which do not enter the optimization process (e.g. scallop dredge fishery). For these fisheries, sea days are allocated proportional to fishing effort (number of trips or number of days fished).

The Mid-Atlantic optimization used data from the SNE, NJ/NY, DE/MD and VA/NC regions with the species weighting coefficients set to 1 for both FSB and MONK and to 0 for NEGF. The NE optimization used data from the SNE, N_MA, and ME-NH regions, with the species weighting coefficients set to 1 for NEGF and to 0 for both FSB and MONK. Data from the SNE region were included in both optimizations due to the intersection of the NE and M-A regions. Stratum indexes were applied to reduce the data set to contain only the relevant fisheries.

Below is a summary of the indexes and thresholds used in the NE and M-A sea day optimizations.

NE region trip and landings setting and thresholds

Switch	Setting	Threshold (fraction)	Description of Filters that Operate on Entire Strata
I(L_negf%)	1	0.0025	Landings of NEGF<Threshold=>0, else 1
I(L_fsb%)	(All)	0.0001	Landings of FSB<Threshold=>0, else 1
I(L_monk%)	(All)	0.0001	Landings of Monk<Threshold=>0, else 1
sum(I(L_all%))	(All)	NA	If any of Landings indices for NEGF,FSB or Monk=1 then =>1, else 0
I(Nh_negf%)	1	0.0001	Trips of NEGF<Threshold=>0, else 1
I(Nh_fsb%)	(All)	0.0001	Trips of FSB<Threshold=>0, else 1
I(Nh_monk%)	(All)	0.0001	Trips of Monk<Threshold=>0, else 1
I(%TotVTR_3sp)	1	0.00005	Filter on % of total landings of 3 species groups
Filter on All Trips	0	NA	Excludes entire Strata if value=0

M-A region trip and landings settings and thresholds

Switch	Setting	Threshold (fraction)	Description of Filters that Operate on Entire Strata
I(L_negf%)	(All)	0.0025	Landings of NEGF<Threshold=>0, else 1
I(L_fsb%)	1	0.0001	Landings of FSB<Threshold=>0, else 1
I(L_monk%)	1	0.0001	Landings of Monk<Threshold=>0, else 1
sum(I(L_all%))	(All)	NA	If any of Landings indices for NEGF,FSB or Monk=1 then =>1, else 0
I(Nh_negf%)	(All)	0.0001	Trips of NEGF<Threshold=>0, else 1
I(Nh_fsb%)	1	0.0001	Trips of FSB<Threshold=>0, else 1
I(Nh_monk%)	1	0.0001	Trips of Monk<Threshold=>0, else 1
I(%TotVTR_3sp)	1	0.00005	Filter on % of total landings of 3 species groups
Filter on All Trips	0	NA	Excludes entire Strata if value=0

NE and M-A regions d/k ratio thresholds

	Threshold (d/k ratio)	Description of Filters that Operate on Individual Cells (Species within Strata)	Number of Cells Included	Number of Cells Excluded
Max d/k_NEGF	1	Maximum d/k ratio used for NEGF. Values>Threshold excluded	25	11
Max d/k_FSB	2	Maximum d/k ratio used for FSB. Values>Threshold excluded	32	4
Max d/k_Monk	2	Maximum d/k ratio used for Monkfish. Values>Threshold excluded	33	3

Some 'post-processing' of the allocation of optimized sea days was necessary. Even though one or more indicator variables (i.e., filters) were applied during optimization, it was necessary to fine-tune the sea day allocations by applying a minimum and maximum amount of coverage, and to maintain coverage of fishing activity throughout the year. The optimized sea days were multiplied by the average trip duration for each stratum to estimate the projected number of observed trips. If the projected number of observed trips was less than 3 trips per strata, then the sea days were redistributed to other strata representing more relevant fisheries. If the number of potential observed trips in a stratum exceeded 15% of the VTR trips, then the sea days in that stratum were reduced to the number of sea days representing 15% (potential observer trips/VTR trips) coverage. The sea days from strata exceeding the 15% coverage cap were reassigned to other strata.

The number of unique vessels and the vessel selection protocols in a stratum limit the number of trips that can be observed in that stratum. The number of unique vessels varies among strata; in the 2005 sea day optimization, the number of unique vessels in a stratum ranged between 1 and 146 vessels, with 85% of the strata having 50 vessels or less. The vessel selection protocols state a vessel is not to be observed more than twice during a month. As an approximate guide for balancing between the potential number of observed trips and the number of unique vessels in a stratum, a 15% trip coverage cap was selected to prevent assigning more sea days to a stratum than the number of vessels could support. The 15% cap prevented clustering of sampling effort, particularly in instances where the estimate of the variance of d/k might be imprecise. In these instances, the optimization model will tend to allocate large number of trips to such strata to reduce the standard error of the estimate. When the analysis was restricted to the relevant strata for the New England groundfish fisheries, the 15% cap was binding in only 4 of 33 strata for the observer coverage allocation scheme based on 2,708 observer days.

The diagnostics within the optimization tool were used to evaluate the imputation process. The optimization algorithm calculates the d/k ratios and the variance estimates for 'all data' and for 'data without imputed values'. Generally, the d/k ratios and variance estimates were similar between the 'all data' and 'data without imputed values' for each species groups. This indicates that the imputation generally provided consistent values across the three levels of aggregation.

Precision, Bias and Sampling Intensity: A Rebuttal to E.A Babcock et al. (2003)

Understanding the sampling properties of estimates of bycatch derived from observer programs and other sources with respect to accuracy and bias is critical. This section reviews issues related to bycatch estimation in observer programs with an emphasis on potential biases that may exist. The NMFS national bycatch report (NMFS 2004) emphasizes that wherever possible, attempts to detect and guard against bias should be made in observer programs. The report strongly advocates the development of rigorous randomization procedures in sample selection to help ensure representative sampling. All can agree that with unlimited resources, the more observer coverage the better. The real issue however is how to allocate finite resources to meet multiple requirements for stock assessment and protected species evaluation. The cases that Babcock et al. (2003) point to as success stories typically have relative few boats involved compared to many other fisheries. These cases are not representative overall of the issues facing program managers.

Babcock et al. (2003) insufficiently distinguish between two very different types of bias. The first type arises when non-representative sampling occurs. The second type is related to the statistical properties of the consistency of the estimators. These two types of bias are very different and it is important to be clear which type of bias is under consideration. The second type of bias is typically reduced with sufficiently large sample size. However, this may not be addressed by increases in sample size if fishermen refuse to take observers, if certain classes of boats cannot accommodate observers, etc. Babcock et al. (2003) take as an article of faith that increasing the number of trips will reduce bias. Some of the solutions identified by Babcock et al. (2003) for correcting bias (e.g. the use of bootstrap estimators) apply to correcting bias of the second type. However, no amount of bootstrapping will overcome non-representative sampling.

The mean square error (MSE) of an estimate is composed of two elements, the variance of the estimate and the square of the bias (defined as the difference between the mean of the sample and the true population value). The MSE therefore comprises two additive elements. Cochran (1977) notes that if bias is less than 10% of the standard deviation of the estimate, the effect of this bias on the accuracy of the estimate is negligible. As noted by Babcock et al. (2003), most work on the properties of estimates derived from observer programs have focused on the variance component, with far fewer studies examining bias. For reasons described in detail below, we believe that estimating the bias of the first type is more difficult than intimated by Babcock et al. (2003). It is nonetheless important to try to estimate this quantity. Focusing on the precision part of the MSE in certain analyses does not imply that bias is unimportant, or that it should be dismissed as insolvable as suggested by Babcock et al. (2003)

A critical element of the arguments developed by Babcock et al. (2003) appears to be that increasing the number of trips sampled will, by itself, reduce bias of the first type. This assertion, if true, is important. However, no corroborative evidence is provided. The argument is that fishermen will change behavior if they are subjected to a higher probability of being included in a sample, or of being sampled more frequently by observers. In essence, fishermen will be less likely to fish in a non-typical manner when an observer is on board if the probability of selection is higher. This may not be true if say a particular fishing trip has a 20% chance of being selected vs. a 10% chance and if the fishermen do not know in advance how many trips they may have to accommodate within a specified time period. In any event, we doubt that this can be calculated unless a model of human behavior is part of the estimation procedure.

Babcock et al. (2003) report that Sampson (2002) detected statistically significant differences between a multivariate indicator of landings composition by participants in the Enhanced Data Collection Project (EDCP) of the Oregon Department of Fish and Wildlife and the composition of landings by the entire groundfish trawl fleet. This analysis is used to indicate that biases exist in voluntary programs such as the EDCP and that it is possible to use similar approaches to identify bias in observer programs in general. What Babcock et al. do not report is that Sampson indicated that the multivariate analysis employed (Principal Components Analysis) was only “moderately successful” in capturing the properties of the data. The first three principal components accounted for 15.4, 12.0, and 8.0 % of the variance `respectively for trips landing more than 10,000 lbs in which hake comprised less than 50% of the total (designated “Big” trips by Sampson). For trips less than 10,000 lbs in which hake comprised less than 50% of the total (“Small” trips), the first three principal components accounted for 13.7, 10.4, and 9.0% of the variance. Sampson (2002) reported significant differences between the participants in the EDCP and the total fleet in the 1^{st} and 3^{rd} principal components for both Big and Small trips and concluded that the EDCP fleet may not be representative of the entire fleet. However, because the first three PCs captured only a moderate fraction of the variance, these analyses should be viewed with caution. It is worth noting that Sampson provided canonical variable plots of PCA 1 against PCA 2 (Figure 6a and 6b of his report) in which both the information from the EDCP and the whole fleet are superimposed and these show that the data from the EDCP do not appear to be markedly different from the total fleet. A truly important bias should show up clearly in these plots, which take into account more of the variance of the samples than the individual t-tests actually used in the report.

The general issue of testing for bias in observer data using landings data raises some important questions concerning the inferences that can be drawn. In particular, if no significant differences are detected between observer and landings data, this does not guarantee that there is no bias in the estimates of discards.

The other major source of information that could be used to test the representativeness of observer data is to test against self-reported estimates by fishermen. Sampson (2002) made such an analysis for the EDCP data and detected differences. In this case, it was inferred that the self-reported estimates were not accurate. In contrast, Liggens (1997) found no differences between observer data for catch and discards against fleet wide estimates. In general, self-reported estimates are rightly viewed with caution and this is the most commonly available type of discard information against which to compare observer data.

To deal with logistical constraints and their effect on observer programs, Babcock et al. (2003) cite the work of Cotter et al. (2002) using a probability proportional to size (PPS) sampling allocation procedure. However, Cotter et al. (2002) concluded that this approach did not markedly improve the performance of the estimators.

Babcock et al. (2003) refer to the method of collapsing strata as an *ad hoc* procedure when, in fact, it is a very well established method (see Cochran 1977). Bias can occur using this method if an investigator deliberately chooses similar strata to combine. However, methods in which objective rules for combining strata are employed are much less likely to cause bias.

Babcock et al. (2003) assert that Fogarty and Gabriel (2002) assumed that the sampling fraction did not matter. In fact, Fogarty and Gabriel (2002) noted that the sampling fraction does affect the precision of the estimate through the finite population correction factor. The effect indicated by Babcock et al. (2003) is a very well established property of the statistical estimators employed. Fogarty and Gabriel (2002) noted in their analysis that "Ignoring the finite population correction factor results in an overestimate of the standard error…" Fogarty and Gabriel (2002) did not include the FPC in their estimates so as to provide a conservative estimate of the variance (e.g. biased on the high side). This is very different than assuming that the sampling fraction does not matter.

Recommendations made by the NMFS National Working Group on Bycatch (NMFS 2004) largely address the issues of major concern – the importance of obtaining representative sampling, careful consideration of stratification, etc. We recommend that information from observer trips (catch, trip duration, number of hauls/tows, fishing location etc.) also be checked against independent sources of information to see if differences can be detected. The only solution that Babcock et al. (2003) provide when such a bias is detected is to increase the number of trips covered by observers. As noted above, this may or may not be effective. Other solutions to the problem need to be explored, as well as increasing observer coverage when analyses indicate it is cost-effective to do so given finite resources and competing programmatic needs.

An Evaluation of Bias in the Northeast Fisheries Observer (Sea Sampling) Program

Several tests were conducted to address the potential sources of bias. We compared several measures of performance for vessels with and without observers present. Bias can arise if the observed trips within a stratum are not representative of the other vessels within the stratum. Such bias could arise if the vessels with observers on board consistently catch more or less than other vessels, if the average trip durations change, or if vessels fish in different areas. Each of these hypotheses was tested by comparing observable properties in strata having data from vessels with and without observers.

All vessels are required to report the total trip landings, the number of days absent from port, and the primary statistical area fished. Average catches (pounds landed) for observed and total trips compare favorably (Figure 5), and follow an expected linear relationship. If the observed and unobserved trips within a stratum measure the same underlying process, one would expect no statistical difference in the average catches (and the standard deviations) between the VTR and observer data sets. An examination of the distribution of these differences (Figures 6A and 6B) indicates no evidence of systematic bias. The mean difference of 238 pounds in average catch rates between the two data sets is not significantly different from zero ($p=0.59$, $df=84$). As well, a paired t-test of the stratum specific standard deviations of pounds kept showed no significant difference from zero ($p=0.08$). A strong correlation was detected in trip duration between observed and unobserved trips (Figure 7), with observed trips averaging about a half-day longer ($p = 0.01$) (Figure 8A). However, the difference in stratum specific standard deviations of trip length was not significantly different from zero ($p = 0.60$) (Figure 8B). Some skewing of the differences in mean trip durations is evident, with observed trips being slightly longer.

Two measures of spatial coherence were also examined. Within stratum $\mathbf{h}$ the expected number of observer trips by statistical area $\mathbf{j}$ as the product of the proportion of VTR trips in Statistical Area $\mathbf{j}$ and stratum $\mathbf{h}$ ($\mathbf{V_{jh}}$) and the number of observed trips in stratum $\mathbf{n_h}$. Thus, $\mathbf{E_{jh} = V_{jh} * n_h}$. These expectations can then be compared to the actual frequencies ($\mathbf{O_{jh}}$) of observed trips by statistical area. Results of these analyses indicate that the spatial distribution of fishing effort for trips with observers on board closely matches the spatial distribution of trips for the stratum as a whole (Table 4). It was possible to compute chi-square statistics for 65 strata. The null hypothesis of observer proportions equal to VTR proportions was rejected ($P<0.05$) in 20 of the 65 comparisons. Of these 20 cases, 11 were from ports in Southern New England and Mid-Atlantic states. Of the remaining nine cases, five involved the large and extra-large gill net fisheries that land both groundfish and monkfish. Thus, the null hypothesis of equivalent spatial distribution of sampling was rejected in only 4 of 50 cases, a rejection rate only slightly higher than expected from chance alone.

As a final measure of the potential spatial bias, a paper by Murawski et al. (2005 in press) is instructive. In this paper, information is presented on the spatial distribution of otter trawl fishing effort for vessels with Vessel Monitoring Systems (VMS) and compared with the distribution of fishing effort from observed trips (Figure 9). Qualitatively, the spatial distributions match very well with high concentrations of effort near the boundaries of existing closed areas on Georges Bank and within the Gulf of Maine. Moreover, the effort concentration profiles deduced from VMS data coincide almost exactly with the profiles derived from the observed trips. Overall, these comparisons suggest strong coherency between these two independent measures of fishing locations.

Sources of Uncertainty

In the Northeast, every effort is made to ensure representative observer coverage. This is accomplished by stratifying the fleet into homogeneous spatial, temporal and gear groups and by randomly selecting vessels from these strata. Stratification and randomization of sampling units are basic principles of survey design (e. g. Cochran 1977; Thompson 2002) and have been used in previous studies of bycatch to improve both "knowledge of the fleet" (Cotter et al. 2002) and precision of estimates (Allen et al. 2002; Borges et al. 2004). VTR data are used to produce a list of fishing vessels, by quarter and fleet sector. The vessel list contains a randomly ordered list of all vessels that participated in each fleet sector. To obtain a representative sample of the fleet, the NEFOP Area Coordinators use this vessel list, in addition to their local knowledge of fleet activity, to identify vessels on which to place observers. Vessels are required to take an observer if requested to do so. The NEFOP has standard protocols regarding vessel selection. A vessel, using the same gear, is not observed more than twice in the same month— this prevents repeated observations from the same vessel. The NEFOP Area Coordinators have protocols for documenting refusals; a refusal occurs when a vessel owner/captain is asked to take an observer and the owner/captain declines — or agrees but does not follow through (i.e. the vessel leaves the dock without the observer on board). Refusals are forwarded to Law Enforcement. A vessel owner can be prosecuted for failing to take an observer.

An objective process is used for imputation of missing values in unsampled strata. The imputation methodology helps identify gaps in sampling strategy and is an important component for ongoing improvements of the survey design. Stratoudakis et al. (1999) employed a post-stratification technique of "collapsing strata" as a way of dealing with unsampled strata. Our method of imputing means and variances for unsampled strata builds on this approach by utilizing information in comparable strata as a basis for initial sample allocation. Imputation represents a tradeoff between a realistic survey consistent with known fishing patterns and a less realistic pooled survey. Excessive imputation, however, can be indicative of an overly ambitious stratification approach; utilizing the observer data at an unrealistically fine temporal or spatial scale (say daily estimates in a small area) not only leads to an excessive extrapolation, but also violates the premise that observations in the current year are sufficient to predict patterns in the following year.

Persistence of annual patterns is critical to the estimation of an 'optimal' scheme. As regulations change and fishing patterns shift, using data based on fleet activity in the preceding year may be problematic. Using the current year's fishing activity pattern to predict future fishing patterns within strata cannot account for changes induced by variations in resource abundance, revenues, or management regimens. In a study of discards in the North Sea, Statoudakis et al. (1998)

reported immediate increases in discarding rates following increases in minimum size limits, but noted consistent patterns over time and among gears for higher value species such as cod and haddock. Without a predictive model of human behavior, it is not possible to anticipate fine-scale changes in fishing patterns. Rochet et al. (2002) were unable to find reliable predictor variables for prediction of bycatch but it should be noted that their study examined only 26 trips, about two orders of magnitude less than the number of trips considered in this report.

A related source of uncertainty is the ability to make inferences about specific species, stocks or age groups. Our evaluation of the Northeast Observer Program considers discard to kept ratios at the level of species groups. This approach is consistent with recent literature (Allen et al. 2001, Borges et al. 2004). An optimal strategy for New England Groundfish as a group however, will not necessarily be optimal for age 2 haddock on Georges Bank. The precision of discard information required at this level will typically exceed the nominal levels predicted as a result of optimal sampling. Figure 10 illustrates the relationship between the coefficient of variation for the overall New England groundfish discard ratio estimate as a function of total observer days allotted to this fishery. Assuming that 2,708 sea days can be allocated in an optimal manner in 2005, the predicted CV of the d/k ratio is well below 4%. The predicted CV drops to 2.5% at about 4,000 days and drops to about 1% at 20,000 days (about 50% coverage). The continuously decreasing slope of the relationship between CV and observer sea days reflects the reduced effectiveness of additional days as a way of improving overall precision.

Several important points are relevant to the interpretation of Figure 10. First, any non-optimal allocation of sampling effort will tend to increase the overall CV of the d/k ratio. Non-optimal allocations occur when the desired sampling plan cannot be followed, or when the pattern of landings among the strata in the current year differs from the pattern used as a basis for the optimal allocation scheme. Second, the CV of the overall d/k ratio is smaller than the precision of the individual components. Thus, the CV of the d/k ratio for a particular gear type or for a d/k ratio based on a finer temporal or spatial scale will generally be greater than the composite estimate. This property is illustrated in Figures 11 and 12 for quarterly estimates in the New England groundfish otter trawl and gillnet fisheries, respectively. Note that the number of observed otter trawl trips would need to be tripled to reduce the CV of the d/k ratio from 20% to 10%.

The coefficient of variation (CV) of the d/k ratios for New England groundfish are well below the 20% - 30% CV range established by the Atlantic Coastal Cooperative Statistics Program (ACCSP) for high priority commercial fisheries (ACCSP 2001) and by NMFS's National Working Group on Bycatch (NWGB) (NMFS 2004). The NWGB recommends: "For fishery resources, excluding protected species, caught as bycatch in a fishery, the recommended precision goal is a 20-30% CV for estimates of total discards (aggregated over all species) for the fishery; or if total catch cannot be divided into discards and retained catch then the recommended goal for estimates of total catch is a CV of 20-30% (NMFS 2004). Assuming that landings are known without error, the precision of estimated total discard for New England groundfish equals the precision of the d/k ratio for this fishery.

A decrease in precision of the d/k ratio is also expected for any single species analysis. For example, the CV of the d/k ratio for haddock alone will probably be much greater than the CV of the d/k ratio for the overall groundfish complex. Once again, it is important to remember that the sampling program must be based on observable properties of the strata, not on the outcome of the experiment. Any efforts to improve the precision of the d/k ratio for a single species will come at the expense of reduced precision for other species. Moreover, oversampling of a particular group of vessels may introduce undesirable properties (e.g., repeat trips on a single vessel) that can make the sampling less representative.

An exact definition of an acceptable level of bias and precision depends on the objectives of the analyses and the levels of acceptable risk to the fishery resource and the fishery. The acceptable level of risk must be defined externally by managers but should, at a minimum, consider the risk of stock collapse if management actions are compromised by imprecise information on discards. From the analyses presented in this report, it would appear that the level of precision is high for the groundfish resource as a whole and that there little evidence of bias in the discard rates.

Presently the optimization model uses aggregate d/k ratios, which are appropriate for most fisheries; however, for other fisheries, d/e ratios are more appropriate. The optimization algorithm can handle datasets containing either type of ratio, but not both in the same set (without external weighting). Input data sets with d/e ratios have been developed, but have not yet been incorporated into the overall process. A comparison of the precision of alternative estimators of discard ratios is the subject of ongoing research.

Acknowledgments

We wish to thank Mark Terceiro, Katherine Sosebee, and Ralph Mayo for their insights and assistance in identifying the fishery strata, the bases for imputation, and the iterative process of refining the application. We also thank Fred Serchuk for his constructive comments and review.

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Table 1. The variables, their description, their associated species group, data source, and units of the input data set of the optimization algorithm.

Variable Name	***Definition***	***Species Group***	***Data Source***	***Units***
year	Year			categories
negear	gear type			categories
qtr	quarter of year			number
mesh	mesh size			categories
region	state grouping, port of departure			categories
trp	Trip Duration (days)			categories
alltrips	Total number of trips, all species	ALL	VTR	trip
allmnda	Ave number of days absent, all species	ALL	VTR	days
vcount	Total number of VTR trips for 3 sp. Groups	3 Sp Grp	VTR	trip
ocount	Total number of observed trips that caught one or more of the 3 sp groups	3 Sp Grp	VTR	trip
vnegfntrips	Number of VTR trips that caught NEGF	NEGF	VTR	trip
vgfda	Total VTR days absent for trips that caught Groundfish	NEGF	VTR	days
vgftotal	Total VTR pounds(all sp) landed for trips landing groundfish	NEGF	VTR	pounds
vgflb	VTR pounds landed—groundfish	NEGF	VTR	pounds
vgfmnda	VTR average days absent—groundfish	NEGF	VTR	days
onegf	Sum of the "0/1 flags" for observed trips that caught NEGF	NEGF	OBS	trip
ogfntrips	Number of observed trips that caught NEGF	NEGF	OBS	trip
ogfparent	Flag indicating if values of d/k are observed (=1) or imputed (=0)	NEGF	OBS	flag
ogfnewcv	Desired CV closest to 0.30--intermediate value	NEGF	OBS	number
ogfnewntrips	Number of Observed trips necessary to achieve CV=ogfxnewcv	NEGF	OBS	trip
ogfxnewcv	Desired CV=0.30 --exact value	NEGF	OBS	number
ogfavgtriplen	Ave Trip Length in days for observed trips	NEGF	OBS	days
ogfntows	Number of observed Tows	NEGF	OBS	tows
ogfksums	Kept—observed	NEGF	OBS	pounds
ogfdsums	Discarded—observed	NEGF	OBS	pounds
ogfdkratio	d/k ratio	NEGF	OBS	number
ogfse	SE of d/k ratio	NEGF	OBS	number
ogfcv	CV of mean d/k ratio	NEGF	OBS	number
ogfseadays	Number of sea days needed to achieve CV=0.3 (=avg triplen x newntrips)	NEGF	OBS	days
ogfndays	Number of observed days	NEGF	OBS	days
vfsbntrips	Number of VTR Trips that caught FSB	FSB	VTR	trip
vfsbda	Total VTR days absent for trips that caught FSB	FSB	VTR	days
vfsbtotal	Total VTR pounds (all sp) landed for trips landing FSB	FSB	VTR	pounds
vfsblb	VTR pounds landed—FSB	FSB	VTR	pounds
vfsbmnda	VTR average days absent—FSB	FSB	VTR	days
ofsb	Sum of the "0/1 flags" for observed trips that caught FSB	FSB	OBS	trip
ofsbntrips	Number of observed trips that caught FSB	FSB	OBS	trip
ofsbparent	Flag indicating if values of d/k are observed (=1) or imputed (=0)	FSB	OBS	flag
ofsbnewcv	Desired CV closest to 0.30--intermediate value	FSB	OBS	number
ofsbnewntrips	Number of Observed trips necessary to achieve CV=ofsbxnewcv	FSB	OBS	trip
ofsbxnewcv	Desired CV=0.30 --exact value	FSB	OBS	number

ofsbavgtriplen	Ave Trip Length in days for observed trips	FSB	OBS	days
ofsbntows	Number of observed Tows	FSB	OBS	Tows
ofsbksums	Kept—observed	FSB	OBS	pounds
ofsbdsums	Discarded—observed	FSB	OBS	pounds
ofsbdkratio	d/k ratio	FSB	OBS	number
ofsbse	SE of d/k ratio	FSB	OBS	number
ofsbcv	CV of mean d/k ratio	FSB	OBS	number
ofsbseadays	Number of sea days needed to achieve CV=0.3 (=avg triplen x newntrips)	FSB	OBS	days
ofsbndays	Number of observed days	FSB	OBS	days
vmonkntrips	Number of VTR Trips that caught Monk	Monk	VTR	trip
vmonkda	Total VTR days absent for trips that caught monk	Monk	VTR	days
vmonktotal	Total VTR pounds (all sp) landed for trips landing Monkfish	Monk	VTR	pounds
vmonklb	VTR pounds landed---Monk	Monk	VTR	pounds
vmonkmnda	VTR average days absent—Monk	Monk	VTR	days
omonk	Sum of the "0/1 flags" for observed trips that caught Monkfish	Monk	OBS	trip
omkntrips	Number of observed trips that caught Monk	Monk	OBS	trip
omkparent	Flag indicating if values of d/k are observed (=1) or imputed (=0)	Monk	OBS	flag
omknewcv	Desired CV closest to 0.30--intermediate value	Monk	OBS	number
omknewntrips	Number of Observed trips necessary to achieve CV=omkxnewcv	Monk	OBS	trip
omkxnewcv	Desired CV=0.30 --exact value	Monk	OBS	number
omkavgtriplen	Ave Trip Length in days for observed trips	Monk	OBS	days
omkntows	Number of observed Tows	Monk	OBS	Tows
omkksums	Kept—observed	Monk	OBS	pounds
omkdsums	Discarded—observed	Monk	OBS	pounds
omkdkratio	d/k ratio	Monk	OBS	number
omkse	SE of d/k ratio	Monk	OBS	number
omkcv	CV of mean d/k ratio	Monk	OBS	number
omkseadays	Number of sea days needed to achieve CV=0.3 (=avg triplen x newntrips)	Monk	OBS	days
omkndays	Number of observed days	Monk	OBS	days
onegfcpue	Observer Catch(kept) per unit effort (lbs/day) for NEGF	NEGF	OBS	lbs/day
ofsbcpue	Observer Catch (kept) per unit effort (lbs/day) for FSB	FSB	OBS	lbs/day
omkcpue	Observer Catch (kept) per unit effort (lbs/day) for Monk	Monk	OBS	lbs/day
alltotal	Total number of pounds of all species landed in this cell	ALL	VTR	pounds
vnegfcpue	VTR Landings per unit effort (lbs/day) for NEGF	NEGF	VTR	lbs/day
vfsbcpue	VTR Landings per unit effort (lbs/day) for FSB	FSB	VTR	lbs/day
vmkcpue	VTR Landings per unit effort (lbs/day) for Monk	Monk	VTR	lbs/day
L_negf%	Fraction of NEGF landings in stratum h	NEGF	VTR	unitless
L_fsb%	Fraction of FSB landings in stratum h	FSB	VTR	unitless
L_monk%	Fraction of Monk landings in stratum h	Monk	VTR	unitless
Nh_negh%	Fraction of NEGF trips in stratum h	NEGF	VTR	unitless
Nh_fsb%	Fraction of FSB trips in stratum h	FSB	VTR	unitless
Nh_monk%	Fraction of Monk trips in stratum h	Monk	VTR	unitless
I(L_negf%)	Indicator {0,1} for Fraction of NEGF landings in stratum h	NEGF	VTR	switch
I(L_fsb%)	Indicator {0,1} for Fraction of FSB landings in stratum h	FSB	VTR	switch
I(L_monk%)	Indicator {0,1} for Fraction of Monk landings in stratum h	Monk	VTR	switch
sum(I(L_all%))	Indicator {0,1} for composite landings. =0 if all species specific indicators=0,else 1	3 Sp Grp	VTR	switch
I(Nh_negf%)	Indicator {0,1} for Fraction of NEGF trips in stratum h	NEGF	VTR	switch
I(Nh_fsb%)	Indicator {0,1} for Fraction of FSB trips in stratum h	FSB	VTR	switch

I(Nh_monk%)	Indicator {0,1} for Fraction of Monk trips in stratum h	Monk	VTR	switch
sum(I(Nh_all%)	Indicator {0,1} for composite TRIPS. =0 if all species specific indicators=0,else 1	3 Sp Grp	VTR	switch
I(onegfcpue)	Indicator {0,1} for observer CPUE in stratum h for NEGF. 1=> exceeds threshold, else 0	NEGF	OBS	switch
I(ofsbcpue)	Indicator {0,1} for observer CPUE in stratum h for FSB. 1=> exceeds threshold, else 0	FSB	OBS	switch
I(omkcpue)	Indicator {0,1} for observer CPUE in stratum h for Monk. 1=> exceeds threshold, else 0	Monk	OBS	switch
I(vnegfcpue)	Indicator {0,1} for VTR CPUE in stratum h for NEGF. 1=> exceeds threshold, else 0	NEGF	VTR	switch
I(vfsbcpue)	Indicator {0,1} for VTR CPUE in stratum h for FSB. 1=> exceeds threshold, else 0	FSB	VTR	switch
I(vmkcpue)	Indicator {0,1} for VTR CPUE in stratum h for Monk. 1=> exceeds threshold, else 0	Monk	VTR	switch
I(d/k_negf)	Indicator {0,1} for Obsvr d/k ratio in stratum h for NEGF. 1=> exceeds threshold,else 0	NEGF	OBS	switch
I(d/k_fsb)	Indicator {0,1} for Obsvr d/k in stratum h for FSB. 1=> exceeds threshold, else 0	FSB	OBS	switch
I(d/k_monk)	Indicator {0,1} for Obsvr d/k in stratum h for Monk. 1=> exceeds threshold, else 0	Monk	OBS	switch
Total VTR 3spgroup	Sum of landings by strata for each species group	3 Sp Grp	VTR	switch
%Total VTR 3 group	Percent of landings of sum of 3 sp groups in strata	3 Sp Grp	VTR	switch
I(%TotVTR_3sp)	flag for total landings of 3 species groups	3 Sp Grp	VTR	switch
ogfimp_level	Indicator {0,1,2,3} of imputation level	NEGF	OBS	category
ofsbimp_level	Indicator {0,1,2,3} of imputation level	FSB	OBS	category
omonkimp_level	Indicator {0,1,2,3} of imputation level	Monk	OBS	category

Table 2. Number of trips, by strata, in the Fishing Vessel Trip Reports (VTR) and Northeast Fisheries Observer Program (NEFOP) data sets used in the 2005 sea day optimization.

				QUARTER							
				1		2		3		4	
Region	**Gear**	**Mesh**	**Trip length**	VTR	NEFOP	VTR	NEFOP	VTR	NEFOP	VTR	NEFOP
DE/MD	Otter Trawl	Large	day			95	0	188	0	52	0
			multi-day	17	0	31	0	8	1	21	0
		Medium	day							1	0
			multi-day	8	2	5	0			5	0
		Small	day	3	0	14	0	3	0	24	0
			multi-day			1	0				
	Gillnet	Medium		1	0	1	0				
		Small		4	0	1	0	1	0		
		XLarge		12	0	19	0	2	0	8	0
ME_NH	Longline	None		20	0	68	0	6	0	5	0
	Otter Trawl	Large	day	187	0	102	2	512	6	568	1
			multi-day	315	9	279	5	479	9	439	15
		Medium	day							1	0
			multi-day			1	0				
		Small	day					1	1	1	0
			multi-day							1	0
		XLarge	day			3	0	1	0	10	0
			multi-day	1	0						
	Gillnet	Large		75	0	242	0	823	10	375	3
		Medium								1	0
		None				1	0	10	0	1	0
		Small						3	0		
		XLarge		19	0	77	0	573	14	247	0
N_MA	Longline	None		407	6	28	1	186	0	243	0
	Otter Trawl	Large	day	789	20	739	21	2015	54	1232	34
			multi-day	501	7	382	13	551	10	613	9
		Medium	day			11	1	1	0		
			multi-day			2	4	3	0	2	1
		Small	day	13	0	119	2	3	1	15	2
			multi-day	12	2	57	2	3	3	15	2
		XLarge	day			1	0				
			multi-day					2	0	1	0
	Gillnet	Large		1061	81	367	83	1481	94	1024	64
		Medium		1	0					2	0
		None		2	0	1	0	22	0	1	0
		Small		4	0	1	0	3	0	8	0
		XLarge		191	11	174	37	694	33	540	35
NC/VA	Otter Trawl	Large	day	2	0	5	0			3	0
			multi-day	542	17	117	0			226	3
		Medium	day	4	0	3	0				
			multi-day	35	7	20	0			15	2
		Small	multi-day	12	4	4	0	2	0	13	0
		XLarge	multi-day	4	0	4	0				
	Gillnet	Large		9	0	46	0	11	0	43	0
		Medium		19	0	5	0			10	0
		Small		2	0	8	0	4	1	15	0
		XLarge		38	0	161	0			35	0
NJ/NY	Longline	None		45	0	5	0				
	Otter Trawl	Large	day	426	4	1878	6	936	0	847	0
			multi-day	342	4	421	3	580	0	199	1
		Medium	day	13	1	267	21	464	5	458	4
			multi-day	170	22	42	5	4	1	64	3
		Small	day	29	0	629	5	894	0	465	0
			multi-day	209	8	99	3	105	1	150	5
		XLarge	day			4	0	31	0	20	0
			multi-day	7	0	2	0	1	0	2	0
	Gillnet	Large				72	0	70	0	29	0
		Medium				49	0	81	0	31	0
		None				2	0			4	0
		Small		2	0	8	0	49	0	51	0
		XLarge		418	0	699	1	166	0	995	0
SNE	Otter Trawl	Large	day	273	2	996	20	1399	2	731	2
			multi-day	571	37	515	8	621	21	525	25
		Medium	day			72	3	41	1	158	2
			multi-day	25	1	19	1	4	2	23	0
		Small	day	11	0	104	6	304	2	333	10
			multi-day	503	12	269	8	188	5	373	7
		XLarge	day			2	0			7	0
			multi-day	3	0	1	0	4	0	11	0
	Gillnet	Large		21	1	124	9	170	3	66	2
		Medium						1	0		
		None		1	0	1	0			1	0
		Small				4	0				
		XLarge		314	13	684	38	202	10	582	28

Table 3. Summary of fleet sectors (strata), by species group, that are imputed (1) and not imputed (0); blank cells indicate no fleet activity.

				QUARTER											
				1			2			3			4		
Region	**Gear**	**Mesh**	**Trip length**	NEGF	FSB	MONK	NEGF	FSB	MONK	NEGF	FSB	MONK	NEGF	FSB	MONK
DE/MD	Otter Trawl	Large	day				0	1	1	0	1	1	0	1	1
			multi-day	0	1	1	0	1	1	0	1	1	0	1	1
		Medium	day										0	1	0
			multi-day	0	0	1	0	1	1				0	1	0
		Small	day	0	1	1	0	1	1	0	1	0	0	1	1
			multi-day				0	1	0						
	Gillnet	Medium		0	1	0	0	1	0						
		Small		0	1	0	0	1	0	0	0	1			
		XLarge		0	0	1	0	1	1	0	0	1	0	0	1
ME_NH	Longline	None		1	0	0	1	0	0	1	0	0	1	0	0
	Otter Trawl	Large	day	1	0	1	0	1	0	0	1	0	1	1	1
			multi-day	0	0	0	0	0	0	0	1	0	0	1	0
		Medium	day										0	1	0
			multi-day				1	0	1						
		Small	day							1	0	0	1	0	1
			multi-day										1	0	1
		XLarge	day				1	0	1	1	0	1	0	0	1
			multi-day	0	0	1									
	Gillnet	Large		1	0	1	1	1	1	0	1	0	0	1	1
		Medium											1	0	1
		None					1	0	1	1	0	1	1	0	1
		Small								1	0	1			
		XLarge		1	0	1	1	1	1	0	0	0	1	1	1
N_MA	Longline	None		0	0	0	1	0	0	1	0	0	1	0	0
	Otter Trawl	Large	day	0	1	0	0	0	0	0	1	0	0	1	0
			multi-day	0	1	0	0	0	0	0	0	0	0	1	0
		Medium	day				1	1	1	1	0	1			
			multi-day				0	0	0	1	0	1	1	0	1
		Small	day	1	0	1	0	0	0	0	1	0	0	0	0
			multi-day	0	1	0	0	1	0	0	0	0	0	0	0
		XLarge	day				0	1	0						
			multi-day							1	0	1	1	0	1
	Gillnet	Large		0	1	0	0	0	0	0	0	0	0	1	0
		Medium		1	0	0							1	0	1
		None		1	0	1	0	0	1	1	0	1	1	0	0
		Small		1	0	0	1	0	1	1	0	1	1	0	1
		XLarge		0	0	0	0	0	0	0	0	0	0	0	0
NC/VA	Otter Trawl	Large	day	0	1	0	0	1	1				1	1	1
			multi-day	0	0	0	0	1	1				1	0	0
		Medium	day	0	1	0	0	1	0						
			multi-day	0	0	0	0	1	1				0	0	1
		Small	multi-day	0	0	0	0	1	1	0	1	0	0	1	0
		XLarge	multi-day	0	1	1	0	1	1						
	Gillnet	Large		0	1	1	0	1	1	0	1	0	0	1	1
		Medium		0	1	1	0	1	1				0	1	1
		Small		0	0	1	0	1	1	0	0	0	0	1	1
		XLarge		0	1	1	0	1	1				0	1	1
NJ/NY	Longline	None		1	0	0	1	0	0						
	Otter Trawl	Large	day	0	0	0	0	0	0	1	1	1	1	1	1
			multi-day	0	0	0	1	0	0	1	1	1	0	1	1
		Medium	day	1	1	0	0	0	0	0	0	0	0	0	0
			multi-day	0	0	0	0	0	0	1	0	0	0	0	0
		Small	day	1	1	1	0	0	0	1	1	1	1	1	1
			multi-day	0	0	0	0	0	0	1	0	0	1	0	0
		XLarge	day				1	1	1	0	1	1	0	1	1
			multi-day	0	1	1	0	0	1	0	1	0	0	1	0
	Gillnet	Large					1	1	1	0	1	1	0	1	1
		Medium					1	1	1	1	1	1	1	1	0
		None					0	1	1				0	1	1
		Small		0	0	1	1	1	0	1	1	0	1	1	1
		XLarge		0	1	1	1	1	1	1	1	1	1	1	1
SNE	Otter Trawl	Large	day	0	0	0	0	0	0	1	0	1	0	0	0
			multi-day	0	0	0	0	0	0	0	0	0	0	0	0
		Medium	day				0	0	1	0	1	1	0	0	0
			multi-day	0	1	1	1	1	1	0	1	0	1	1	1
		Small	day	1	1	1	0	0	0	0	0	1	0	0	0
			multi-day	0	0	0	0	0	0	0	1	0	0	0	0
		XLarge	day				0	1	1				0	1	1
			multi-day	1	1	1	0	1	1	1	0	1	0	1	1
	Gillnet	Large		1	0	1	0	0	0	1	0	1	1	0	1
		Medium								0	1	0			
		None		1	0	1	0	0	1				0	1	0
		Small					0	1	1						
		XLarge		0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Summary of contingency table analyses of spatial distribution of VTR and observed trips. Expected value of observed trips is based on proportions of VTR trips by Statistical Area. Critical value of Chi-Square statistics is based on alpha level of 0.05. Degrees of freedom are based on number of Statistical Areas reported in VTR database.

Quarter	Gear	Mesh	Region	Trip Duration	Chi Sqr Test Statistic	df	Chi Sqr Crit Value	Signif Level
3	Gill Net	Large	ME_NH	all	41.92	6	12.59	0.000
3	Gill Net	XLarge	ME_NH	all	32.19	4	9.49	0.000
3	Gill Net	Large	N_MA	all	36.92	11	19.68	0.000
3	Gill Net	XLarge	NJ/NY	all	20.30	5	11.07	0.001
4	Gill Net	XLarge	N_MA	all	16.89	4	9.49	0.002
4	Gill Net	Large	ME_NH	all	14.76	4	9.49	0.005
4	Gill Net	XLarge	NJ/NY	all	10.46	2	5.99	0.005
2	Gill Net	XLarge	ME_NH	all	12.06	7	14.07	0.098
2	Gill Net	Large	NC/VA	all	3.06	2	5.99	0.216
1	Gill Net	XLarge	NC/VA	all	2.15	2	5.99	0.341
1	Gill Net	Large	SNE	all	0.40	1	3.84	0.527
4	Gill Net	Large	N_MA	all	2.69	4	9.49	0.611
2	Gill Net	Large	N_MA	all	6.10	8	15.51	0.636
2	Gill Net	XLarge	N_MA	all	1.48	3	7.81	0.687
1	Gill Net	XLarge	N_MA	all	1.23	3	7.81	0.746
3	Gill Net	XLarge	N_MA	all	2.29	5	11.07	0.808
1	Gill Net	Large	N_MA	all	1.29	4	9.49	0.862
2	Longline	None	ME_NH	all	1.15	3	7.81	0.764
1	Longline	None	N_MA	all	1.63	7	14.07	0.977
2	Trawl	Large	N_MA	1day	243.29	6	12.59	0.000
2	Trawl	Medium	SNE	2+day	120.00	3	7.81	0.000
3	Trawl	Large	NJ/NY	1day	80.97	13	22.36	0.000
2	Trawl	Large	NJ/NY	1day	61.00	5	11.07	0.000
4	Trawl	Large	ME_NH	2+day	49.91	9	16.92	0.000
1	Trawl	Small	NJ/NY	1day	32.36	3	7.81	0.000
4	Trawl	Medium	NJ/NY	2+day	28.00	2	5.99	0.000
3	Trawl	Large	N_MA	1day	37.19	9	16.92	0.000
4	Trawl	Small	NJ/NY	1day	15.00	2	5.99	0.001
4	Trawl	Small	N_MA	2+day	14.00	2	5.99	0.001
1	Trawl	Large	NC/VA	2+day	29.65	13	22.36	0.005
2	Trawl	Small	DE/MD	1day	8.67	3	7.81	0.034
1	Trawl	Medium	SNE	2+day	4.00	1	3.84	0.046
2	Trawl	Large	NC/VA	2+day	14.28	8	15.51	0.075
2	Trawl	Large	N_MA	2+day	22.66	15	25.00	0.092
2	Trawl	Small	NJ/NY	1day	13.22	8	15.51	0.105
2	Trawl	Large	DE/MD	2+day	13.03	8	15.51	0.111
4	Trawl	Large	SNE	2+day	2.00	1	3.84	0.157
3	Trawl	Large	ME_NH	1day	14.30	10	18.31	0.160
4	Trawl	Large	NC/VA	2+day	19.92	15	25.00	0.175
2	Trawl	Small	NJ/NY	2+day	7.58	5	11.07	0.181
3	Trawl	Small	NJ/NY	1day	1.00	1	3.84	0.317
1	Trawl	Large	SNE	2+day	3.81	4	9.49	0.432
4	Trawl	Small	N_MA	1day	0.60	1	3.84	0.439
2	Trawl	Medium	N_MA	1day	0.50	1	3.84	0.480
4	Trawl	Large	NC/VA	1day	7.45	8	15.51	0.489
2	Trawl	Large	DE/MD	1day	0.41	1	3.84	0.520
4	Trawl	Small	NJ/NY	2+day	8.01	9	16.92	0.533
4	Trawl	Medium	NC/VA	2+day	0.33	1	3.84	0.564
2	Trawl	Small	SNE	1day	1.00	2	5.99	0.607
4	Trawl	Large	N_MA	1day	5.25	7	14.07	0.630
1	Trawl	Small	N_MA	2+day	1.67	3	7.81	0.644
1	Trawl	Large	NJ/NY	1day	3.08	5	11.07	0.687
4	Trawl	Large	NJ/NY	2+day	0.71	2	5.99	0.700
1	Trawl	Large	N_MA	1day	6.29	10	18.31	0.790
3	Trawl	Large	ME_NH	2+day	3.02	6	12.59	0.807
4	Trawl	Large	N_MA	2+day	5.87	10	18.31	0.826
1	Trawl	Large	N_MA	2+day	1.08	4	9.49	0.897
1	Trawl	Large	ME_NH	1day	3.40	8	15.51	0.907
3	Trawl	Large	N_MA	2+day	2.06	6	12.59	0.914
1	Trawl	Large	NJ/NY	2+day	2.00	6	12.59	0.920
4	Trawl	Large	ME_NH	1day	0.39	3	7.81	0.943
2	Trawl	Large	ME_NH	2+day	4.43	11	19.68	0.956
1	Trawl	Large	ME_NH	2+day	0.85	6	12.59	0.991
3	Trawl	Large	DE/MD	1day	0.81	6	12.59	0.992
2	Trawl	Large	ME_NH	1day	1.67	9	16.92	0.996

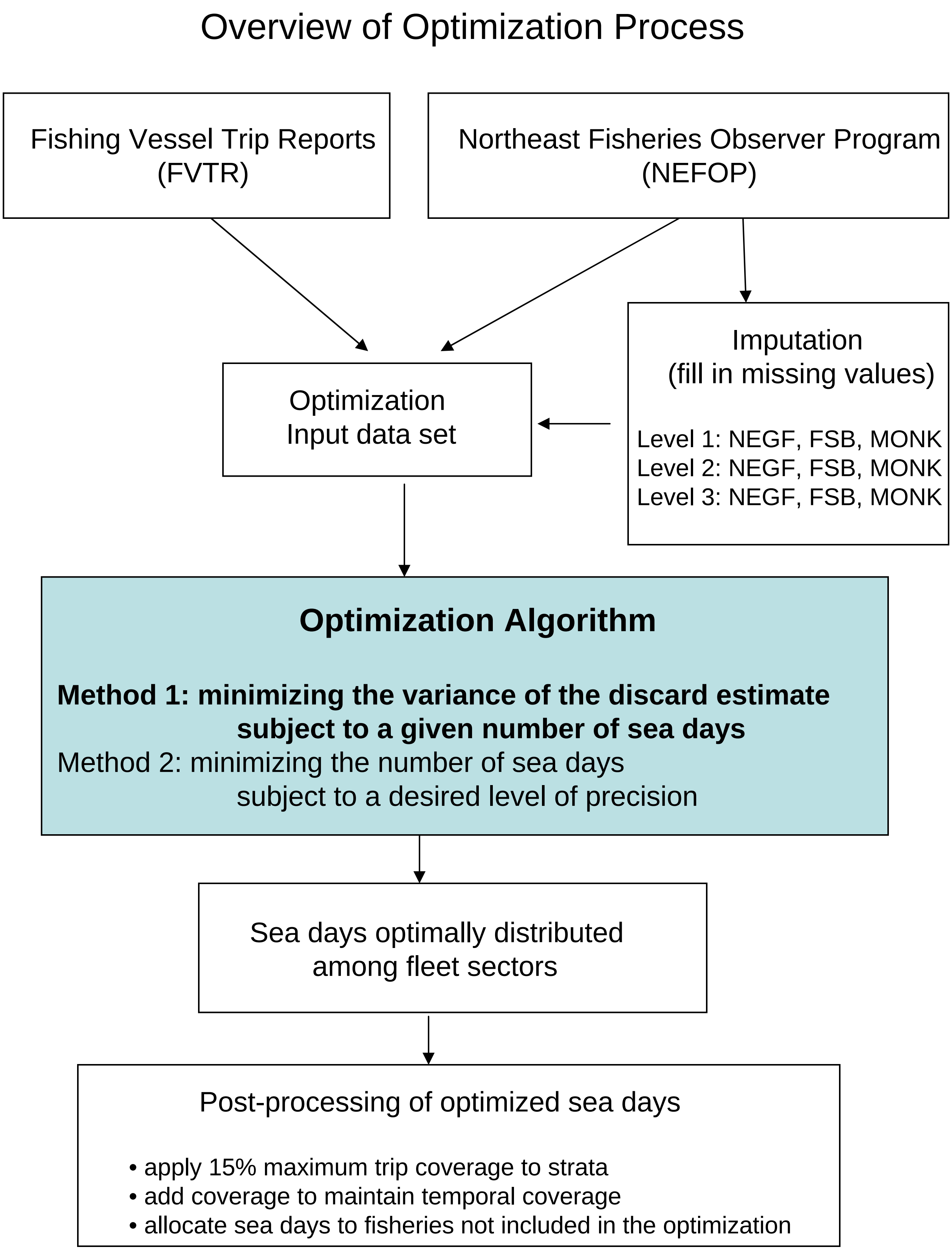
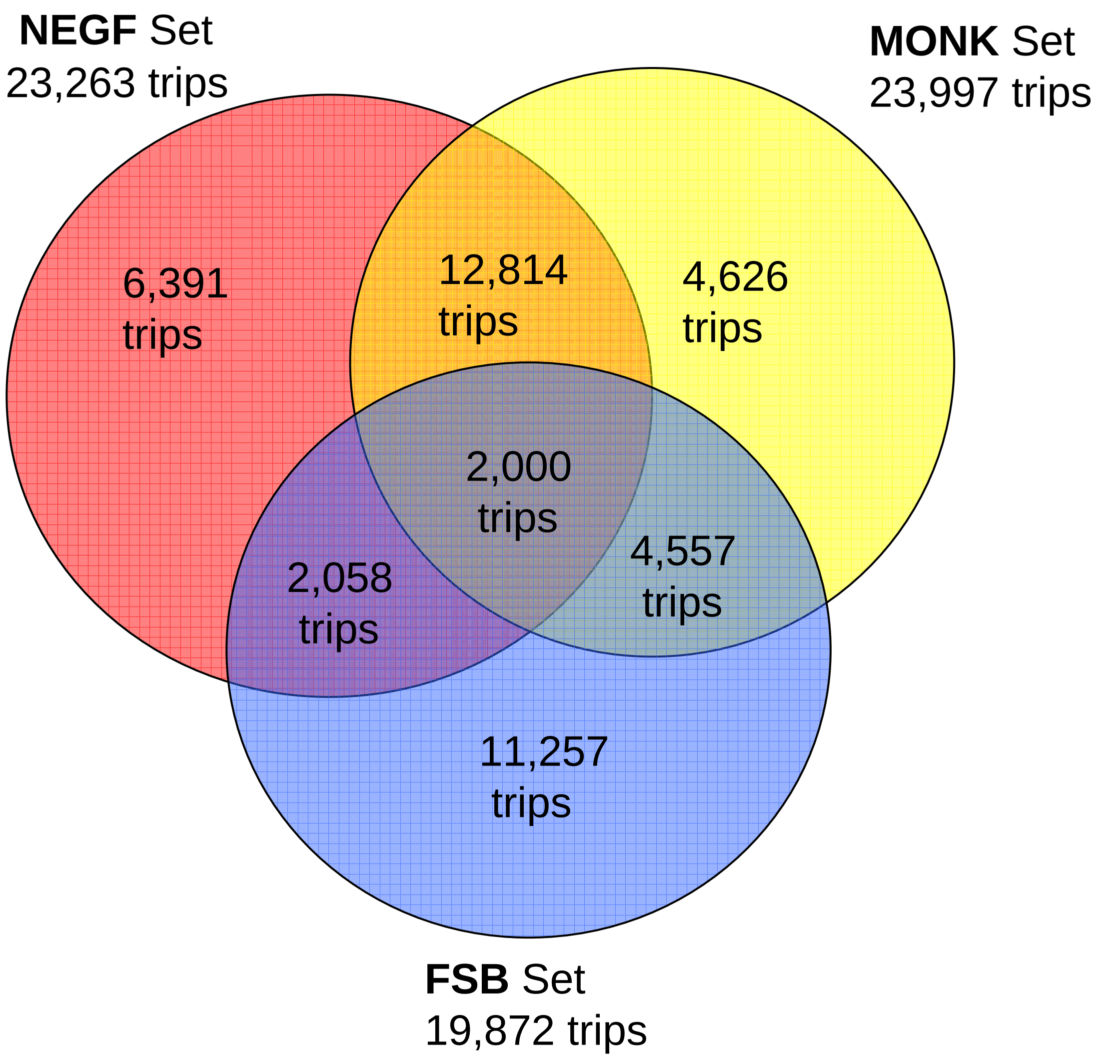


Figure 1. An overview of the optimization process used to allocate sea days to fisheries in the Northeast region.

Number of trips in 2003/2004 VTR data subsets for otter trawl, gillnet and longline trips
(43,703 trips)



Total Unique Trips: 43,703
Total Trips with Overlap: 21,429
Sum of Trip Sets: 67,132

Figure 2. Number of trips in the 2003/2004 Vessel Trip Report (VTR), by data subsets (New England groundfish -NEGF; Monkfish - MONK; and summer flounder, scup and black sea bass - FSB) for otter trawl, gillnet and longline trips.

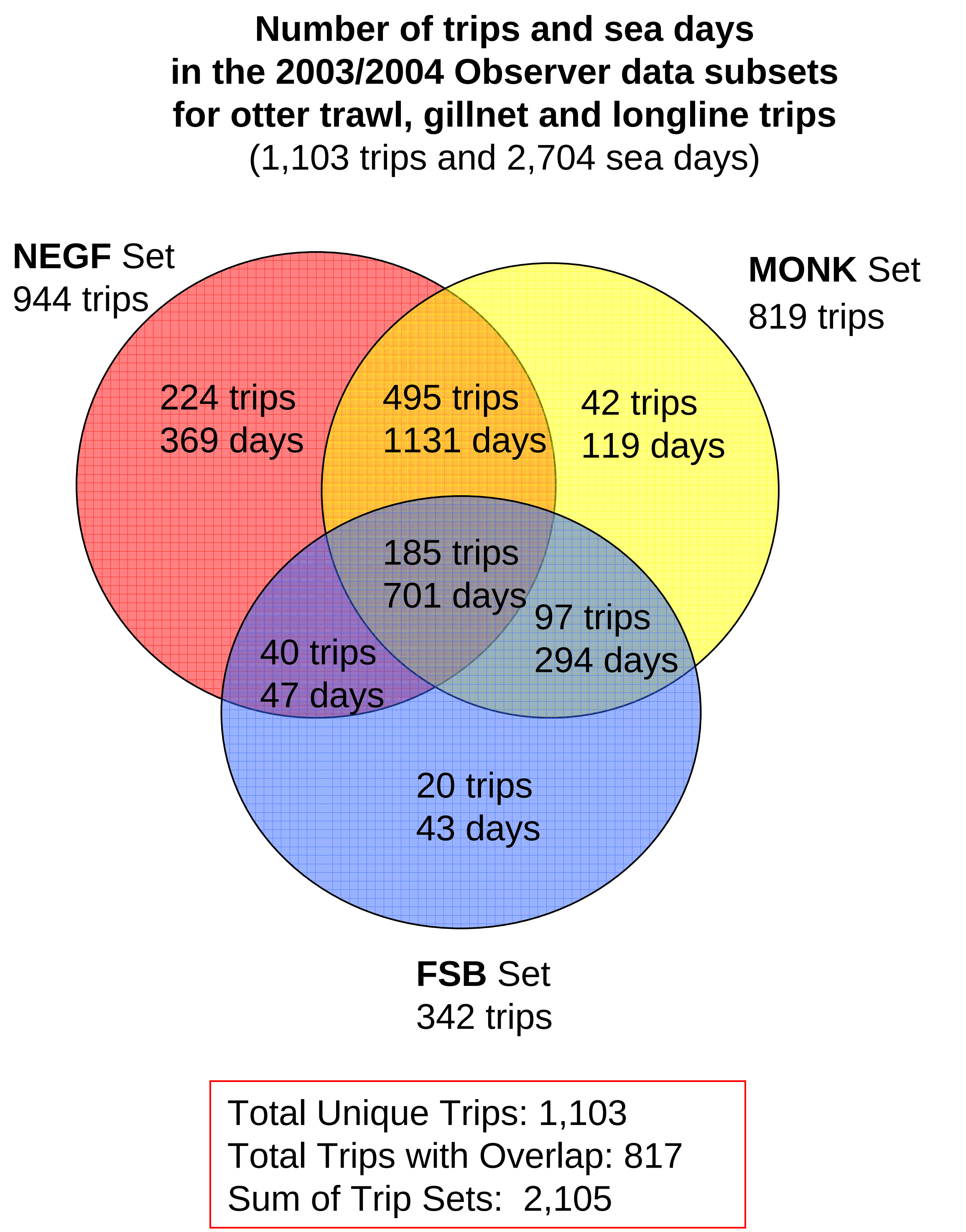
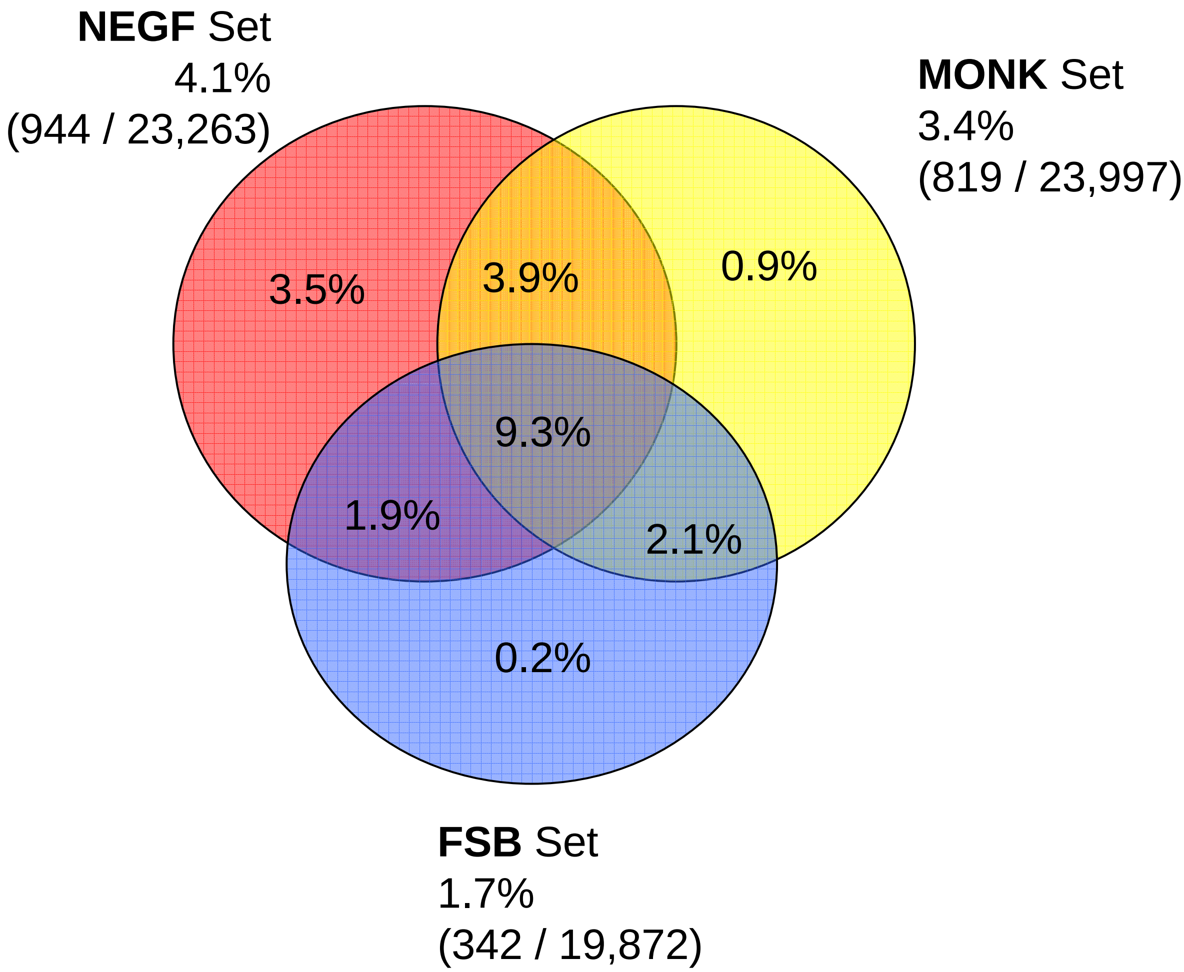


Figure 3. Number of trips and sea days in the 2003/2004 Northeast Fisheries Observer Program, by data subsets (New England groundfish - NEFG; Monkfish - MONK; and summer flounder, scup and black sea bass - FSB) for otter trawl, gillnet and longline trips.

Sampling Fraction: 2003/2004 Observer trips/VTR trips for otter trawl, gillnet and longline trips
(43,703 unique trips)



Total Unique Trips: 2.5% (1,103 / 43,703)
Total Trips with Overlap: 3.8% (817/ 21,429)
Sum of Trip Sets: 3.1% (2,105 / 67,132)

Figure 4. The sampling fraction of 2003/2004 Observed trips to Vessel Trip Report trips, by data subset (New England groundfish - NEGF; Monkfish - MONK; and summer flounder, scup and black sea bass - FSB) for otter trawl, gillnet and longline trips.

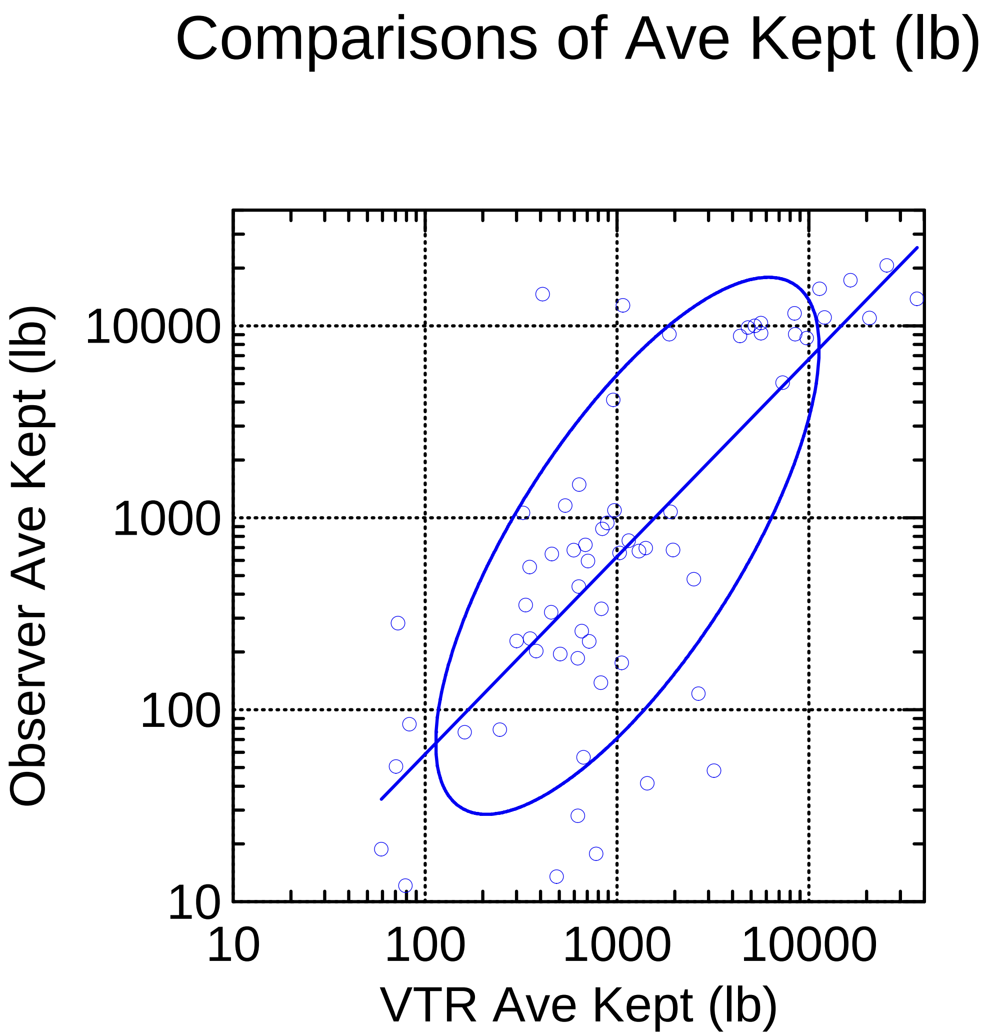
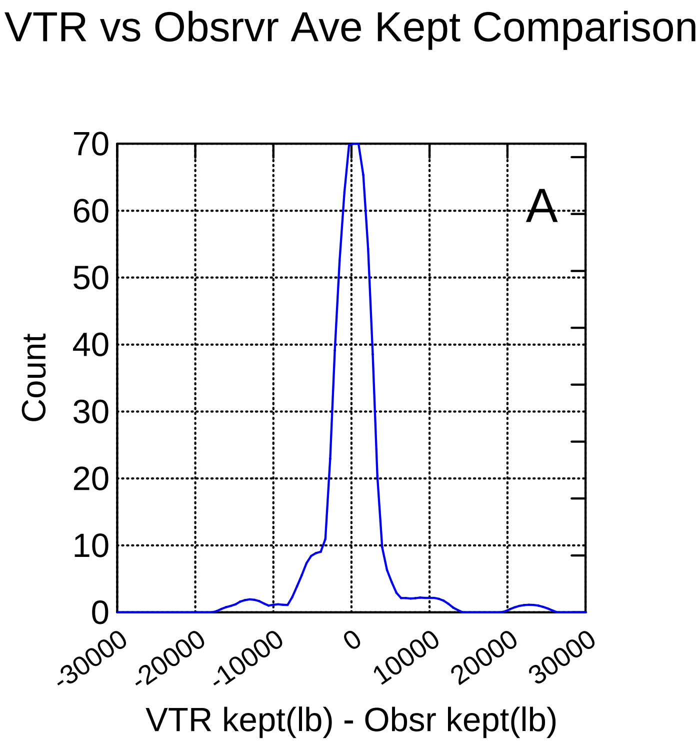


Figure 5. Comparison of average kept pounds of groundfish (natural log scale) in the Northeast Fisheries Observer Program and Vessel Trip Report data sets for 2003/2004. Each point represents the mean of an individual stratum.



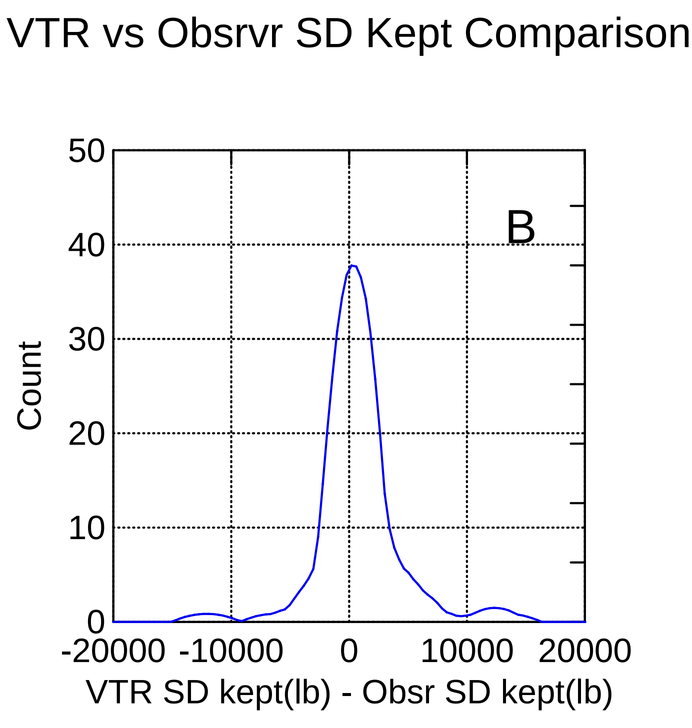


Figure 6. The distribution of differences between the average kept pounds (A) and the standard deviation (SD) of average kept pounds (B) of groundfish in the Northeast Fisheries Observer Program (Obsrvr) and the Vessel Trip Report (VTR) data for 2003/2004. Histograms are non-parametric smooths of the stratum specific differences.

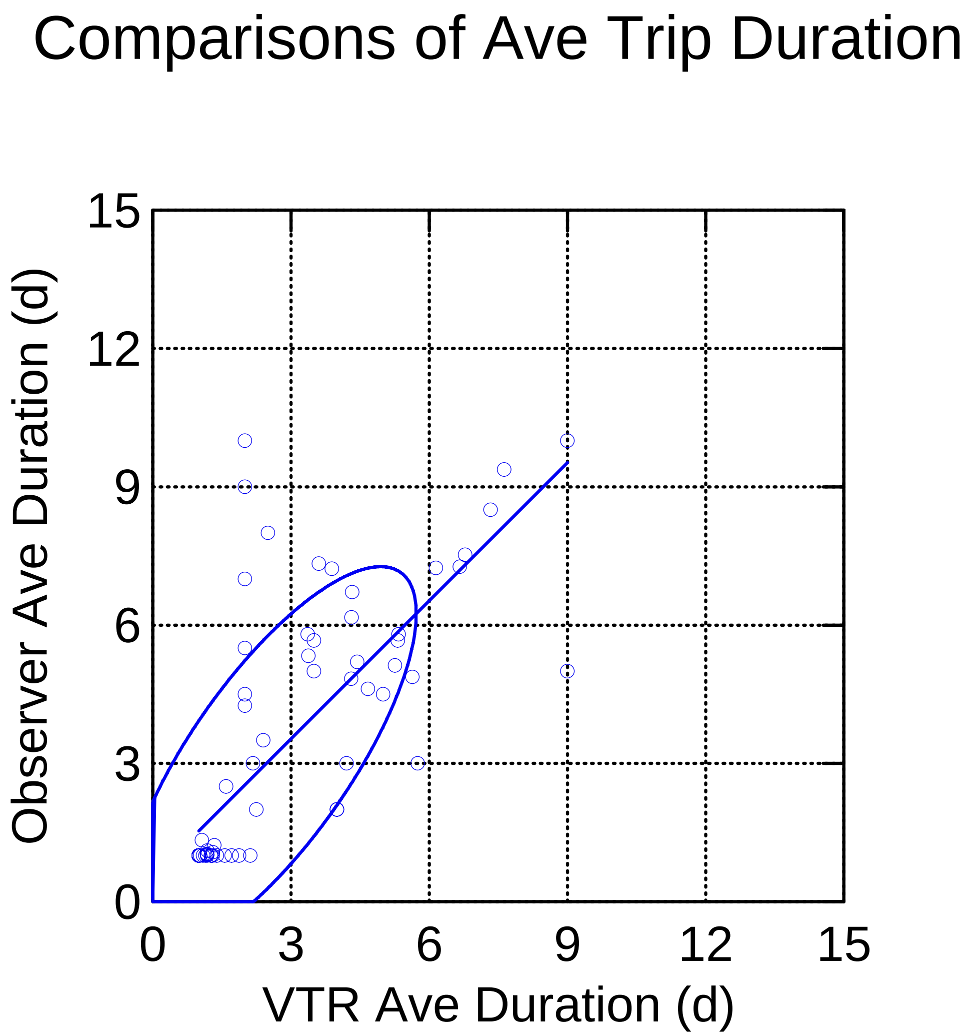
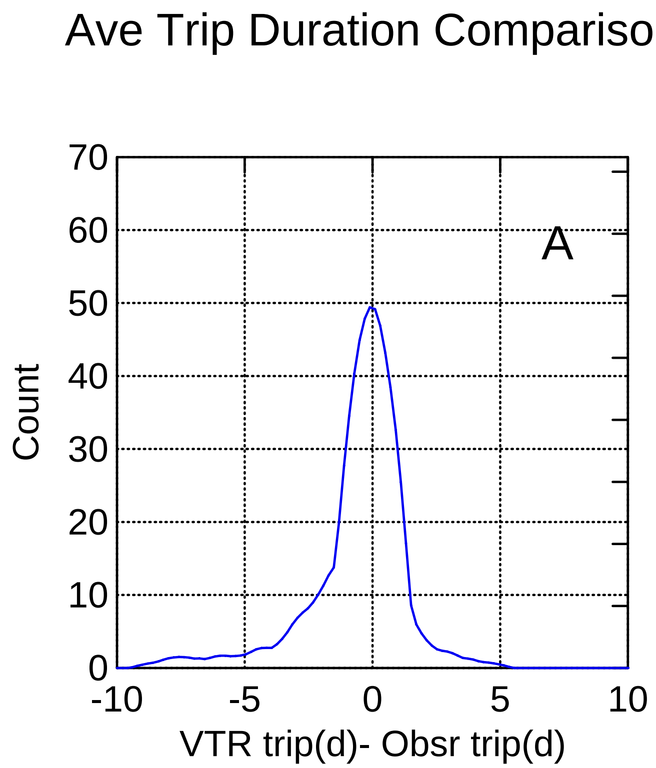


Figure 7. Comparison of average trip duration (in days) for trips that caught groundfish in the Northeast Fisheries Observer Program and Vessel Trip Report (VTR) data sets for 2003/2004. Each point represents the mean of an individual stratum.



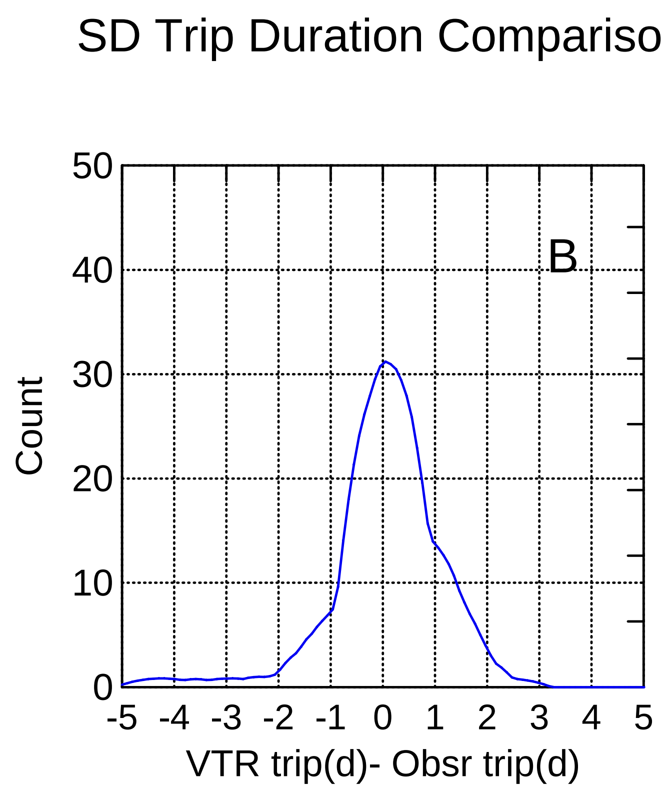


Figure 8. The distribution of differences in average trip duration (in days) (A) and the standard deviation of average trip duration (B) of trips that caught groundfish in the Northeast Fisheries Observer Program (Obsrvr) and the Vessel Trip Report (VTR) data for 2003/2004. Histograms are non-parametric smooths of the stratum specific differences.

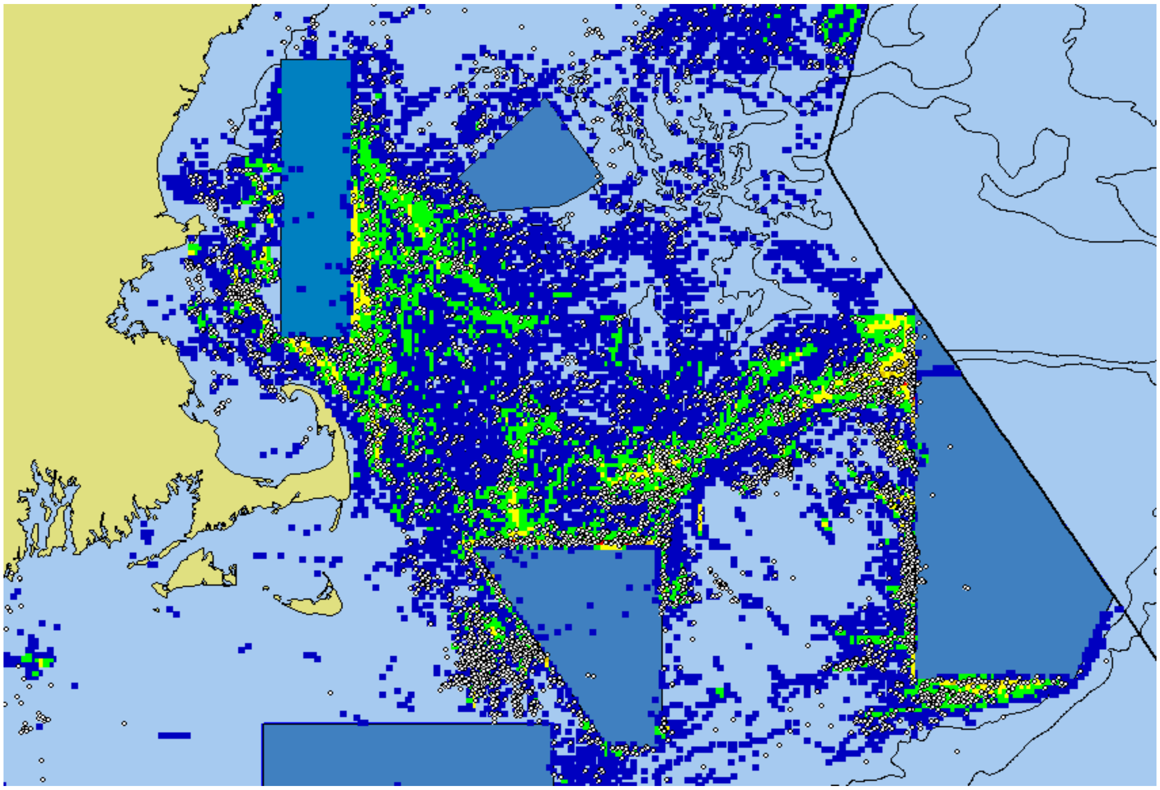


Figure 9. Locations of otter trawl fishing effort (color squares) in 2003 from vessels using VMS (vessel monitoring systems). Locations are plotted only for vessels speeds <= 3.5 knots and data are aggregated to 1’ square. Blue squares represent 1-8 hours, green 9 – 25 hours; yellow 26-63 hours; orange 64 – 145 hours, and red 146 – 309 hours. Observed otter trawl tows (white circles) in 2003. Locations are the starting positions of each tow. Taken from Murawski et al. (article in press).

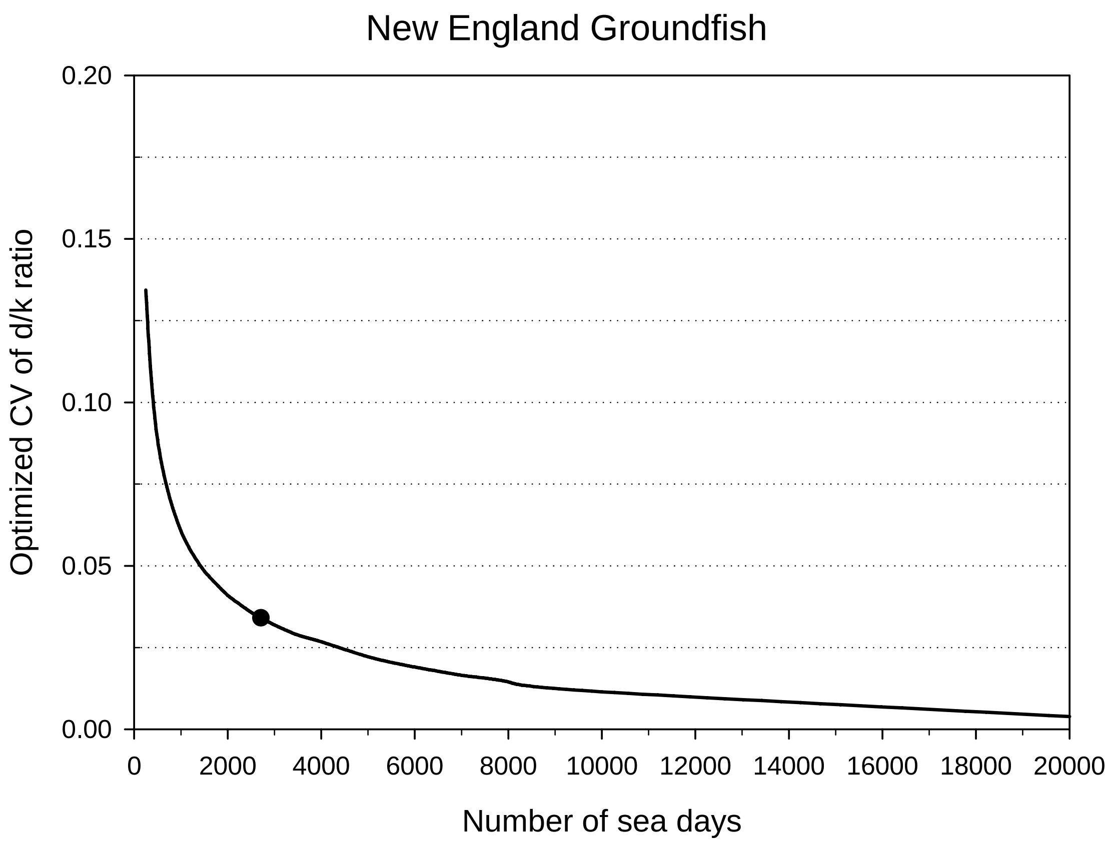


Figure 10. The optimized coefficient of variation (CV) of the discard to kept ratio (d/k) for New England groundfish over a range of sea days; 2,708 sea days (solid circle) are allocated to cover New England groundfish fisheries in 2005.

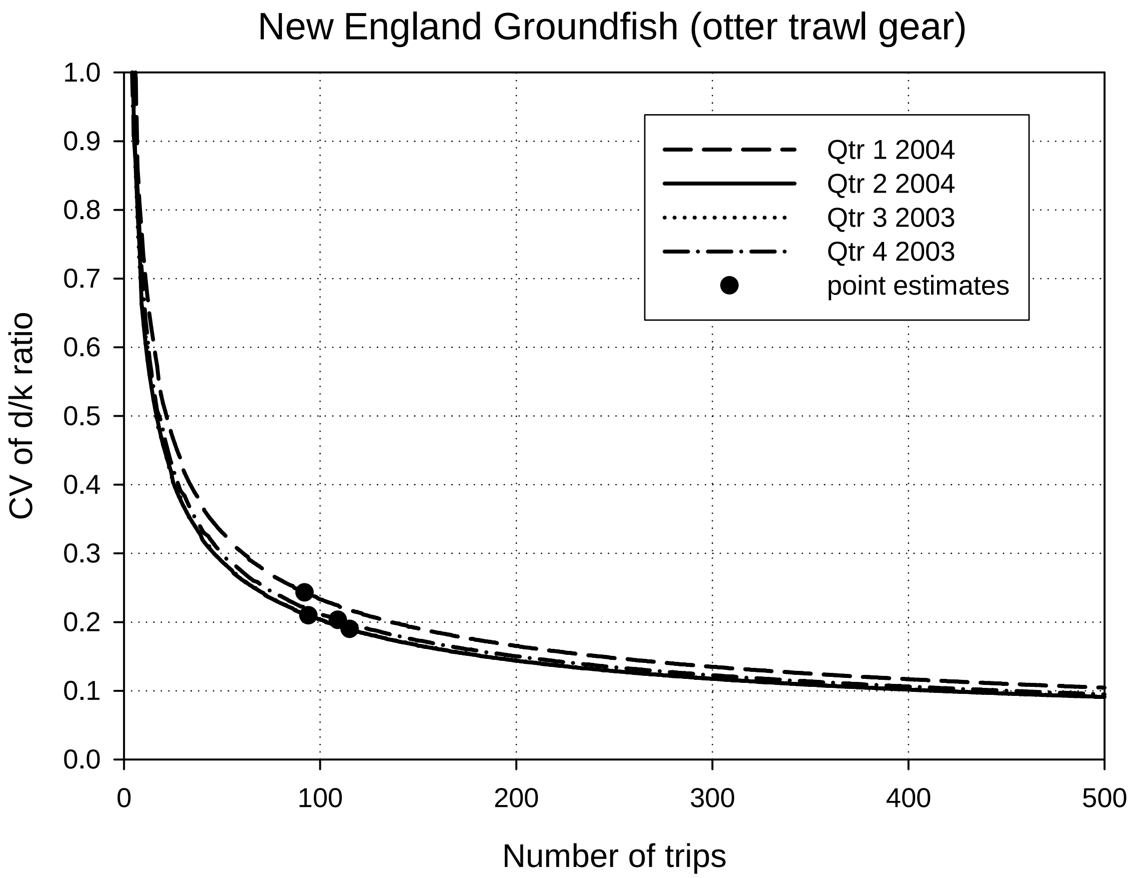


Figure 11. The 2003/2004 point estimates of the coefficient of variation (CV) of the discard to kept (d/k) ratio for New England groundfish caught with otter trawl gear, and the expected coefficient of variation of the discard to kept ratio over a range of sample sizes (number of trips).

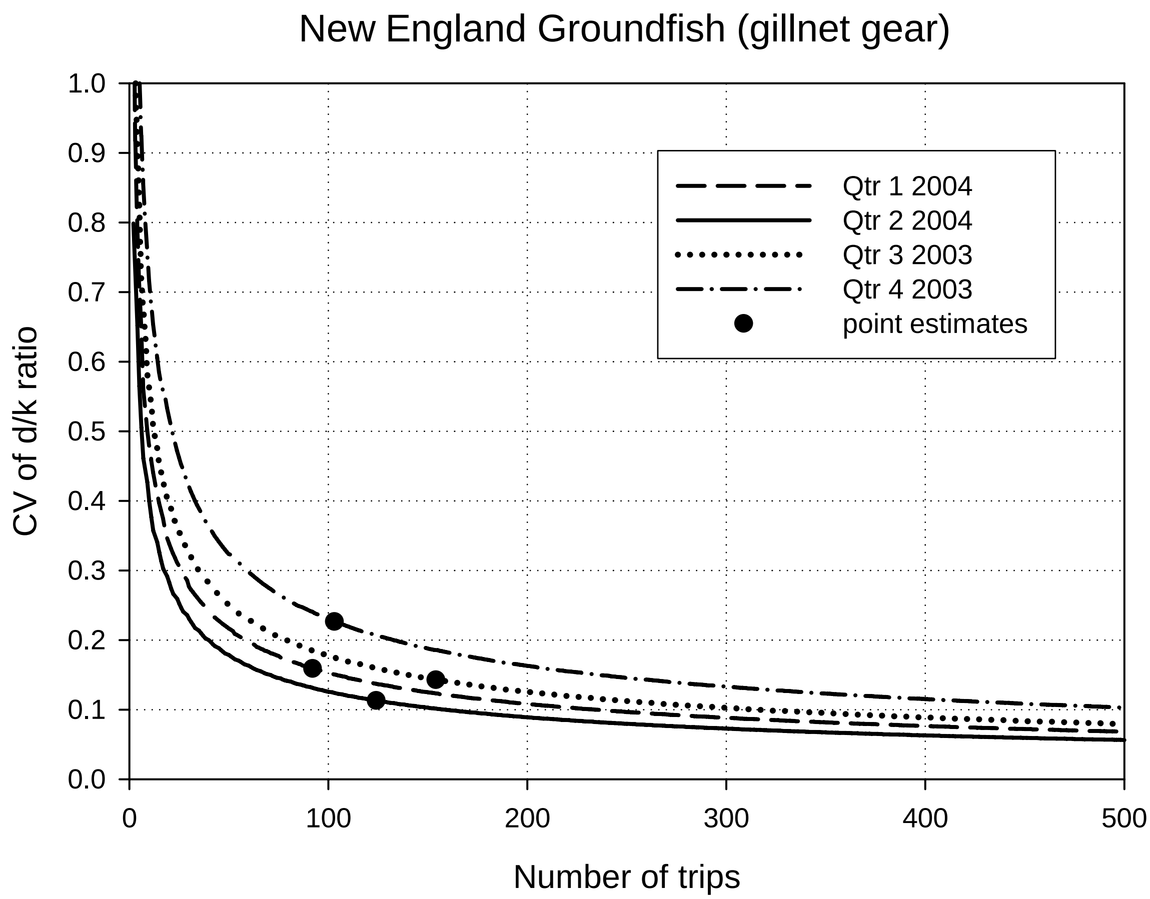


Figure 12. The 2003/2004 point estimates of the coefficient of variation (CV) of the discard to kept (d/k) ratio for New England groundfish caught with gillnet gear, and the expected coefficient of variation of the discard to kept ratio over a range of sample sizes (number of trips).

Procedures for Issuing Manuscripts in the *Northeast Fisheries Science Center Reference Document* (CRD) Series

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The CRD series uses the American Fisheries Society's guides to names of fishes, mollusks, and decapod crustaceans, the Society for Marine Mammalogy's guide to names of marine mammals, the Biosciences Information Service's guide to serial title abbreviations, and the International Standardization Organization's guide to statistical terms.

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Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review, but no technical or copy editing.

Resource Survey Report (formerly *Fishermen's Report*) -- This information report is a quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. There is no scientific review, nor any technical or copy editing, of this report.

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SOUTHEAST FISHERIES SCIENCE CENTER

Shrimp Trawl Observer Program
Southeast Shark Gillnet Fishery
Atlantic and Gulf of Mexico Shark Bottom Longline Fishery
Pelagic Observer Program

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Elizabeth Scott-Denton, Research Fishery Biologist

2. What is the name of your Observer Program?

Shrimp Trawl Observer Program

3. In which NOAA Region is it implemented?

Southeast

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below)

The two primary objectives of this research effort are (1) to estimate catch rates during commercial shrimping operations for both target and non-target species by area, season and depth, and (2) to evaluate bycatch reduction devices (BRDs) designed to eliminate or significantly reduce non-targeted catch, particularly red snapper, Lutjanus campechanus.

5. Provide a general description of the fleet to which the program is applied

Approximately 2,800 federally- permitted vessels.

5.1. Gear type(s)

Bottom otter trawl.

5.2. Number of active vessels by gear and size category

Approximately 2,800 vessels; approximate length75 foot

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Year round; peak May through December. Approximate length 25 days

5.4. Number of ports and distribution of vessels and trips among ports

Gulf and South Atlantic (see NOAA port agent listing for ports).

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Penaeid shrimp; major bycatch species are Atlantic croaker and longspine porgy.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

   MSA and ESA

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

   8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

   Port sampling

   8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

   1963 to present; consistent 1963-2002.

   8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

   Data sets include: Trip (limited to interview data), gear type, monthly status, location.

   8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

   Oracle

9. ***Describe the Design of Your Observer Program***

   9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

   Vessel, tows

   9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

   Tows

   9.3. ***How were the sampling frames established?***

   Stratification

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Most (2002) current active effort ;by vessel, season and depth

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Most (2002) current active effort by vessel, season and depth.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Voluntary program. NOAA Fisheries-approved observers are placed year round on cooperating shrimp vessels. Placement intensity is typically based on vessel availability and current commercial effort trends by area and season. From February 1992 through May 1998 vessel operators were solicited to participate through phone and mail correspondence, port agents, and the Foundation. In May 1998, the NOAA Fisheries component of the program became mandatory following federal requirements for mandatory observer coverage. Under the mandatory selection process, vessels were randomly selected based on the previous complete year of effort (i.e., 1996) stratified by statistical area, depth and season. These data were derived from NOAA Fisheries shrimp landings file and cross-referenced with USCG documentation records. This yielded a list of active vessels with owner names and addresses. Port agents, when possible, obtained the contact information (e.g., owner phone numbers) for selected vessels. Efforts to place observers randomly, through mandatory measures, were met with a high rate of refusal from industry. Observer safety, inadequate sleeping facilities, liability insurance concerns, combined with the lack of an enforcement mechanism for a non-permitted fishery, ultimately resulted in the program becoming a voluntary charter program in June 1998. Since that time, efforts to randomize the selection of charter vessels have been based on selecting vessels from the previous complete year of shrimp effort as described above. Similarly, port agents, when possible, provided owner contact information. In May 2003, a portion of the shrimp permit file (vessel name, documentation number, vessel owner's name and phone number) was obtained from SERO, and used to facilitate contacting selected vessels. Vessel operators who volunteered to participate were used if vessels, selected under the randomized process, were not available.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

9.7. *Number of observers per trip?*

One

9.8. *Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?*

Different projects.

Onboard data collection for the purpose of bycatch characterization consists of sampling trawl catches taken from commercial shrimp vessels operating in the US Gulf of Mexico and southeastern Atlantic. Fishery-specific data are collected from one randomly-selected net for each tow. Nets trailing behind the try net are not selected for sampling. The catch from the selected net are placed into a partitioned area (e.g., separated from the catch from the remaining nets). The catch is then mixed to ensure randomness, shoveled into baskets, and a total weight obtained. A subsample (approximately 20% of the total catch weight) is processed for species composition. Species weight and number are obtained from the subsample. Length frequencies for 30 specimens were recorded for selected species.

Bycatch characterization efforts involve identifying all species in the subsample to species level. During modified characterization trips, 20 selected species (or taxa) of finfish are processed with the remaining subsample grouped into one of the following categories: non-shrimp crustaceans, fish, other non-crustacean invertebrates, or debris (e.g., rocks, logs, trash).

Sea turtles are identified to species, measured, tagged, photographed and released. Sea turtles are handled and released according to the Cooperative Marine Turtle Tagging Program protocol.

9.9. *Provide details of primary and secondary sample selection guidelines*

9.9.1 *Target sample sizes (vessels, trips) by stratum (if applicable)*

1,300 sea days

9.9.2 *Coverage (proportion of vessels & trips observed) by stratum (if applicable)*

In 2003, total sea days 1394 (2,716 tows). Sea days and tows by area are as follows:

NC (8, 6) SC (0,0) GA (4,11) EFL (73, 174), WFL (158,305) AL/MS (365, 675); LA (534, 1055); TX (301,490).

9.9.3 *Sample allocation of vessels and trips by gear/size group*

None

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

All tows sampled except safety/weather related

9.9.5 Sample allocation of trips in time and space

Above

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

See above

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

Typically nighttime fishery, if 24-hour some day tows and some night.

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

None

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Total catch rates of species by area and season; BRD evaluation.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

N/A

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

From the federal permit file, yes. 2002 for port sampling files.

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes, limited space and no safety decal. Insurance concerns also a problem.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Voluntary program.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

Voluntary program; randomized efforts typically result in very low compliance.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Can obtain targeted number of sea days and tows through voluntary program.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Represents when and where the fishing effort is highest.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

Not to a measurable degree.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Yes

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  No

- ***Vessel Monitoring Systems (VMS)***

  Yes

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery;***

  Yes

- ***Are the surveys limited to daytime tows/sets?)***

  No

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  No

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  Yes

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  Yes

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  Yes

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  Yes

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

  Yes

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

John Carlson, Ph.D.; Research Fishery Biologist

2. What is the name of your Observer Program?

Southeast Shark Gillnet Fishery

3. In which NOAA Region is it implemented?

SEFSC

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below)

To obtain estimates of catch and bycatch and bycatch mortality rates of protected species and other fish species. Catch and bycatch estimates are gathered to meet the mandates of the Atlantic Large Whale Take Reduction Plan and the Biological Opinion issued under requirements of the Fishery Management Plan for Highly Migratory Species. The Atlantic Large Whale Take Reduction Plan and The Biological Opinion issued under Section 7 of the Endangered Species Act mandate that, with respect to the southeast shark gillnet fishery, 100% observer coverage is required during the Right Whale Calving Season (15 Nov-1 Apr) for vessels operating from West Palm Beach, FL to Sebastian Inlet, FL. Outside the right whale calving season (1 Apr-14 Nov), an interim final rule published in March 2001 (March 30, 2001; 66 FR 17370) to the Fishery Management Plan for Highly Migratory Species (NMFS, 1999) established a level of observer coverage equal to that which would attain a sample size needed to provide estimates of sea turtle or marine mammal interactions with an expected coefficient of variation of 0.3.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Gillnet

5.2. Number of active vessels by gear and size category

6-15

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Sharks are landed primarily by two types of gear. The most common type is drift gillnet gear, wherein the vessel basically sets a gillnet in a straight line off the stern. The net soaks or fishes at the surface for a period of time, is inspected at various occasions during the soak, and then hauled onto the vessel when the captain/crew feel the catch is adequate. It is usually a nighttime fishery and takes place between 3 and 9 nmi from shore. Mesh size ranges from 12.7-29.9 cm (5-12”) stretched. The other type of gear utilized is strike-netting, wherein the vessel takes it’s gillnet and encircles a school of sharks. This is done usually during daylight hours, using visual sighting of shark schools from the vessel and or a spotter plane, and sometimes at night. The gear is encircled around the sharks, but is otherwise hauled back onto the vessel without much soak time.

5.4. Number of ports and distribution of vessels and trips among ports

5

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: shark
Bycatch: sea turtles, marine mammals, smalltooth sawfish

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

Atlantic Large Whale Take Reduction Plan and the Biological Opinion issued under requirements of the Fishery Management Plan for Highly Migratory Species. The Atlantic Large Whale Take Reduction Plan and The Biological Opinion issued under Section 7 of the Endangered Species Act.

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Logbooks, trip-reports, dealer reports

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

5

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

Access database

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips):

Trips/sets

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Directed Shark Permit

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Yes

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

100% observer coverage is required during the Right Whale Calving Season (15 Nov-1 Apr) for vessels operating from West Palm Beach, FL to Sebastian Inlet, FL. Outside the right whale calving season (1 Apr-14 Nov), a level of observer coverage equal to that which would attain a sample size needed to provide estimates of sea turtle or marine mammal interactions with an expected coefficient of variation of 0.3 is required.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Stay entire trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

9.9.3 Sample allocation of vessels and trips by gear/size group

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random);

9.9.5 Sample allocation of trips in time and space

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest).

Stock assessments for sharks, marine mammals, and sea turtles

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

None

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

No

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

John Carlson, Ph.D.; Research Fishery Biologist

2. What is the name of your Observer Program?

Atlantic and Gulf of Mexico Shark Bottom Longline Fishery

3. In which NOAA Region is it implemented?

SEFSC

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below): To obtain estimates of catch and bycatch of sharks and bycatch mortality rates of protected species and other fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Longline

5.2. Number of active vessels by gear and size category

60-100

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Vessels in the fishery are typically fiberglass and average up to 50 feet in length. Longline characteristics vary regionally with gear normally consisting of about 5-15 miles of longline and 500-1500 hooks. Gear is set at sunset and allowed to soak overnight before hauling back in the morning.

5.4. Number of ports and distribution of vessels and trips among ports

20

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: shark
Bycatch: sea turtles, marine mammals, smalltooth sawfish

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

   Fishery Management Plan for Highly Migratory Species.

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data***

   8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling***

   Logbooks, trip-reports, dealer reports

   8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

   3

   8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other.***

   8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

   Access database

9. ***Describe the Design of Your Observer Program***

   9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

   trips/sets

   9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

   set

   9.3. ***How were the sampling frames established?***

   9.3.1 ***Primary Sampling Level (e.g., yearly list of active vessels by gear/size)***

   Directed Shark Permit

   9.3.2 ***Secondary Sampling Level (trips)***

   9.3.3 ***Other pertinent details***

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

yes

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Stay entire trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

9.9.3 Sample allocation of vessels and trips by gear/size group

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random);

9.9.5 Sample allocation of trips in time and space

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of

effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest).

Stock assessments for sharks, marine mammals, and sea turtles

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

None

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

n/a

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

No

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing

and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Dennis Lee, Fisheries Biologist, Senior program leader
Lawrence Beerkircher, Fisheries Biologist, coordinator and data manager.

2. What is the name of your Observer Program?

Pelagic Observer Program

3. In which NOAA Region is it implemented?

Southeast Regional. Program is located at SEFSC Miami Laboratory.

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below):

Observation of the U.S. flagged pelagic longline fleet operating in the northwestern Atlantic.

Coverage rate of 5% to 8% of the fleet effort (number of sets) distributed within 11 geographical areas of the Atlantic.

Record catch (species, length, weight, sex) and effort (numbers of sets and hooks observed) data associated with pelagic species of fish taken, including protected species such as mammals, sea turtles, sea birds, and any regulatory prohibited species of fish.

Maintain an observer data base.

5. Provide a general description of the fleet to which the program is applied:

5.1. Gear type(s)

Pelagic Longline

5.2. Number of active vessels by gear and size category:

80 to 100 active vessel holding swordfish, tuna, and shark fishing permits.

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Pelagic longline fleet fishes year round.

Majority of vessel have trips lasting 3 to 14 days venturing between 150-200 miles offshore. A small portion of vessels traveling 200-1000 miles have trips lasting 20-40 days. Duration and travel dependent on size, horsepower, and fuel capacity of vessel.

Target species may be swordfish or yellowfin tuna. Occasionally, an operator may target other pelagic species (bigeye tuna, shark, or a mixed tuna).

Trips usually scheduled around new and full moon phases.

5.4. Number of ports and distribution of vessels and trips among ports

Pelagic longline fleet is transient in nature. Depending on size of vessel and horsepower, they can fish waters of the Grand Banks, offshore waters of U.S. east coast from New York to Florida, Gulf of Mexico, Caribbean, and as far south as the equator. Ports of entry and debarkation range from Portland, ME to Key West, FL; Tampa, FL to Galveston, TX; and San Juan, Puerto Rico. On some occasions, Canadian ports have been used by the U.S. longline fleet.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Primary target species is swordfish or Yellowfin tuna.

Major marketable by-catch includes: swordfish, yellowfin tuna, bigeye tuna, albacore tuna, bluefin tuna, shortfin mako shark, porbeagle shark, and a host of minor market and non-market species too numerable to list.

Critical by-catch species which are rare events are mammals, turtles, seabird, seabirds, and some prohibited shark and billfish species.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

Atlantic Highly Migratory Species Fisheries Management Plan (50 CFR Part 635.7 At-Sea Observer Coverage)

The 2004 Biological Opinion under the Section 7 of the ESA of 1973 (16 U.S.C. 1531 et seq.).

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Pelagic Logbook forms, dealer reports

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Logbook data available from 1986 to present.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Regulations require mandatory submission of logbook forms to be filled out by permit holders/operators for each set made. Logbook forms provide information on vessel name and documentation number; target species; gear type used; the dates, times, location of begin set and haul; number of hooks set; number of floats used; number of light sticks used; mainline length; average gangion length; average floatline length; hook type and size; bait and bait type used. In addition, there is self reporting numbers of fish species (by common name) kept and discarded (alive and dead).

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

Oracle database.
Excel spreadsheet available on website.

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling unit is the vessel by numbers of sets and location.

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Numbers of fish species taken by hooks and set.

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Random selection of vessels reporting effort (sets) within 11 designated geographical zones of the Atlantic.

9.3.2 Secondary Sampling Level (trips)

Not Applicable

9.3.3 Other pertinent details

Not Applicable

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Stratification is by quarter of calendar year and location (latitude and longitude) within 11 geographical zones of the Atlantic.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

The HMS FMP has a mandatory requirement that all operators/permit holders possessing pelagic fishing permits and that operates pelagic longline gear, must fillout and submit a pelagic logbook form for each set completed during a fishing trip. The selection of vessels is based on an 8% subsampling of the fleet effort (number of sets reported) by calendar quarter (Jan-Mar, Apr-Jun, Jul- Sep, and Oct-Dec). The POP utilizes a computer program that accesses the logbook effort database from the previous year and quarter. The program summarizes all sets and set locations reported within each of the 11 geographic zones. In addition, the program computes the 8% coverage rate (number of sets), the average sets made during the quarter for each vessel within that zone, and then randomly orders the vessels by name and documentation number. From the randomly ordered list, the POP staff, beginning with the first vessel, selects each vessel until the sum of the average total sets equals the 8% effort needed within a geographical zone. The vessel name and documentation number is then correlated with the vessel permit holder and address. A selection letter is then mailed to the permit holder notifying the person of their mandatory obligation for observer coverage.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes, once notified in writing by selection letter.

9.7. Number of observers per trip?

One observer is assigned per trip.

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

The POP staff arranges all potential observed trips. The observer travels to the location (port) of the vessel, makes contact with the operator, confirms that a Commercial Fishing Vessel Safety decal is current, conducts a safety check list inspection of the vessel, faxes the check list to the POP office, deploys with the vessel for the duration of the trip. The trip is based on a minimum number of sets completed before the vessel is released of its coverage obligation, with some exceptions. The observer, while onboard the vessel, records statistical and biological data of all species of fish boarded and/or released at the surface (dead or alive), included protected species such as mammals, turtles, and seabirds. After the vessel returns to port, the landed catch is monitored for final dressed weight during offloading. The completed observer data forms are sent to the POP office and the observer debrief on the data collected.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

A minimum number of sets, related to the average sets reported by the permit holder for that quarter from the previous years.

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Successfully covered trips for all zones combined provide a coverage rate of 3-9% of the fleet on any given calendar quarter or 3-6% during any calendar year.

9.9.3 Sample allocation of vessels and trips by gear/size group

Not Applicable.

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random);

All sets during an observed trip are selected and observed, with rare exceptions being observer sickness or unsafe conditions.

9.9.5 Sample allocation of trips in time and space

Clarify question

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Generally only one set is made daily in this fishery. See answer to 9.9.4.

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

Not applicable.

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

Not Applicable.

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded

to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Observer data base used by scientists in stock assessments on ICCAT pelagic species such as swordfish, tunas, sharks, and billfish, as well as estimates of mortality of various protected resource species (mammals, turtles, and seabirds). Methods vary depending on need, but most approaches model probability of interaction independently of interaction rate

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Estimates of mortality and/or interaction rates are used for monitoring fishery performance. Management usage depends upon species of interest.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

A vessel is considered unsafe if it does not possess a current Commercial Fishing Vessel Safety Decal or provide accommodation and food comparable to the crew (bunk availability and food).

The observer would exceed the life raft capacity of vessel.

Vessel owner or operator fails to communicate with the observer office of its arrivals and departures.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

50-60 percent of vessels selected on any given calendar quarter.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Yes. Although sometimes achievement of overall target coverage levels has happened at the yearly and quarterly overall temporal strata, achievement of target coverage levels for each specific spatial stratum is almost never achieved (i.e., actual coverage may be well above target in some spatial strata and well below in others). This results from use of prior year distribution of effort, which can change from year-to-year.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Generally yes, however due to the highly mobile nature of this fleet, actual fleet effort in one year may not correspond with anticipated effort in the selection process. This can result in low or no coverage in certain spatial strata. However, in most of the heavily fished areas coverage is well distributed.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

Possibly, since a fraction of the fleet is resistant to observation and since permits for fishing are not linked to compliance with selection for observation, there exists a possibility that the vessels observed are not representative of the performance of the unobserved vessels.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

For the commercially valuable species in this fleet, estimates of landed catch (considering the uncertainty in the estimates) from observer data generally (although not always) agree with landings statistics, which are reported independently from the observer data. Observer data indicate that there is a tendency to underreport through logbooks most, but not all, catches of species with no commercial value (and thus not retained by the vessel).

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Some use

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  Unknown use, potential if the system is difficult to defeat

- ***Vessel Monitoring Systems (VMS)***

  perhaps increases precision of information on effort distribution (catch?) compared to logbooks

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  Unlikely to be of sufficient sampling intensity and geographic extent for quantifying potential bias to a practical extent.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers).***

  Unknown utility in this sense since it is unclear what comprises a 'roving survey' in the context of this particular fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  This is typically done for this fleet

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  This is typically done for this fleet

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit***.

  This has been done for this fleet.

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  Some potential

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

NORTHWEST FISHERIES SCIENCE CENTER

Fishery: Shore-based Hake
Fishery: Oregon Nearshore Rockfish
Fishery: Limited Entry Fixed Gear Sablefish
Fishery: Limited Entry Non-endorsed Fixed Gear (0 tier)
Fishery: California Nearshore Rockfish
Fishery: Limited Entry Bottom Trawl

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

Fishery: Shore-based Hake

1. *Your name and title:*

Jonathan Cusick, West Coast Program Lead

2. *What is the name of your Observer Program?*

West Coast Groundfish Observer Program (WCGOP)

3. *In which NOAA Region is it implemented?*

Northwest, Northwest Fisheries Science Center

4. *List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).*

1) Test the use of electronic monitoring systems to confirm maximized retention in the shore-based hake fishery.
2) To confirm what is being sampled shoreside is representative of what is being caught.

5. *Provide a general description of the fleet to which the program is applied*

5.1. *Gear type(s)*

Mid-water trawl

5.2. *Number of active vessels by gear and size category*

Vessels are not separated into gear or size categories. There were active 28 vessels during the 2005 season.

5.3. *Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)*

Average trip length is 1 day. The majority of the fleet will fish 6 of 7 days in a week throughout the season. The season opens June 15 and ends when the quota is taken. This year, the season ended on August 15. The vessels tow during daylight hours when the hake are congregated.

5.4. *Number of ports and distribution of vessels and trips among ports*

The vessels predominantly operate out of the Oregon ports of Astoria, Newport and Coos Bay. Two vessels operated out of Eureka, CA, and about 6 other vessels operated out of southwest Washington ports.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

There are 89 groundfish species managed through the policies of the Pacific Fishery Management Council's Groundfish Fishery Management Plan (FMP) (Appendix A). The groundfish species include:

> Roundfish: sablefish, Pacific whiting (hake), lingcod, cabezon, Pacific cod, and kelp greenling
>
> Rockfish: 62 species of rockfish from the nearshore, shelf, and slope environments
>
> Flatfish: 9 species of sole, Pacific sanddab, Arrowtooth flounder, and starry flounder, but not Pacific Halibut.

The primary target of this fishery is hake.

The critical bycatch issues are:

- Overfished groundfish species
  - Bocaccio Rockfish
  - Canary Rockfish
  - Cowcod Rockfish
  - Darkblotched Rockfish
  - Pacific Ocean Perch
  - Widow Rockfish
  - Yelloweye Rockfish
- Salmon

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

Exempted Fishing Permit (EFP)

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

The electronic systems were placed aboard 100% of the shore-based hake vessels to document any discard taking place while at-sea.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Logbooks and fish tickets (landing receipts), port sampling. However, these data sources only collect retained catch data. There was some effort to record discard information in the logbooks this year.

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

This fishery has operated as an EFP for over 10 years.

Fish ticket data and logbooks are available for the extent of the fishery.

Port sampling is industry funded and plant samplers are hired directly by the plants.

Consistency of data sets is not fully known. In the last five years, the data set is consistent with no known major gaps.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Fish Ticket Data: trip id, landing date, port, state, processor, vessel, area, gear type, landed wt, catch category (single species or species group), catch condition, catch disposition, product form, product use, removal type

Logbook Data: vessel, departure date, return date, departure port, return port, crew size, net type, area, block number (10 x 10 min), haul set/up location (lat/long), depth, depth type, haul number, haul set/up date/time, haul duration, retained hailed pounds by catch category (single species or species group) (sporadic recording of discard)

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

PacFIN Oracle database tables are directly available for use by the WCGOP

9. Describe the Design of Your Observer Program

9.1 What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling units in order
- Vessel
- Trips
- Set

9.2 What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3 How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

All vessels must carry an operating EM system the extent of the season. It is a condition of the terms of the EFP.

9.3.2 Secondary Sampling Level (trips)

EM systems collect images and sensor data during all trips.

9.3.3 Other pertinent details

This fleet is 100% monitored for all vessels, all hauls; except in cases of electronic malfunction (<5%).

9.4 Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

There is no stratification of the fleet. EM systems are deployed on all vessels for the entire length of the season.

9.5 How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Every vessel that signs onto the EFP, sign onto the terms and conditions of that agreement and are required to take an EM system as per those terms.

9.6 Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7 Number of observers per trip?

One system per vessel which includes collection of data via a video camera, hydraulic pressure sensor, trawl winch sensor and GPS receiver.

9.8 Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

All data collected is collected from each vessel by a technician and sent to a data processor who reviews the video footage for discard events.

9.9 Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

All vessels participating in this EFP.

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

100% of the fleet.

9.9.3 Sample allocation of vessels and trips by gear/size group

Vessels are not separated into gear or size categories.

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.5 Sample allocation of trips in time and space

Attempted census

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

Not Applicable

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

NA

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other

This is an experimental project to confirm maximized retention on the vessels. The bycatch in this fishery is quantified from port sampler data.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

As this is still a pilot project, it has not been folded into management as yet.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

None.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%. Every vessel that signs onto the EFP, sign onto the terms and conditions of that agreement and are required to take an EM system as per those terms.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

NA

12.6. Is there any basis for believing that the estimators employed may result in a bias?

NA

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be

appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  As this EM pilot is focusing on discard while at sea, there are no fisheries dependent data except logbooks. Only last year, due to the 2004 pilot have the vessels started to consistently record discard in the logbooks.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  No other systems besides the one describe.

- ***Vessel Monitoring Systems (VMS)***

  VMS data for the Limited Entry Sablefish fleet is collected by NMFS enforcement. The data, however, is likely of limited use due to infrequent pooling rates and the inability to conclusively determine if fishing is in progress (winch sensor information is not coupled with the location data). Also since enforcement does not allow direct access to their database, data must be exported and loaded into independent tables in order to be used.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  There is a biennial hake acoustic survey to estimate hake biomass. It is no the objective of the survey to estimate biomass of any associated bycatch.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Roving survey data does not exist for this fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.

Common Name	Scientific Name
Sharks	
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
California skate	*R. inornata*
Longnose skate	*R. rhina*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling	*Antimora microlepis*
Grenadies	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

Fishery: Oregon Nearshore Rockfish

1. Your name and title:

Nancy Gove, Observer Program Data Analyst

2. What is the name of your Observer Program?

West Coast Groundfish Observer Program (WCGOP)

3. In which NOAA Region is it implemented?

Northwest, Northwest Fisheries Science Center

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

1) Improve management of groundfish by improving estimate of total catch, primarily through ongoing collection of information on discarded catch that will complement current shoreside information on landed catch
2) Improve estimate of total catch of prohibited species in the groundfish fishery
3) Improve management by collecting better biological information from the groundfish fishery
4) Provide timely and efficient system for collection, storage, analysis and communication of information

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Bottom longline, fish pot, vertical hook and line, pole (commercial), other hook and line gear

5.2. Number of active vessels by gear and size category

Vessels are not separated into gear or size categories. Vessels are selected by permit (one permit per vessel), 143 permits total. There are 89 vessels in this fleet that actively fished their permit (landings > 1000 lbs) during the last year and a half.

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Average trip length is 1 day.

Table A - Observed Vessels and Trips by Month and Year (2004 – 2005)				
YEAR	**MONTH**	**VESSELS**	**TRIPS**	**AVERAGE TRIPS/VESSEL**
2004	05	9	34	3.78
	06	10	24	2.40
	07	9	18	2.00
	08	8	16	2.00
	09	4	13	3.25
2005	01	4	5	1.25
	02	2	4	2.00
	03	1	4	4.00
	04	4	7	1.75
	05	6	16	2.67
	06	11	30	2.73
	07	8	15	1.88
	08	8	19	2.38
	09	9	19	2.11
	10	4	6	1.50

5.4. Number of ports and distribution of vessels and trips among ports

Vessel counts are for distinct vessels landing in each port. A single vessel may be counted multiple times if they landed in multiple ports.

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004	OR	BROOKINGS	4	10
	OR	GARIBALDI (TILLAMOOK)	3	14
	OR	GOLD BEACH	3	13
	OR	PACIFIC CITY	6	13
	OR	PORT ORFORD	14	55
2005	OR	BROOKINGS	7	18
	OR	CHARLESTON (COOS BAY)	1	1
	OR	GARIBALDI (TILLAMOOK)	3	8
	OR	GOLD BEACH	7	14
	OR	PACIFIC CITY	9	16
	OR	PORT ORFORD	21	69

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

There are 89 groundfish species managed through the policies of the Pacific Fishery Management Council's Groundfish Fishery Management Plan (FMP) (Appendix A). The groundfish species include:

Roundfish: sablefish, Pacific whiting, lingcod, cabezon, Pacific cod, and kelp greenling

Rockfish: 62 species of rockfish from the nearshore, shelf, and slope environments

Flatfish: 9 species of sole, Pacific sanddab, Arrowtooth flounder, and starry flounder, but not Pacific Halibut.

The target strategies in the observer data are Lingcod, Nearshore Rockfish, Nearshore Mix. Retained species are presented in Appendix B

The major discard species by weight is Lingcod. A list of discarded species are in Appendix C

The critical bycatch issues are:

- Rebuilding groundfish species
  - Bocaccio Rockfish
  - Canary Rockfish
  - Cowcod Rockfish
  - Darkblotched Rockfish
  - Pacific Ocean Perch
  - Widow Rockfish
  - Yelloweye Rockfish
- Salmon

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

MSA

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Fish Tickets (landing receipts), state port sampling

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Fish Ticket Data: 25 years (1981 to date)

This fishery functions primarily within OR state waters (within 3 mi) and has become a major fishery over the last decade and a half. State port sampling has been sporadic in the beginning of the fishery and Oregon has focused more sampling of the nearshore landings in recent years.

Consistency of data sets is not fully known. In the last five years, the data set is consistent with no known major gaps. The data set, however, is not 100% complete as fish tickets sometimes are never entered into the PacFIN data system.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Fish Ticket Data: trip id, landing date, port, state, processor, vessel, area, gear type, landed wt, catch category (single species or species group), catch condition, catch disposition, product form, product use, removal type

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

PacFIN Oracle database tables are directly available for use by the WCGOP

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling units in order
Vessels
Trips
Set

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

The list of Oregon Nearshore Rockfish vessels is generated as follows:

1. The PacFIN state permit table is queried for a list of all Oregon Blue/Black Rockfish permits (with or without a nearshore endorsement) that have been renewed for the current year. Only one permit per vessel is allowed.
2. The list is then culled to remove permits/vessels with the following characteristics:
    a. The permit was not assigned to a vessel during the last year and therefore is not being fished.
    b. The vessel has less than 1000 lbs of rockfish landings with fixed gear during the last year and a half.
    c. The vessel is less than 18 ft in length.

9.3.2 Secondary Sampling Level (trips)

The selected vessels are required to notify WCGOP 24 hours before they leave on a fishing trip. We attempt to sample all trips for the period which a vessel is selected.

9.3.3 Other pertinent details

Catch categories were set up to be similar to the market categories on fish tickets.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Vessels are stratified into port groups and selected for two month periods. The sampling occurs in 'selection cycles' which refer to the length of time given to select the entire fleet without replacement. Sampling cycles have been 8 months and 1 year long.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Since sampling is ongoing, we have defined the entire sampling period as a selection cycle, where we attempt to 'cycle' through all of the vessels in the fleet. The length of a selection cycle is determined by the desired sampling intensity and the anticipated availability of observers. For example, the current length of the selection cycle is 1 year. All vessels are selected for coverage in 2006.

Vessel selection is based on a stratified random sample, sampled without replacement. For each selection cycle, the vessels are assigned to port groups and then for each port group, randomly assigned to a 2-month period for observation. The port groups were chosen for logistical reasons, so that an observer can readily travel to any one of the ports in a group, given short notice. We've tried to allocate similar effort among port groups, but the effort has not been constant across the strata (port groups).

Once a vessel has been selected for observer coverage during a seven-month period, we attempt to sample every set on every trip until the trip limit has been met.

The set maybe subsampled or sampled in its entirety.

Changes Associated With the Implementation Of The Sampling Plan:

Certain vessels are not observed either because they are deemed unsafe or have no room for an observer.

When there is not an observer available to cover a trip, the vessel receives a waiver and the trip is not covered.

Sets have been missed or have incomplete data for a variety of reasons, such as observer illness, rough weather, gear problems.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers are responsible for entirely covering each fishing trip. While on board, the observer's duties, in order of priority, are as follows:

1. Record incidental takes of endangered species and marine mammals. Collect appropriate biological specimens.
2. Record interactions by marine mammals, sea turtles, and seabirds with fishing gear.
3. Estimate total catch weight, even for tows with 100% discard.
4. Estimate the weight of retained and discarded catch categories.
5. Sample discarded catch categories to determine species composition.
6. Document reasons for discard for each species and/or catch category.
7. Record weight, length, sex, and take necessary dissections from tagged fish.
8. Maintain the Observer Logbook.
9. Take biological samples such as sexed lengths, otoliths, stomachs, coral tissue, etc. from discarded individuals.
10. Sample retained catch categories to determine species composition.
11. Record weight, length, and viability of Pacific halibut.
12. Record sightings of marine mammals, sea turtles, and seabirds.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

Currently, we select the entire fleet (with landings >1,000 lbs) for coverage over one year.

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Our goal is to maximize coverage given our available resources.

9.9.3 Sample allocation of vessels and trips by gear/size group

Vessels are not separated into gear or size categories.

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.5 Sample allocation of trips in time and space

Attempted census

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

Not Applicable

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

NA

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The reports contain the following estimates from data combined with CA nearshore for targeted and rebuilding species:

By gear (Hook & Line, Pot), depth (0-10fm, 11-20fm, 21-50fm), area (north, south) and season (winter, summer)

Percentage of species/species group discarded/retained

The reports contain the following estimates from data combined with OR nearshore for rebuilding species:

By depth (0-10fm, 11-20fm, 21-50fm), area (north, south) and season (winter, summer)

lb/100lb retained nearshore species

The data are given to the stock assessment scientists who estimate bycatch per retained nearshore species. The bycatch ratio is expanded to estimate total bycatch using the amount of landed nearshore species from fish tickets. The caveat for this estimate is that neither the fisheries nor permit number/type is included on the fish ticket, so it is possible that landings from other fisheries may be included in the total landings used in the calculations.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Forecasts of bycatch based on ratios and expected catch are used to adjust cumulative trip limits as needed. Cumulative limits are set by gear type and area and are not allowed to carry over from one period to another. In general, the goal is for discarded and landed catch to equal the optimal yield.

The OR Nearshore fishery is a state managed fishery. There are federal limits for the open access fisheries, but states may set stricter limits.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Vessels with no sampling space for observer on deck
Vessels without sleeping room for observer
Vessels that are unsafe

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Some selected vessels cannot be observed due to size or safety constraints. Other selected vessels may switch to another fishery (e.g. crab or shrimp) and need to be covered for groundfish at a later point in the coverage cycle.

Vessel skippers occasionally avoid coverage by not returning phone calls or informing the program of fishing trips. In addition, selected trips are occasionally not sampled due to observer availability (observer may be injured or ill).

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

The OR nearshore fleet is fluid. As this is a small boat fleet, many vessels are trailered and are not necessarily located at a slip. In addition, this fleet is very weather dependent and fishing is hard to predict, even for the fisher. This makes this fleet difficult to track for both the observer program and state managers. However, this coming year, the program will be increasing its focus on this fleet and utilize a newly built automated system to track selected vessels more closely during their selection.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Due to limited resources, we are missing trips because the limited entry trawl and fixed gear fleets are our highest priority. In 2006, we're working on increasing the effort allocated to the open access fisheries. In 2004, our coverage was less than 5 percent.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

The port groups are distributed along the west coast. The number of vessels select from each port group is spread across the fishing seasons.

We do not have control over the specific locations or depths a vessel fishes.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

There is a potential for bias. Currently, ratio estimates have been used as a faster and simpler method for estimation. Small sample sizes in some port groups have resulted in the data being pooled across port groups, potentially biasing the estimates toward the port groups that are more heavily sampled. Also, ratio estimates from small sample sizes are biased.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be

appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Fish tickets are currently used by the program. Difficulties with this data set include delays in the electronic submission of the data (minimum of 2 month lag for a useable amount of data), incomplete data submission, and challenges with matching data to observer data due to erroneous dates or mismatched species/catch category assignments.

  Port sampling data exists but the quality, consistency and availability of this data needs to be addressed before considering use in any analysis.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  Video and/or scanner data does not exist for this fleet.

- ***Vessel Monitoring Systems (VMS)***

  VMS data is not collected for this fleet.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  No regularly scheduled nearshore survey takes place on the West Coast.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Roving survey data does not exist for this fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.

Common Name	Scientific Name
Sharks	
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
California skate	*R. inornata*
Longnose skate	*R. rhina*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling	*Antimora microlepis*
Grenadies	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Black Rockfish	Sebastes melanops
Blue Rockfish	Sebastes mystinus
Cabezon	Scorpaenichthys marmoratus
China Rockfish	Sebastes nebulosus
Copper Rockfish	Sebastes caurinus
Grass Rockfish	Sebastes rastrelliger
Greenling Unid	Hexagrammidae
Kelp Greenling	Hexagrammos decagrammus
Lingcod	Ophiodon elongatus
Olive Rockfish	Sebastes serranoides
Quillback Rockfish	Sebastes maliger
Redbanded Rockfish	Sebastes babcocki
Sablefish	Anoplopoma fimbria
Vermilion Rockfish	Sebastes miniatus
Yellowtail Rockfish	Sebastes flavidus

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Black Rockfish	Sebastes melanops
Blue Rockfish	Sebastes mystinus
Buffalo Sculpin	Enophrys bison
Cabezon	Scorpaenichthys marmoratus
Canary Rockfish	Sebastes pinniger
China Rockfish	Sebastes nebulosus
Kelp Greenling	Hexagrammos decagrammus
Kelp, Rocks, Wood, etc Mud	Mud
Lingcod	Ophiodon elongatus
Red Irish Lord Sculpin	Hemilepidotus hemilepidotus
Sablefish	Anoplopoma fimbria
Sea Star Unid	Asteroidea
Skate Unid	Rajidae
Spiny Dogfish Shark	Squalus acanthias
Vermilion Rockfish	Sebastes miniatus
Yelloweye Rockfish	Sebastes ruberrimus
Yellowtail Rockfish	Sebastes flavidus

Request for Information Needed to Evaluate Vessel Selection Bias in *NOAA Observer programs*

Fishery: Limited Entry Fixed Gear Sablefish

1. Your name and title:

Nancy Gove, Observer Program Data Analyst

2. What is the name of your Observer Program?

West Coast Groundfish Observer Program (WCGOP)

3. In which NOAA Region is it implemented?

Northwest, Northwest Fisheries Science Center

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

1) Improve management of groundfish by improving estimate of total catch, primarily through ongoing collection of information on discarded catch that will complement current shoreside information on landed catch
2) Improve estimate of total catch of prohibited species in the groundfish fishery
3) Improve management by collecting better biological information from the groundfish fishery
4) Provide timely and efficient system for collection, storage, analysis and communication of information

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Bottom longline and fish pot

5.2. Number of active vessels by gear and size category

Vessels are not separated into gear or size categories. There are 97 vessels in this fleet that had an active permit during 2005.

Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Average trip length is 4 days.

Table A - Observed Vessels and Trips by Month and Year (2004 – 2005)				
YEAR	**MONTH**	**VESSELS**	**TRIPS**	**AVERAGE TRIPS/VESSEL**
2004	04	2	3	1.5
	05	2	4	2.0
	06	5	12	2.4
	07	4	7	1.8
	08	4	6	1.5
	09	9	16	1.8
	10	6	12	2.0
2005	04	5	10	2.0
	05	7	10	1.4
	06	14	30	2.1
	07	16	29	1.8
	08	19	31	1.6
	09	13	22	1.7
	10	7	13	1.9

5.3. Number of ports and distribution of vessels and trips among ports

Vessel counts are for distinct vessels landing in each port. A single vessel may be counted multiple times if they landed in multiple ports.

LE Sablefish vessels are covered on multi-year cycles. Therefore, the table below provides a snapshot of a subsection of the fleet during the specified years.

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004	CA	EUREKA	2	4
	CA	FORT BRAGG	2	9
	CA	MOSS LANDING	1	2
	CA	PRINCETON (HALF MOON BAY)	2	6
	OR	ASTORIA / WARRENTON	3	6
	OR	CHARLESTON (COOS BAY)	1	7
	OR	NEWPORT	3	10
	WA	BELLINGHAM BAY	3	5
	WA	LAPUSH	1	3
	WA	NEAH BAY	2	4
	WA	WESTPORT	2	4
2005	CA	EUREKA	1	3
	CA	FORT BRAGG	1	4
	CA	MOSS LANDING	2	6
	CA	PRINCETON (HALF MOON BAY)	2	8
	OR	ASTORIA / WARRENTON	2	6

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2005 Continued	OR	CHARLESTON (COOS BAY)	5	21
	OR	NEWPORT	6	29
	OR	PORT ORFORD	4	26
	WA	BELLINGHAM BAY	6	12
	WA	NEAH BAY	4	6
	WA	WESTPORT	4	24

6. *What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?*

There are 89 groundfish species managed through the policies of the Pacific Fishery Management Council's Groundfish Fishery Management Plan (FMP) (Appendix A). The groundfish species include:

Roundfish: sablefish, Pacific whiting, lingcod, cabezon, Pacific cod, and kelp greenling

Rockfish: 62 species of rockfish from the nearshore, shelf, and slope environments

Flatfish: 9 species of sole, Pacific sanddab, Arrowtooth flounder, and starry flounder, but not Pacific Halibut.

The primary target of this fishery is sablefish. Retained species are presented in Appendix B

The species/species groups with the highest discard by weight in 2004 are listed below. A list of discarded species is in Appendix C

COMMON_NAME	**SCIENTIFIC_NAME**
Spiny Dogfish Shark	Squalus acanthias
Sablefish	Anoplopoma fimbria
Pacific Halibut	Hippoglossus stenolepis
Other sharks	

The critical bycatch issues are:

- Overfished groundfish species
  - Bocaccio Rockfish
  - Canary Rockfish
  - Cowcod Rockfish
  - Darkblotched Rockfish
  - Pacific Ocean Perch
  - Widow Rockfish
  - Yelloweye Rockfish
- Salmon

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MSA

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Fish tickets (landing receipts), state port sampling

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Fish Ticket Data: 25 years (1981 to date)
State port sampling: varies between the states, CA has collected sporadic data on groundfish since the 1940's; the other states, more recently.

Consistency of data sets is not fully known. In the last five years, the data set is consistent with no known major gaps. The data set, however, is not 100% complete as fish tickets sometimes are never entered into the PacFIN data system.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Fish Ticket Data: trip id, landing date, port, state, processor, vessel, area, gear type, landed wt, catch category (single species or species group), catch condition, catch disposition, product form, product use, removal type

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

PacFIN Oracle database tables are directly available for use by the WCGOP

9. ***Describe the Design of Your Observer Program***

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling units in order

- Permit/Vessel
- Trips
- Set

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3. How were the sampling frames established?

9.9.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

The list of Limited Entry Sablefish vessels is generated as follows:

1. The NMFS NWR Limited Entry permit table is queried for a list of all LE permits with a sablefish tier 1,2 or 3 endorsement that have been renewed for the current year.
2. Permit owners may stack up to 3 permits per vessel. Each distinct vessel is selected for coverage once during a given selection cycle and all stacked permits are covered at the same time.
3. The selection cycle for this fishery spans multiple years. The past cycle was a 4 year cycle while the current cycle is only a 2 year cycle.
4. The sablefish fishing season lasts for 7 months (April-October). Selected vessels are covered until they reach their sablefish quota or until the season ends, which ever comes first.

9.9.2 Secondary Sampling Level (trips)

Each selected vessel is required to notify WCGOP 24 hours before they leave on a fishing trip. We attempt to sample all trips for the season which a vessel is selected.

9.9.3 Other pertinent details

Catch categories were set up to be similar to the market categories on fish tickets.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Permits are stratified into port groups and selected for the sablefish fishing season (April-October).

The sampling occurs in ‘selection cycles’ which refer to the length of time given to select the entire fleet without replacement. Sampling cycles are currently 2 years long i.e. two complete seasons.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Since sampling is ongoing, we have defined the entire sampling period as a selection cycle, where we attempt to 'cycle' through all of the permits. The length of a selection cycle is determined by the desired sampling intensity and the anticipated availability of observers. For example, the current length of the selection cycle is 2 years with fishing open from April to October. One half of the vessels in the fleet are selected during each season.

Vessel selection is based on a stratified random sample, sampled without replacement. For each selection cycle, the vessels are assigned to port groups and then for each port group, randomly assigned to a 7-month period for observation. The port groups were chosen for logistical reasons, so that an observer can readily travel to any one of the ports in a group, given short notice. We've tried to allocate similar effort among port groups, but the effort has not been constant across the strata (port groups).

Once a vessel has been selected for observer coverage during a seven-month period, we attempt to sample every set on every trip until the vessel's season quota has been met.

The set may be subsampled or sampled in its entirety.

Changes Associated With the Implementation Of The Sampling Plan:

One twist to the sable fish fishery is that vessels can 'stack' up to three permits (i.e., carry three permits and add the limits on the permits for the combined limit for the vessel in a season).

Certain vessels are not observed either because they are deemed unsafe or have no room for an observer.

When there is not an observer available to cover a trip, the vessel receives a waiver and the trip is not covered.

Sets have been missed or have incomplete data for a variety of reasons, such as observer illness, rough weather, gear problems.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers are responsible for entirely covering each fishing trip. While on board, the observer's duties, in order of priority, are as follows:

1. Record incidental takes of endangered species and marine mammals. Collect appropriate biological specimens.
2. Record interactions by marine mammals, sea turtles, and seabirds with fishing gear.
3. Estimate total catch weight, even for sets with 100% discard.
4. Estimate the weight of retained and discarded catch categories.
5. Sample discarded catch categories to determine species composition.
6. Document reasons for discard for each species and/or catch category.
7. Record weight, length, sex, and take necessary dissections from tagged fish.
8. Maintain the Observer Logbook.
9. Take biological samples such as sexed lengths, otoliths, stomachs, coral tissue, etc. from discarded individuals.
10. Sample retained catch categories to determine species composition.
11. Record weight, length, and viability of Pacific halibut.
12. Record sightings of marine mammals, sea turtles, and seabirds.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1. Target sample sizes (vessels, trips) by stratum (if applicable)

Currently, we select one-half of the permits.

9.9.2. Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Our goal is to maximize coverage given our available resources.

9.9.3. Sample allocation of vessels and trips by gear/size group

Vessels are not separated into gear or size categories.

9.9.4. Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.5. Sample allocation of trips in time and space

Attempted census

9.9.6. Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.7. Allocation of sampling effort within trips between night and day (if applicable)

Not Applicable

9.9.8. Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

NA

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The reports contain the following estimates for assessed and overfished species:

By gear (Hook & Line, Pot)
- Percentage of species/species group discarded/retained
- Discarded lbs per unit of effort
- Discarded lbs/100lbs of retained sablefish

The reports contain the following estimates for overfished species:

By gear
- lb/100lb retained groundfish

By depth (0-150fm, >150fm, All Depths)

The data are given to stock assessment scientists who estimate bycatch per retained sablefish. The bycatch ratio is expanded to estimate total bycatch using the amount of landed sablefish from fish tickets.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Forecasts of bycatch based on ratios and expected catch are used to adjust cumulative trip limits as needed. Cumulative limits are set by gear type and area and are not allowed to carry over from one period to another. In general, the goal is for discarded and landed catch to equal the optimal yield. Bycatch ratios from the sablefish-endorsed observer data are also used to for estimating bycatch for the non-endorsed sablefish fishery whose vessels use similar gear in targeting sablefish, but are managed through use of a combination of daily and weekly limits.

For the rebuilding species, the preseason numbers are provided to the groundfish management team. This team is an advisory body associated with the Council and provides advice for Council decisions.

Post season, bycatch data is used to estimate if overfishing has occurred.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Vessels with no sampling space for observer on deck
Vessels without sleeping room for observer
Vessels that are unsafe

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Some selected vessels cannot be observed due to size or safety constraints. Other selected vessels may switch to another fishery (e.g., crab or shrimp) and need to be covered for groundfish at a later point in the coverage cycle.

Vessel skippers occasionally avoid coverage by not returning phone calls or informing the program of fishing trips. In addition, selected trips are occasionally not sampled due to observer availability (observer may be injured or ill).

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

The LE sablefish fleet is relatively compliant. As the number of non-compliant vessels has been low in this fleet to date (estimated at less than 5% of vessels, program wide), the program has focused on other priorities such as observer safety, sampling protocol, data quality. This year the program will utilize a newly built automated system to track selected vessels more closely during their selection.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Not to our knowledge. Starting in 2005, we increased the number of permits selected for coverage. In 2004, we covered roughly 13% of the metric tons of sablefish landed.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

The port groups are distributed along the west coast. The number of vessels select from each port group is spread across the fishing seasons.

We do not have control over the specific locations or depths a vessel fishes.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

There is a potential for bias. Currently, ratio estimates have been used as a faster and simpler method for estimation. Small sample sizes in some port groups have resulted in the data being pooled across port groups, potentially biasing the estimates toward the port groups that are more heavily sampled. Also, ratio estimates from small sample sizes are biased.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Fish tickets are currently used by the program. Difficulties with this data set include delays in the electronic submission of the data (minimum of 2 month lag for a useable amount of data), incomplete data submission, and challenges with matching data to observer data due to erroneous dates or mismatched species/catch category assignments.

  Port sampling data exists but the quality, consistency and availability of this data needs to be addressed before considering use in any analysis.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  Video and/or scanner data does not exist for this fleet.

- ***Vessel Monitoring Systems (VMS)***

  VMS data for the Limited Entry Sablefish fleet is collected by NMFS enforcement. The data, however, is likely of limited use due to infrequent pooling rates and the inability to conclusively determine if fishing is in progress (winch sensor information is not coupled with the location data). Also since enforcement does not allow direct access to their database, data must be exported and loaded into independent tables in order to be used.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  No regularly scheduled fixed gear sablefish survey takes place on the West Coast.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Roving survey data does not exist for this fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

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Ratfish	*Hydrolagus colliei*
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Grenadies	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
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Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Aurora Rockfish	Sebastes aurora
Bank Rockfish	Sebastes rufus
Black and Yellow Rockfish	Sebastes chrysomelas
Black Rockfish	Sebastes melanops
Blackgill Rockfish	Sebastes melanostomus
Blue Rockfish	Sebastes mystinus
Bocaccio Rockfish	Sebastes paucispinus
Bronzespotted Rockfish	Sebastes gilli
Brown Rockfish	Sebastes auriculatus
Calico Rockfish	Sebastes dalli
Canary Rockfish	Sebastes pinniger
Chameleon Rockfish	Sebastes phillipsi
Chilipepper Rockfish	Sebastes goodei
China Rockfish	Sebastes nebulosus
Common/Giant Pacific Octopus	Enteroctopus dofleini
Copper Rockfish	Sebastes caurinus
Cowcod Rockfish	Sebastes levis
Darkblotched Rockfish	Sebastes crameri
Dwarf-red Rockfish	Sebastes rufianus
Flag Rockfish	Sebastes rubrivinctus
Freckled Rockfish	Sebastes lentiginosus
Giant Grenadier	Albatrossia pectoralis
Gopher Rockfish	Sebastes carnatus
Grass Rockfish	Sebastes rastrelliger
Greenblotched Rockfish	Sebastes rosenblatti
Greenspotted Rockfish	Sebastes chlorostictus
Greenstriped Rockfish	Sebastes elongates
Grenadier Unid	Macrouridae
Halfbanded Rockfish	Sebastes semicinctus
Harlequin Rockfish	Sebastes variegatus
Honeycomb Rockfish	Sebastes umbrosus
Kelp Rockfish	Sebastes atrovirens
Lingcod	Ophiodon elongatus
Longspine Thornyhead	Sebastolobus altivelis
Mexican Rockfish	Sebastes macdonaldi
Northern Rockfish	Sebastes polyspinis
Octopus Unid	Octopoda
Olive Rockfish	Sebastes serranoides
Pacific Grenadier	Coryphaenoides acrolepis
Pacific Halibut	Hippoglossus stenolepis
Pacific Ocean Perch Rockfish	Sebastes alutus
Petrale Sole	Eopsetta jordani
Pink Rockfish	Sebastes eos
Pinkrose Rockfish	Sebastes simulator
Popeye Grenadier	Coryphaenoides cinereus
Prickly Shark	Echinorhinus cookei
Puget Sound Rockfish	Sebastes emphaeus
Pygmy Rockfish	Sebastes wilsoni
Quillback Rockfish	Sebastes maliger
Redbanded Rockfish	Sebastes babcocki

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Redstripe Rockfish	Sebastes proriger
Rockfish Unid	Sebastes
Rosethorn Rockfish	Sebastes helvomaculatus
Rosy Rockfish	Sebastes rosaceus
Rougheye Rockfish	Sebastes aleutianus
Sablefish	Anoplopoma fimbria
Semaphore Rockfish	Sebastes melanosema
Shark Unid	Squaliformes
Sharpchin Rockfish	Sebastes zacentrus
Shortbelly Rockfish	Sebastes jordani
Shortraker Rockfish	Sebastes borealis
Shortraker/Rougheye Rockfish	Sebastes Shortraker/Rougheye
Shortspine Thornyhead	Sebastolobus alascanus
Shortspine/Longspine Thornyhead	Sebastolobus
Silvergray Rockfish	Sebastes brevispinus
Skate Unid	Rajidae
Speckled Rockfish	Sebastes ovalis
Splitnose Rockfish	Sebastes diploproa
Squarespot Rockfish	Sebastes hopkinsi
Starry Rockfish	Sebastes constellatus
Stripetail Rockfish	Sebastes saxicola
Swordspine Rockfish	Sebastes ensifer
Tiger Rockfish	Sebastes nigrocinctus
Treefish Rockfish	Sebastes serriceps
Vermilion Rockfish	Sebastes miniatus
Widow Rockfish	Sebastes entomelas
Yelloweye Rockfish	Sebastes ruberrimus
Yellowmouth Rockfish	Sebastes reedi
Yellowtail Rockfish	Sebastes flavidus

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Arrowtooth Flounder	Atheresthes stomias
Big Skate	Raja binoculata
Blue Shark	Prionace glauca
Brown Cat Shark	Apristurus brunneus
Canary Rockfish	Sebastes pinniger
Dover Sole	Microstomus pacificus
Giant Grenadier	Albatrossia pectoralis
Greenstriped Rockfish	Sebastes elongates
Lingcod	Ophiodon elongatus
Longnose Skate	Raja rhina
Pacific Cod	Gadus macrocephalus
Pacific Halibut	Hippoglossus stenolepis
Redbanded Rockfish	Sebastes babcocki
Rockfish Unid	Sebastes
Rougheye Rockfish	Sebastes aleutianus
Sablefish	Anoplopoma fimbria
Sandpaper Skate	Bathyraja kincaidii

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Sea Star Unid	Asteroidea
Shortraker Rockfish	Sebastes borealis
Shortraker/Rougheye Rockfish	Sebastes Shortraker/Rougheye
Shortspine Thornyhead	Sebastolobus alascanus
Skate Unid	Rajidae
Spiny Dogfish Shark	Squalus acanthias
Spotted Ratfish	Hydrolagus colliei
Tanner Unid Crab	Chionoecetes spp.
Tanneri Tanner Crab	Chionoecetes tanneri
Vermilion Rockfish	Sebastes miniatus
Yelloweye Rockfish	Sebastes ruberrimus

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

Fishery: Limited Entry Non-endorsed Fixed Gear (0 tier)

1. *Your name and title:*

Nancy Gove, Observer Program Data Analyst

2. *What is the name of your Observer Program?*

West Coast Groundfish Observer Program (WCGOP)

3. *In which NOAA Region is it implemented?*

Northwest, Northwest Fisheries Science Center

4. *List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below.)*

1) Improve management of groundfish by improving estimate of total catch, primarily through ongoing collection of information on discarded catch that will complement current shoreside information on landed catch
2) Improve estimate of total catch of prohibited species in the groundfish fishery
3) Improve management by collecting better biological information from the groundfish fishery
4) Provide timely and efficient system for collection, storage, analysis and communication of information

5. *Provide a general description of the fleet to which the program is applied*

5.1. *Gear type(s)*

Bottom longline, fish pot, vertical hook and line, pole (commercial), other hook and line gear

5.2. *Number of active vessels by gear and size category*

Vessels are not separated into gear or size categories. There are 65 vessels in this fleet that had an active permit during 2005.

Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Average trip length is 1 day.

Table A - Observed Vessels and Trips by Month and Year (2004 – 2005)				
YEAR	**MONTH**	**VESSELS**	**TRIPS**	**AVERAGE TRIPS/VESSEL**
2004	02	1	4	4.0
	05	6	26	4.3
	06	4	8	2.0
	07	1	3	3.0
	08	2	7	3.5
	09	2	5	2.5
	10	1	3	3.0
	11	1	6	6.0
	12	2	3	1.5
2005	02	1	3	3.0
	04	1	3	3.0
	06	2	4	2.0
	07	1	6	6.0
	08	1	5	5.0
	10	1	3	3.0

5.3. Number of ports and distribution of vessels and trips among ports

Vessel counts are for distinct vessels landing in each port. A single vessel may be counted multiple times if they landed in multiple ports.

LE Non-endorsed Fixed Gear (0 tier) vessels are covered on multi-year cycles. Therefore, the table below provides a snapshot of a subsection of the fleet during the specified years.

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004	CA	DANA POINT HARBOR	4	22
	CA	LOS ANGELES	2	9
	CA	MARINA DEL REY	4	14
	CA	MOSS LANDING	2	3
	CA	OCEANSIDE	1	2
	CA	OXNARD	1	4
	CA	SAN DIEGO	2	6
	CA	SAN DIEGO AREA	1	5
2005	CA	MARINA DEL REY	3	11
	CA	MOSS LANDING	1	1
	CA	OCEANSIDE	2	9
	CA	OXNARD	1	3

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

There are 89 groundfish species managed through the policies of the Pacific Fishery Management Council's Groundfish Fishery Management Plan (FMP) (Appendix A). The groundfish species include:

Roundfish: sablefish, Pacific whiting, lingcod, cabezon, Pacific cod, and kelp greenling

Rockfish: 62 species of rockfish from the nearshore, shelf, and slope environments

Flatfish: 9 species of sole, Pacific sanddab, Arrowtooth flounder, and starry flounder, but not Pacific Halibut.

The targeted strategies found in the observer data are Spiny Dogfish Shark; Dover, Thornyheads, and Sablefish; Slope Rockfish; Nearshore Mix; Rockfish; Sablefish; Shortspine Thornyheads; and Mixed Thornyheads. Retained species are presented in Appendix B.

The major discard species are sablefish and shark. A list of discarded species is in Appendix C.

The critical bycatch issues are:

- Rebuilding groundfish species
  - Bocaccio Rockfish
  - Canary Rockfish
  - Cowcod Rockfish
  - Darkblotched Rockfish
  - Pacific Ocean Perch
  - Widow Rockfish
  - Yelloweye Rockfish
- Salmon

7. *Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)*

MSA

8. *In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.*

8.1. *Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)*

Fish tickets (landing receipts), state port sampling

8.2. *Number of years of catch, landings, and effort data, and the consistency of data among years*

Fish Ticket Data: 25 years (1981 to date)
State port sampling: varies between the states, CA has collected sporadic data on groundfish since the 1940's; the other states, more recently.

Consistency of data sets is not fully known. In the last five years, the data set is consistent with no known major gaps. The data set, however, is not 100% complete as fish tickets sometimes are never entered into the PacFIN data system.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Fish Ticket Data: trip id, landing date, port, state, processor, vessel, area, gear type, landed wt, catch category (single species or species group), catch condition, catch disposition, product form, product use, removal type

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

PacFIN Oracle database tables are directly available for use by the WCGOP

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling units in order

- Vessels
- Trips
- Set

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3. How were the sampling frames established?

9.9.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

The list of Limited Entry Non-endorsed Fixed Gear (0 tier) vessels is generated as follows:

1. The NMFS NWR Limited Entry permit table is queried for a list of all LE permits with a longline or pot endorsement that do not have a sablefish tier endorsement and have been renewed for the current year. Only one permit per vessel is allowed.
2. The selection cycle for this fishery spans multiple years. The past cycle was a 4 year cycle while the current cycle is only a 2 year cycle.
3. The fishing season is year round and vessels are covered for a single 2 month trip limit period during the course of the selection cycle.

9.9.2 Secondary Sampling Level (trips)

In an effort to keep the fishery open year round and the market supplied with fish, each species' annual quota is divided into six two-month limits. Each vessel commonly makes multiple trips in a two month period to catch their limits. Each selected vessel is required to notify WCGOP 24 hours before they leave on a fishing trip. We attempt to sample all trips for the period which a vessel is selected.

9.9.3 Other pertinent details

Catch categories were set up to be similar to the market categories on fish tickets.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Vessels are stratified into port groups and selected for two month periods.
The sampling occurs in 'selection cycles' which refer to the length of time given to select the entire fleet without replacement. Sampling cycles have been 4 and 2 years long.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Since sampling is ongoing, we have defined the entire sampling period as a selection cycle, where we attempt to 'cycle' through all of the vessel in the fleet. The length of a selection cycle is determined by the desired sampling intensity and the anticipated availability of observers. For example, the current length of the selection cycle is 2 years. One half of the vessels in the fleet are selected each year.

Vessel selection is based on a stratified random sample, sampled without replacement. For each selection cycle, the vessels are assigned to port groups and then for each port group, randomly assigned to a 2-month period for observation. The port groups were chosen for logistical reasons, so that an observer can readily travel to any one of the ports in a group, given short notice. We've tried to allocate similar effort among port groups, but the effort has not been constant across the strata (port groups).

Once a vessel has been selected for observer coverage for a two-month period, we attempt to sample every set on every trip until the trip limit has been met.
The set maybe subsampled or sampled in its entirety.

Changes Associated With the Implementation Of The Sampling Plan:

Certain vessels are not observed either because they are deemed unsafe or have no room for an observer.

When there is not an observer available to cover a trip, the vessel receives a waiver and the trip is not covered.

Sets have been missed or have incomplete data for a variety of reasons, such as observer illness, rough weather and gear problems.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers are responsible for entirely covering each fishing trip. While on board, the observer's duties, in order of priority, are as follows:

1. Record incidental takes of endangered species and marine mammals. Collect appropriate biological specimens.
2. Record interactions by marine mammals, sea turtles, and seabirds with fishing gear.
3. Estimate total catch weight, even for tows with 100% discard.
4. Estimate the weight of retained and discarded catch categories.
5. Sample discarded catch categories to determine species composition.
6. Document reasons for discard for each species and/or catch category.
7. Record weight, length, sex, and take necessary dissections from tagged fish.
8. Maintain the Observer Logbook.
9. Take biological samples such as sexed lengths, otoliths, stomachs, coral tissue, etc. from discarded individuals.
10. Sample retained catch categories to determine species composition.
11. Record weight, length, and viability of Pacific halibut.
12. Record sightings of marine mammals, sea turtles, and seabirds.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1. Target sample sizes (vessels, trips) by stratum (if applicable)

Currently, we select one-half of the permits in a given year.

9.9.2. Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Our goal is to maximize coverage given our available resources.

9.9.3. Sample allocation of vessels and trips by gear/size group

Vessels are not separated into gear or size categories.

9.9.4. Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.5. Sample allocation of trips in time and space

Attempted census

9.9.6. Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.7. Allocation of sampling effort within trips between night and day (if applicable)

Not Applicable

9.9.8. Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

NA

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The reports contain the following estimates for assessed and rebuilding species:

- By gear (Hook & Line, Pot)
  - Percentage of species/species group discarded/retained

The reports contain the following estimates for rebuilding species:

- By gear and area (north, south)
  - lb/100lb retained thornyheads, sablefish, other roundfish, and other slope rockfish

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Forecasts of bycatch based on ratios and expected catch are used to adjust cumulative trip limits as needed. Cumulative limits are set by gear type and area and are not allowed to carry over from one period to another. In general, the goal is for discarded and landed catch to equal the optimal yield.

For the rebuilding species, the preseason numbers are provided to the groundfish management team. This team is an advisory body associated with the Council and provides advice for Council decisions.

Post season, bycatch data is used to estimate if overfishing has occurred

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Vessels with no sampling space for observer on deck
Vessels without sleeping room for observer
Vessels that are unsafe

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Some selected vessels cannot be observed due to size or safety constraints. Other selected vessels may switch to another fishery (e.g., crab or shrimp) and need to be covered for groundfish at a later point in the coverage cycle.

Vessel skippers occasionally avoid coverage by not returning phone calls or informing the program of fishing trips. In addition, selected trips are occasionally not sampled due to observer availability (observer may be injured or ill).

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

The limited entry non-endorsed fixed gear (0 tier) fleet is relatively compliant overall. Vessel activity in some port groups have been hard to track for this fleet due to the size of some port groups (Los Angeles). The program has focused on other priorities such as observer safety, sampling protocol, data quality in the past.

However, this year the program will utilize a newly built automated system to track selected vessels more closely during their selection.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Not to our knowledge. Starting in 2005, we increased the number of permits selected for coverage. In 2004, we covered roughly 13% of the metric tons of sablefish landed.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

The port groups are distributed along the west coast. The number of vessels select from each port group is spread across the fishing seasons.

We do not have control over the specific locations or depths a vessel fishes.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

There is a potential for bias. Currently, ratio estimates have been used as a faster and simpler method for estimation. Small sample sizes in some port groups have resulted in the data being pooled across port groups, potentially biasing the estimates toward the port groups that are more heavily sampled. Also, ratio estimates from small sample sizes are biased.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Fish tickets are currently used by the program. Difficulties with this data set include delays in the electronic submission of the data (minimum of 2 month lag for a useable amount of data), incomplete data submission, and challenges with matching data to observer data due to erroneous dates or mismatched species/catch category assignments.

  Port sampling data exists but the quality, consistency and availability of this data needs to be addressed before considering use in any analysis.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  Video and/or scanner data does not exist for this fleet.

- ***Vessel Monitoring Systems (VMS)***

  VMS data for the Limited Entry Non-endorsed Fixed Gear (0 tier) fleet is collected by NMFS enforcement. The data, however, is likely of limited use due to infrequent pooling rates and the inability to conclusively determine if fishing is in progress (winch sensor information is not coupled with the location data). Also since enforcement does not allow direct access to their database, data must be exported and loaded into independent tables in order to be used.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  No regularly scheduled fixed gear survey takes place on the West Coast.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Roving survey data does not exist for this fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Sharks	
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
California skate	*R. inornata*
Longnose skate	*R. rhina*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling	*Antimora microlepis*
Grenadies	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Aurora Rockfish	Sebastes aurora
Bank Rockfish	Sebastes rufus
Black and Yellow Rockfish	Sebastes chrysomelas
Black Rockfish	Sebastes melanops
Blackgill Rockfish	Sebastes melanostomus
Blue Rockfish	Sebastes mystinus
Bocaccio Rockfish	Sebastes paucispinus
Bronzespotted Rockfish	Sebastes gilli
Brown Rockfish	Sebastes auriculatus
Calico Rockfish	Sebastes dalli
Canary Rockfish	Sebastes pinniger
Chameleon Rockfish	Sebastes phillipsi
Chilipepper Rockfish	Sebastes goodei
China Rockfish	Sebastes nebulosus
Common/Giant Pacific Octopus	Enteroctopus dofleini
Copper Rockfish	Sebastes caurinus
Cowcod Rockfish	Sebastes levis
Darkblotched Rockfish	Sebastes crameri
Dwarf-red Rockfish	Sebastes rufianus
Flag Rockfish	Sebastes rubrivinctus
Freckled Rockfish	Sebastes lentiginosus
Giant Grenadier	Albatrossia pectoralis
Gopher Rockfish	Sebastes carnatus
Grass Rockfish	Sebastes rastrelliger
Greenblotched Rockfish	Sebastes rosenblatti
Greenspotted Rockfish	Sebastes chlorostictus
Greenstriped Rockfish	Sebastes elongates
Grenadier Unid	Macrouridae
Halfbanded Rockfish	Sebastes semicinctus
Harlequin Rockfish	Sebastes variegatus
Honeycomb Rockfish	Sebastes umbrosus
Kelp Rockfish	Sebastes atrovirens
Lingcod	Ophiodon elongatus
Longspine Thornyhead	Sebastolobus altivelis
Mexican Rockfish	Sebastes macdonaldi
Northern Rockfish	Sebastes polyspinis
Octopus Unid	Octopoda
Olive Rockfish	Sebastes serranoides
Pacific Grenadier	Coryphaenoides acrolepis
Pacific Halibut	Hippoglossus stenolepis
Pacific Ocean Perch Rockfish	Sebastes alutus
Petrale Sole	Eopsetta jordani
Pink Rockfish	Sebastes eos
Pinkrose Rockfish	Sebastes simulator
Popeye Grenadier	Coryphaenoides cinereus
Prickly Shark	Echinorhinus cookei
Puget Sound Rockfish	Sebastes emphaeus
Pygmy Rockfish	Sebastes wilsoni
Quillback Rockfish	Sebastes maliger
Redbanded Rockfish	Sebastes babcocki

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Redstripe Rockfish	Sebastes proriger
Rockfish Unid	Sebastes
Rosethorn Rockfish	Sebastes helvomaculatus
Rosy Rockfish	Sebastes rosaceus
Rougheye Rockfish	Sebastes aleutianus
Sablefish	Anoplopoma fimbria
Semaphore Rockfish	Sebastes melanosema
Shark Unid	Squaliformes
Sharpchin Rockfish	Sebastes zacentrus
Shortbelly Rockfish	Sebastes jordani
Shortraker Rockfish	Sebastes borealis
Shortraker/Rougheye Rockfish	Sebastes Shortraker/Rougheye
Shortspine Thornyhead	Sebastolobus alascanus
Shortspine/ Longspine Thornyhead	Sebastolobus
Silvergray Rockfish	Sebastes brevispinus
Skate Unid	Rajidae
Speckled Rockfish	Sebastes ovalis
Splitnose Rockfish	Sebastes diploproa
Squarespot Rockfish	Sebastes hopkinsi
Starry Rockfish	Sebastes constellatus
Stripetail Rockfish	Sebastes saxicola
Swordspine Rockfish	Sebastes ensifer
Tiger Rockfish	Sebastes nigrocinctus
Treefish Rockfish	Sebastes serriceps
Vermilion Rockfish	Sebastes miniatus
Widow Rockfish	Sebastes entomelas
Yelloweye Rockfish	Sebastes ruberrimus
Yellowmouth Rockfish	Sebastes reedi
Yellowtail Rockfish	Sebastes flavidus

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Arrowtooth Flounder	Atheresthes stomias
Big Skate	Raja binoculata
Blue Shark	Prionace glauca
Brown Cat Shark	Apristurus brunneus
Canary Rockfish	Sebastes pinniger
Dover Sole	Microstomus pacificus
Giant Grenadier	Albatrossia pectoralis
Greenstriped Rockfish	Sebastes elongates
Lingcod	Ophiodon elongatus
Longnose Skate	Raja rhina
Pacific Cod	Gadus macrocephalus
Pacific Halibut	Hippoglossus stenolepis
Redbanded Rockfish	Sebastes babcocki
Rockfish Unid	Sebastes
Rougheye Rockfish	Sebastes aleutianus
Sablefish	Anoplopoma fimbria
Sandpaper Skate	Bathyraja kincaidii

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Sea Star Unid	Asteroidea
Shortraker Rockfish	Sebastes borealis
Shortraker/Rougheye Rockfish	Sebastes Shortraker/Rougheye
Shortspine Thornyhead	Sebastolobus alascanus
Skate Unid	Rajidae
Spiny Dogfish Shark	Squalus acanthias
Spotted Ratfish	Hydrolagus colliei
Tanner Unid Crab	Chionoecetes spp.
Tanneri Tanner Crab	Chionoecetes tanneri
Vermilion Rockfish	Sebastes miniatus
Yelloweye Rockfish	Sebastes ruberrimus

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

Fishery: California Nearshore Rockfish

1. Your name and title:

Nancy Gove, Observer Program Data Analyst

2. What is the name of your Observer Program?

West Coast Groundfish Observer Program (WCGOP)

3. In which NOAA Region is it implemented?

Northwest, Northwest Fisheries Science Center

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

1) Improve management of groundfish by improving estimate of total catch, primarily through ongoing collection of information on discarded catch that will complement current shoreside information on landed catch
2) Improve estimate of total catch of prohibited species in the groundfish fishery
3) Improve management by collecting better biological information from the groundfish fishery
4) Provide timely and efficient system for collection, storage, analysis and communication of information

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Bottom longline, fish pot, vertical hook and line, pole (commercial), other hook and line gear

5.2. Number of active vessels by gear and size category

In this fishery, the permits are associated directly with fishermen and not with vessels. The fisher may fish his permit(s) on multiple vessels. In this instance, the WCGOP selects and covers fishers, not vessels.

There are a total of 330 fishermen that have either a Nearshore Fishery Permit or Deeper Nearshore Species Fishery Permit that was renewed for 2005. From this group, there are 129 fishers in this fleet that actively fished their permit(s) (landings > 1000 lbs) during the last year and a half.

Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Average trip length is 1 day.

Table A - Observed Vessels and Trips by Month and Year (2004 – 2005)				
YEAR	**MONTH**	**VESSELS**	**TRIPS**	**AVERAGE TRIPS/VESSEL**
2004	01	3	5	1.67
	02	6	7	1.17
	03	11	30	2.73
	04	14	27	1.93
	05	22	69	3.14
	06	19	40	2.11
	07	7	19	2.71
	08	7	11	1.57
	09	8	13	1.63
	10	9	25	2.78
	11	5	11	2.20
	12	2	6	3.00
2005	01	7	9	1.29
	02	6	18	3.00
	03	3	6	2.00
	04	2	6	3.00
	05	10	25	2.50
	06	12	20	1.67
	07	10	29	2.90
	08	11	23	2.09
	09	8	24	3.00
	10	5	11	2.20

5.3. Number of ports and distribution of vessels and trips among ports

Vessel counts are for distinct vessels landing in each port. A single vessel may be counted multiple times if they landed in multiple ports.

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004	CA	AVILA	9	37
	CA	CRESCENT CITY	14	110
	CA	DANA POINT HARBOR	1	1
	CA	FORT BRAGG	4	16
	CA	LOS ANGELES AREA	1	3
	CA	MONTEREY	4	9
	CA	MORRO BAY	6	10
	CA	NEWPORT BEACH	3	5
	CA	OCEANSIDE	2	7
	CA	OXNARD	7	14
	CA	PRINCETON (HALF MOON BAY)	4	14
	CA	SAN DIEGO	6	26
	CA	SAN DIEGO AREA	1	1
	CA	SAN FRANCISCO	1	3

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004 Continued	CA	SANTA BARBARA	3	4
	CA	SANTA CRUZ	1	1
	CA	TRINIDAD	1	1
	CA	VENTURA	1	1
2005	CA	AVILA	4	12
	CA	BODEGA BAY	2	2
	CA	CRESCENT CITY	9	58
	CA	FORT BRAGG	4	12
	CA	LOS ANGELES	3	13
	CA	LOS ANGELES AREA	4	5
	CA	MONTEREY	3	6
	CA	MORRO BAY	2	11
	CA	OXNARD	2	2
	CA	PRINCETON (HALF MOON BAY)	5	22
	CA	SAN DIEGO	4	7
	CA	SAN DIEGO AREA	2	6
	CA	SAN FRANCISCO	2	5
	CA	SAN FRANCISCO AREA	1	4
	CA	SANTA CRUZ	3	4
	CA	TRINIDAD	2	3

6. *What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?*

There are 89 groundfish species managed through the policies of the Pacific Fishery Management Council's Groundfish Fishery Management Plan (FMP) (Appendix A). The groundfish species include:

Roundfish: sablefish, Pacific whiting, lingcod, cabezon, Pacific cod, and kelp greenling

Rockfish: 62 species of rockfish from the nearshore, shelf, and slope environments

Flatfish: 9 species of sole, Pacific sanddab, arrowtooth flounder, and starry flounder, but not Pacific halibut

The target strategies found in the observer data are shelf rockfish, nearshore rockfish, sheephead, rockfish, shark, nearshore mix, lingcod, cabezon, and California halibut. Retained species are presented in Appendix B

The major discard species by weight are cabezon, California sheephead, kelp bass, lingcod and sea stars. A list of discarded species are in Appendix C

The critical bycatch issues are:

Rebuilding groundfish species
- Bocaccio Rockfish
- Canary Rockfish
- Cowcod Rockfish
- Darkblotched Rockfish
- Pacific Ocean Perch

Widow Rockfish
Yelloweye Rockfish
Salmon

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

MSA

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Fish tickets (landing receipts), state port sampling

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Fish Ticket Data: 25 years (1981 to date)

This fishery functions primarily within CA state waters (within 3 mi) and has become a major fishery over the last two decades. State port sampling has been sporadic in the beginning of the fishery and CA has focused more sampling of the nearshore landings in recent years.

Consistency of data sets is not fully known. In the last five years, the data set is consistent with no known major gaps. The data set, however, is not 100% complete as fish tickets sometimes are never entered into the PacFIN data system.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Fish Ticket Data: trip id, landing date, port, state, processor, vessel, area, gear type, landed wt, catch category (single species or species group), catch condition, catch disposition, product form, product use, removal type

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

PacFIN Oracle database tables are directly available for use by the WCGOP

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling units in order
- Fisher
- Trips
- Set

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

The list of California Nearshore Rockfish fishers is generated as follows:

1. A request is submitted to CA Fish and Game for a list of all fishers having a Nearshore Fishery Permit or Deeper Nearshore Species Fishery Permit that was renewed for the current year.
2. The list is then culled to remove fishers with the following characteristics:
   a. The fisher has less than 1000 lbs of nearshore rockfish landings with fixed gear during the last year and a half.

9.3.2 Secondary Sampling Level (trips)

The selected fishers are required to notify WCGOP 24 hours before they leave on a fishing trip. We attempt to sample all trips for the period which a vessel is selected.

9.3.3 Other pertinent details

Catch categories were set up to be similar to the market categories on fish tickets.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Fishers are stratified into port groups and selected for two month periods.

The sampling occurs in 'selection cycles' which refer to the length of time given to select the entire fleet without replacement. Sampling cycles have been 6 months and 1 year long.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Since sampling is ongoing, we have defined the entire sampling period as a selection cycle, where we attempt to 'cycle' through all of the fishers in the fleet. The length of a selection cycle is determined by the desired sampling intensity and the anticipated availability of observers. For example, the current length of the selection cycle is 1 year. All fishers are selected for coverage in 2006.

Vessel selection is based on a stratified random sample, sampled without replacement. For each selection cycle, the vessels are assigned to port groups and then for each port group, randomly assigned to a 2-month period for observation. The port groups were chosen for logistical reasons, so that an observer can readily travel to any one of the ports in a group, given short notice. We've tried to allocate similar effort among port groups, but the effort has not been constant across the strata (port groups).

Once a vessel has been selected for observer coverage during a seven-month period, we attempt to sample every set on every trip until the trip limit has been met.

The set maybe subsampled or sampled in its entirety.

Changes Associated With the Implementation Of The Sampling Plan:

Certain vessels are not observed either because they are deemed unsafe or have no room for an observer.

When there is not an observer available to cover a trip, the vessel receives a waiver and the trip is not covered.

Sets have been missed or have incomplete data for a variety of reasons, such as observer illness, rough weather, gear problems.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers are responsible for entirely covering each fishing trip. While on board, the observer's duties, in order of priority, are as follows:

1. Record incidental takes of endangered species and marine mammals. Collect appropriate biological specimens.
2. Record interactions by marine mammals, sea turtles, and seabirds with fishing gear.
3. Estimate total catch weight, even for tows with 100% discard.
4. Estimate the weight of retained and discarded catch categories.
5. Sample discarded catch categories to determine species composition.
6. Document reasons for discard for each species and/or catch category.
7. Record weight, length, sex, and take necessary dissections from tagged fish.
8. Maintain the Observer Logbook.
9. Take biological samples such as sexed lengths, otoliths, stomachs, coral tissue, etc. from discarded individuals.
10. Sample retained catch categories to determine species composition.
11. Record weight, length, and viability of Pacific halibut.
12. Record sightings of marine mammals, sea turtles, and seabirds.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

Currently, we select the entire fleet (with landings >1,000 lbs) for coverage over one year.

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Our goal is to maximize coverage given our available resources.

9.9.3 Sample allocation of vessels and trips by gear/size group

Vessels are not separated into gear or size categories.

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.5 Sample allocation of trips in time and space

Attempted census

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

Not Applicable

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

NA

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The reports contain the following estimates from data combined with OR nearshore for targeted and rebuilding species:

By gear (Hook & Line, Pot), depth (0-10fm, 11-20fm, 21-50fm), area (north, south) and season (winter, summer)

Percentage of species/species group discarded/retained

The reports contain the following estimates from data combined with OR nearshore for rebuilding species:

By depth (0-10fm, 11-20fm, 21-50fm), area (north, south) and season (winter, summer)

lb/100lb retained nearshore species

The data are given to the stock assessment scientists who estimate bycatch per retained nearshore species. The bycatch ratio is expanded to estimate total bycatch using the amount of landed nearshore species from fish tickets. The caveat for this estimate is that neither the fisheries nor permit number/type is included on the fish ticket, so it is possible that landings from other fisheries may be included in the total landings used in the calculations.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Forecasts of bycatch based on ratios and expected catch are used to adjust cumulative trip limits as needed. Cumulative limits are set by gear type and area and are not allowed to carry over from one period to another. In general, the goal is for discarded and landed catch to equal the optimal yield.

The CA Nearshore fishery is a state managed fishery. There are federal limits for the open access fisheries, but states may set stricter limits.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Vessels with no sampling space for observer on deck
Vessels without sleeping room for observer
Vessels that are unsafe

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Some selected vessels cannot be observed due to size or safety constraints. Other selected vessels may switch to another fishery (e.g. crab or shrimp) and need to be covered for groundfish at a later point in the coverage cycle.

Vessel skippers occasionally avoid coverage by not returning phone calls or informing the program of fishing trips. In addition, selected trips are occasionally not sampled due to observer availability (observer may be injured or ill).

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

The CA nearshore fleet is fluid. As this is a small boat fleet, many vessels are trailered and are not necessarily located at a slip. In addition, this fleet is very weather dependent and fishing is hard to predict, even for the fisher. This makes this fleet difficult to track for both the observer program and state managers. However, this coming year, the program will be increasing its focus on this fleet and utilize a newly built automated system to track selected vessels more closely during their selection.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Due to limited resources, we are missing trips because the limited entry trawl and fixed gear fleets are the program's highest priority. In 2006, we're working on increasing the effort allocated to the open access fisheries. In 2004, our coverage was less than 5 percent.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

The port groups are distributed along the west coast. The number of vessels select from each port group is spread across the fishing seasons.

We do not have control over the specific locations or depths a vessel fishes.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

There is a potential for bias. Currently, ratio estimates have been used as a faster and simpler method for estimation. Small sample sizes in some port groups have resulted in the data being pooled across port groups, potentially biasing the estimates toward the port groups that are more heavily sampled. Also, ratio estimates from small sample sizes are biased.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Fish tickets are currently used by the program. Difficulties with this data set include delays in the electronic submission of the data (minimum of 2 month lag for a useable amount of data), incomplete data submission, and challenges with matching data to observer data due to erroneous dates or mismatched species/catch category assignments.

  Port sampling data exists but the quality, consistency and availability of this data needs to be addressed before considering use in any analysis.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  Video and/or scanner data does not exist for this fleet.

- ***Vessel Monitoring Systems (VMS)***

  VMS data is not collected for this fleet.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  No regularly scheduled nearshore fixed gear survey takes place on the West Coast.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Roving survey data does not exist for this fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Sharks	
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
California skate	*R. inornata*
Longnose skate	*R. rhina*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling	*Antimora microlepis*
Grenadies	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
Lingcod	*Ophiodon elongatus*
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*
Harlequin rockfish	*S. variegatus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Black and Yellow Rockfish	Sebastes chrysomelas
Black Rockfish	Sebastes melanops
Black Surfperch	Embiotoca jacksoni
Blue Rockfish	Sebastes mystinus
Bocaccio Rockfish	Sebastes paucispinus
Brown Rockfish	Sebastes auriculatus
Brown Smoothhound Shark	Mustelus henlei
Cabezon	Scorpaenichthys marmoratus
California Halibut	Paralichthys californicus
California Scorpionfish	Scorpaena guttata
California Sheephead	Semicossyphus pulcher
China Rockfish	Sebastes nebulosus
Copper Rockfish	Sebastes caurinus
Gopher Rockfish	Sebastes carnatus
Grass Rockfish	Sebastes rastrelliger
Greenspotted Rockfish	Sebastes chlorostictus
Jack Smelt	Atherinops californiensis
Kelp Greenling	Hexagrammos decagrammus
Kelp Rockfish	Sebastes atrovirens
King (Chinook) Salmon	Oncorhynchus tshawytscha
Leopard Shark	Triakis semifasciata
Lingcod	Ophiodon elongatus
Mackerel Unid	Scombridae
Ocean Whitefish	Caulolatilus princeps
Olive Rockfish	Sebastes serranoides
Quillback Rockfish	Sebastes maliger
Redbanded Rockfish	Sebastes babcocki
Rosy Rockfish	Sebastes rosaceus
Sanddab Unid	Citharichthys
Sheep Crab	Loxorhynchus grandis
Shovelnose Guitarfish	Rhinobatos productus
Soupfin Shark	Galeorhinus galeus
Treefish Rockfish	Sebastes serriceps
Vermilion Rockfish	Sebastes miniatus
White Croaker	Genyonemus lineatus
Widow Rockfish	Sebastes entomelas
Yellowtail Rockfish	Sebastes flavidus

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Barred Sand Bass	Paralabrax nebulifer
Bat Ray	Myliobatis californica
Big Skate	Raja binoculata
Black and Yellow Rockfish	Sebastes chrysomelas
Black Rockfish	Sebastes melanops
Black Surfperch	Embiotoca jacksoni
Blue Rockfish	Sebastes mystinus
Brown Rockfish	Sebastes auriculatus
Brown Smoothhound Shark	Mustelus henlei
Cabezon	Scorpaenichthys marmoratus
California Moray	Gymnothorax mordax
California Scorpionfish	Scorpaena guttata
California Sheephead	Semicossyphus pulcher
Canary Rockfish	Sebastes pinniger
China Rockfish	Sebastes nebulosus
Garibaldi	Hypsypops rubicundus
Gopher Rockfish	Sebastes carnatus
Grass Rockfish	Sebastes rastrelliger
Greenling Unid	Hexagrammidae
Halfmoon	Medialuna californiensis
Kelp Bass	Paralabrax clathratus
Kelp Greenling	Hexagrammos decagrammus
Kelp Rockfish	Sebastes atrovirens
Leopard Shark	Triakis semifasciata
Lingcod	Ophiodon elongatus
Longfin Sanddab	Citharichthys xanthostigma
Longnose Skate	Raja rhina
Mackerel Unid	Scombridae
Ocean Whitefish	Caulolatilus princeps
Olive Rockfish	Sebastes serranoides
Pacific Halibut	Hippoglossus stenolepis
Pacific Rock Crab	Cancer antennarius
Red Rock Crab	Cancer productus
Sargo	Anisotremus davidsonii
Sculpin Unid	Cottidae
Sea Star Unid	Asteroidea
Shovelnose Guitarfish	Rhinobatos productus
Silver (Coho) Salmon	Oncorhynchus kisutch
Spiny Dogfish Shark	Squalus acanthias
Spotted Ratfish	Hydrolagus colliei
Swell Shark	Cephaloscyllium ventriosum
Thornback Skate	Platyrhiniodis triseriata
Treefish Rockfish	Sebastes serriceps
Vermilion Rockfish	Sebastes miniatus
White Croaker	Genyonemus lineatus
Widow Rockfish	Sebastes entomelas
Wolf-eel	Anarrhichthys ocellatus
Yelloweye Rockfish	Sebastes ruberrimus
Yellowtail Rockfish	Sebastes flavidus

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

Fishery: Limited Entry Bottom Trawl

1. Your name and title:

Nancy Gove, Observer Program Data Analyst

2. What is the name of your Observer Program?

West Coast Groundfish Observer Program (WCGOP)

3. In which NOAA Region is it implemented?

Northwest, Northwest Fisheries Science Center

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

1) Improve management of groundfish by improving estimate of total catch, primarily through ongoing collection of information on discarded catch that will complement current shoreside information on landed catch
2) Improve estimate of total catch of prohibited species in the groundfish fishery
3) Improve management by collecting better biological information from the groundfish fishery
4) Provide timely and efficient system for collection, storage, analysis and communication of information

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Groundfish trawl, footrope < 8 inches (small footrope)
Groundfish trawl, footrope > 8 inches (large footrope)
Oregon set-back flatfish net

5.2. Number of active vessels by gear and size category

Vessels are not separated into gear or size categories.

Vessels are selected by permit (one permit per vessel). There are 180 Limited Entry Trawl Permits. 127 of these permits have been selected for the current coverage cycle. 53 permits have been assigned a status of non-active because the permit was not actively fished in the last year or the permit is currently not assigned to a vessel.

Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Average trip length is 3 days

Table A – Observed Vessels and Trips by Month and Year (2004 – 2005)				
YEAR	**MONTH**	**VESSEL COUNT**	**TRIP COUNT**	**AVERAGE TRIPS/VESSEL**
2004	01	17	48	2.82
	02	17	48	2.82
	03	24	56	2.33
	04	35	109	3.11
	05	15	63	4.20
	06	17	64	3.76
	07	18	58	3.22
	08	26	75	2.88
	09	22	53	2.41
	10	20	35	1.75
	11	18	31	1.72
	12	12	20	1.67
2005	01	16	37	2.31
	02	17	48	2.82
	03	23	65	2.83
	04	21	53	2.52
	05	23	62	2.70
	06	23	71	3.09
	07	21	75	3.57
	08	24	91	3.79
	09	13	35	2.69
	10	7	12	1.71

5.3. Number of ports and distribution of vessels and trips among ports

Vessel counts are for distinct vessels landing in each port. A single vessel may be counted multiple times if they landed in multiple ports.

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004	CA	AVILA	3	8
	CA	CRESCENT CITY	2	10
	CA	EUREKA	10	58
	CA	FORT BRAGG	9	45
	CA	MONTEREY	2	13
	CA	MORRO BAY	5	13
	CA	MOSS LANDING	6	37
	CA	PRINCETON (HALF MOON BAY)	6	51
	CA	SAN FRANCISCO	6	40
	OR	ASTORIA / WARRENTON	23	118
	OR	BROOKINGS	4	10
	OR	CHARLESTON (COOS BAY)	14	76

Table B – Observed Vessels and Trips by Port (2004 - 2005)				
YEAR	**STATE**	**PORT**	**VESSELS**	**TRIPS**
2004 Continued	OR	GARIBALDI (TILLAMOOK)	2	6
	OR	NEWPORT	15	41
	OR	PORT ORFORD	1	1
	WA	BELLINGHAM BAY	4	12
	WA	BLAINE	1	2
	WA	NEAH BAY	3	102
	WA	WESTPORT	5	17
2005	CA	CRESCENT CITY	5	16
	CA	EUREKA	11	40
	CA	FORT BRAGG	8	30
	CA	MONTEREY	1	13
	CA	MORRO BAY	4	12
	CA	MOSS LANDING	4	17
	CA	PRINCETON (HALF MOON BAY)	5	65
	CA	SAN FRANCISCO	5	26
	CA	SANTA CRUZ	1	6
	OR	ASTORIA / WARRENTON	26	112
	OR	BROOKINGS	3	8
	OR	CHARLESTON (COOS BAY)	16	64
	OR	GARIBALDI (TILLAMOOK)	1	1
	OR	NEWPORT	14	53
	WA	BELLINGHAM BAY	4	18
	WA	BLAINE	1	3
	WA	NEAH BAY	6	66
	WA	WESTPORT	2	8

6. *What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?*

There are 89 groundfish species managed through the policies of the Pacific Fishery Management Council's Groundfish Fishery Management Plan (FMP) (Appendix A). The groundfish species include:

Roundfish: sablefish, Pacific whiting, lingcod, cabezon, Pacific cod, and kelp greenling

Rockfish: 62 species of rockfish from the nearshore, shelf, and slope environments

Flatfish: 9 species of sole, Pacific sanddab, Arrowtooth flounder, and starry flounder, but not Pacific Halibut.

It is difficult to separate target species from species caught opportunistically and retained, so target strategies are used instead of target species. A list of retained species in Appendix B.

The target strategies used in vessel logbooks include:

- Nearshore Mix
- Deepwater Dover (Focus on Dover Rather Than Entire DTS)
- Dover Sole/Thornyheads/Sablefish complex (DTS)
- Thornyheads (Mixed)
- Bottom Rockfish-Shelf
- Bottom Rockfish-Slope
- Nearshore Mix

The target strategies used in 2004 observer trawl data are:

- Arrowtooth Flounder
- Bank Rockfish
- Bottom Rockfish Shelf
- Bottom Rockfish Slope
- California Halibut
- Dover Sole
- Dover, Thornyheads, and Sablefish
- Deep water Dover
- English Sole
- Longspine Thornyhead
- Shelf Rockfish – North
- Slope Rockfish – North
- Nearshore Mix
- Pacific Cod
- Pacific Ocean Perch
- Petrale Sole
- Rex Sole
- Rockfish
- Rock Sole
- Sablefish
- Sanddab
- Splitnose Rockfish
- Slope Rockfish – South
- Sand Sole
- Shortspine Thornyhead
- Mixed Thornyheads

The 30 species/species groups with the highest discard by weight in 2004 are listed below. A list of discarded species is in Appendix C.

COMMON_NAME	**SCIENTIFIC_NAME**
Anemone Unid	Actiniaria
Arrowtooth Flounder	Atheresthes stomias
Big Skate	Raja binoculata
Brown Cat Shark	Apristurus brunneus
Dover Sole	Microstomus pacificus
Dungeness Crab	Cancer magister

COMMON_NAME	SCIENTIFIC_NAME
English Sole	Pleuronectes vetulus
Giant Grenadier	Albatrossia pectoralis
Grenadier Unid	Macrouridae
Kelp, Rocks, Wood, etc Mud	Mud
Lingcod	Ophiodon elongatus
Longnose Skate	Raja rhina
Longspine Thornyhead	Sebastolobus altivelis
Pacific Grenadier	Coryphaenoides acrolepis
Pacific Hake	Merluccius productus
Pacific Halibut	Hippoglossus stenolepis
Pacific Sanddab	Citharichthys sordidus
Petrale Sole	Eopsetta jordani
Rex Sole	Errex zachirus
Sablefish	Anoplopoma fimbria
Sanddab Unid	Citharichthys
Sandpaper Skate	Bathyraja kincaidii
Shortspine Thornyhead	Sebastolobus alascanus
Shortspine/ Longspine Thornyhead	Sebastolobus
Skate Unid	Rajidae
Spiny Dogfish Shark	Squalus acanthias
Splitnose Rockfish	Sebastes diploproa
Spotted Ratfish	Hydrolagus colliei
Squid Unid	Teuthoidea
Tanner Unid Crab	Chionoecetes spp.

The critical bycatch issues are:

- Overfished groundfish species
  - Bocaccio Rockfish
  - Canary Rockfish
  - Cowcod Rockfish
  - Darkblotched Rockfish
  - Pacific Ocean Perch
  - Widow Rockfish
  - Yelloweye Rockfish
- Salmon

7. *Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)*

MSA

8. *In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.*

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Vessel Logbooks, Fish Tickets (landing receipts), state port sampling

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

Vessel Logbook Data: 25 years (1981 to date)

Fish Ticket Data: 25 years (1981 to date)

State port sampling: varies between the states, CA has collected sporadic data on groundfish since the 1940's; the other states, more recently.

Consistency of data sets is not fully known. For early years, logbook data is likely incomplete as only a subset of the data may have been key punched. In the last five years, the data sets are consistent with no known major gaps. However, the recent data sets are not 100% complete as logbooks and fish tickets sometimes are never entered into the PacFIN data system.

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

Logbook Data: vessel, departure date, return date, departure port, return port, crew size, net type, area, block number (10 x 10 min), haul set/up location (lat/long), depth, depth type, haul number, haul set/up date/time, haul duration, retained hailed pounds by catch category (single species or species group) (no information on discard is recorded)

Fish Ticket Data: trip id, landing date, port, state, processor, vessel, area, gear type, landed wt, catch category (single species or species group), catch condition, catch disposition, product form, product use, removal type

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

PacFIN Oracle database tables are directly available for use by the WCGOP

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

Sampling units in order

- Vessels
- Trips
- Tow

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Tow

9.3. How were the sampling frames established?

9.9.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

The list of Limited Entry Trawl vessels is generated as follows:

1. The NMFS NWR Limited Entry permit table is queried for a list of all LE Trawl permits that have been renewed for the current year. Only one permit per vessel is allowed.
2. The list is then culled to remove permits/vessels with the following characteristics:
   a. The permit was not assigned to a vessel during the last year and therefore is not being fished.
   b. The vessel is a mother ship that only participates in the Pacific Hake fishery and not the West Coast Groundfish fishery.
   c. The vessel does not have any groundfish landings with trawl gear during the last year.

9.9.2 Secondary Sampling Level (trips)

In an effort to keep the fishery open year round and the market supplied with fish, each species' annual quota is divided into six two-month limits. Each trawl vessel commonly makes 2 to 5 trips in a two-month period to catch their limits. Each selected vessel is required to notify WCGOP 24 hours before they leave on a fishing trip. We attempt to sample all trips for the period which a vessel is selected.

9.9.3 Other pertinent details

When sampling each tow, an observer can split the discard into separate categories, termed catch categories. These categories lessen the difficulty of matching observer discard data to fish ticket data (also recorded by catch category). Also, splitting the discard into categories allows the observer to focus on rarely caught overfished rockfish stocks by classifying them as a unique catch category and take their census, without having to count and weigh all of the discard.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

Vessels are stratified into port groups and selected for two month periods.

The sampling occurs in ‘selection cycles’ which refer to the length of time given to select the entire fleet without replacement. Sampling cycles have been 8, 10, and 12 months long, or 4, 5, and 6 2-month periods respectively.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Since sampling is ongoing, we have defined the entire sampling period as a selection cycle, where we attempt to ‘cycle’ through all of the vessels in the fleet. The length of a selection cycle is determined by the desired sampling intensity and the anticipated availability of observers. For example, an 8-month long selection cycle is broken into four 2-month periods. One fourth of the vessels in the fleet are selected during each period.

Vessel selection is based on a stratified random sample, sampled without replacement. For each selection cycle, the vessels are assigned to port groups and then for each port group, randomly assigned to a 2-month period for observation. The port groups were chosen for logistical reasons, so that an observer can readily travel to any one of the ports in a group, given short notice. We’ve tried to allocate similar effort among port groups, but the effort has not been constant across the strata (port groups).

Once a vessel has been selected for observer coverage during a two-month period, we attempt to sample every tow on every trip.

The tows are sorted into catch categories, corresponding to the fish market categories. Weights are estimated for the catch categories. Subsamples are taken from catch categories with multiple species. The observer focuses on sampling the discard. Hail weights and fish tickets are used for retained catch. The motivation behind this sampling scheme is to improve the detection of rare, overfished species in the catch.

Changes Associated With the Implementation Of The Sampling Plan:

Vessels do not always participate in the fishery during the period for which they were chosen. When a vessel does not fish in the period for which it is selected, it is selected for the next period.

Certain vessels are not observed either because they are deemed unsafe or have no room for an observer.

When there is not an observer available to cover a trip, the vessel receives a waiver and the trip is not covered.

Tows have been missed or have incomplete data for a variety of reasons, such as observer illness, rough weather, gear problems, catch being dumped before being brought onboard.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers are responsible for entirely covering each fishing trip. While on board, the observer's duties, in order of priority, are as follows:

1. Record incidental takes of endangered species and marine mammals. Collect appropriate biological specimens.
2. Record interactions by marine mammals, sea turtles, and seabirds with fishing gear.
3. Estimate total catch weight, even for tows with 100% discard.
4. Estimate the weight of retained and discarded catch categories.
5. Sample discarded catch categories to determine species composition.
6. Document reasons for discard for each species and/or catch category.
7. Record weight, length, sex, and take necessary dissections from tagged fish.
8. Maintain the Observer Logbook.
9. Take biological samples such as sexed lengths, otoliths, stomachs, coral tissue, etc. from discarded individuals.
10. Sample retained catch categories to determine species composition.
11. Record weight, length, and viability of Pacific halibut.
12. Record sightings of marine mammals, sea turtles, and seabirds.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1. Target sample sizes (vessels, trips) by stratum (if applicable)

Currently, we select one-fifth of the vessels.

9.9.2. Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Our goal is to maximize coverage given our available resources.

9.9.3. Sample allocation of vessels and trips by gear/size group

Vessels are not separated into gear or size categories.

9.9.4. Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.5. Sample allocation of trips in time and space

Attempted census.

9.9.6. Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Attempted census

9.9.7. Allocation of sampling effort within trips between night and day (if applicable)

Not Applicable

9.9.8. Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

NA

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The reports contain the following estimates for 32 assessed and overfished species and species groups:

By area (North/South) and depth group (0-75fm, 75-150fm, >150fm)
Percentage of species/species group discarded/retained

By area, depth, and period
Discarded lbs/ hour of towing
Discarded lbs/100lbs of retained groundfish
Percent of species discarded from total catch

The reports contain the following estimates for overfished species:
By area, depth, and period
lb/100lb retained groundfish

The data are given to stock assessment scientists who estimate discard ratios by depth and area. The total discard is then estimated by expanding the discard ratios for the amount of landed catch (using fish tickets) and logbooks (for the distribution of fishing effort i.e., depth).

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

Forecasts of bycatch based on ratios and expected catch are used to adjust cumulative trip limits as needed. Cumulative limits are set by gear type and area and are not allowed to carry over from one period to another. In general, the goal is for discarded and landed catch to equal the optimal yield.

For the rebuilding species, the preseason numbers are provided to the groundfish management team. This team is an advisory body associated with the Council and provides advice for Council decisions.

Post season, bycatch data is used to estimate if overfishing has occurred.

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Vessels with no sampling space for observer on deck
Vessels without sleeping room for observer
Vessels that are unsafe

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Some selected vessels cannot be observed due to size or safety constraints. Other selected vessels may switch to another fishery (e.g. crab or shrimp) and need to be covered for groundfish at a later point in the coverage cycle.

Vessel skippers occasionally avoid coverage by not returning phone calls or informing the program of fishing trips. In addition, selected trips are occasionally not sampled due to observer availability (observer may be injured or ill).

12.3. *What is the level of compliance (proportion of selected vessels/trips that take observers)?*

The limited entry trawl fleet is relatively compliant. As the number of non-compliant vessels has been low in this fleet to date (estimated at less than 5% of vessels, program wide; even lower in this LE trawl fleet), the program has focused on other priorities such as observer safety, sampling protocol, data quality. This year the program will utilize a newly built automated system to track selected vessels more closely during their selection.

12.4. *Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?*

Overall, we are satisfied with our coverage. However, the actual coverage level for the port groups does vary a bit from period to period. Reasons for this variation are the small number of vessels in some port group and the logistical issues that come with covering a fishery. For example, we can control when the vessels are selected for observation, but we have no control over where they fish, how often they fish, or even if they fish in the period for which they are selected as many of the fishers participate in other fisheries through out the year.

For 2004, it is roughly estimated that we observed 24% of the fish tickets, 28% of the sum of the vessels fishing in each period across all periods, and 27% of the metric tons landed by this fleet.

12.5. *Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?*

The port groups are distributed along the west coast. The number of vessels select from each port group is spread across the periods. Occasionally, a port group will not have a vessel selected for a period. The lack of selected vessel occurs because some of the port groups have a small list of vessel. Again, the port groups are determined by logistical needs, not statistical design.

We do not have control over the specific locations or depths a vessel fishes.

12.6. *Is there any basis for believing that the estimators employed may result in a bias?*

There is a potential for bias. Currently, ratio estimates have been used as a faster and simpler method for estimation. Small sample sizes in some port groups have resulted in the data being pooled across port groups, potentially biasing the estimates toward the port groups that are more heavily sampled. Also, ratio estimates from small sample sizes are biased.

13. *In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing*

and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Logbooks and fish tickets are currently used by the program.

  Difficulties with these data sets include

    Delays in the electronic submission of the data (minimum of 2 month lag to get useful fish ticket data and logbooks are not available until the April after the year the fishing occurs),

    Incomplete data submission, and

    Challenges with matching data to observer data due to erroneous dates or mismatched species/catch category assignments.

  Port sampling data exists but the quality, consistency and availability of this data needs to be addressed before considering use in any analysis.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  Video and/or scanner data does not exist for this fleet.

- ***Vessel Monitoring Systems (VMS)***

  VMS data for the Limited Entry Trawl fleet is collected by NMFS enforcement. The data, however, is likely of limited use due to infrequent pooling rates and the inability to conclusively determine if fishing is in progress (net sensor information is not coupled with the location data). Also since enforcement does not allow direct access to their database, data must be exported and loaded into independent tables in order to be used.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  Limitations of the West Coast Groundfish Survey data are as follows:

  1. The survey is only conducted during the summer months while the commercial fishery is year round.
  2. Tows are only made during the daytime while the commercial fleet fishes 24/7.

3. Tows are limited to 15 minutes while the commercial tows are usually an hour or longer.
4. The trawl net used for the survey is not a standard commercial fishing net.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Roving survey data does not exist for this fleet.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Sharks	
Leopard shark	*Triakis semifasciata*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
California skate	*R. inornata*
Longnose skate	*R. rhina*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling	*Antimora microlepis*
Grenadies	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
Lingcod	*Ophiodon elongates*
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*S. rufus*
Black rockfish	*S. melanops*
Black and yellow rockfish	*S. chrysomelas*
Blackgill rockfish	*S. melanostomus*
Blue rockfish	*S. mystinus*
Bocaccio	*S. paucispinis*
Bronzespotted rockfish	*S. gilli*
Brown rockfish	*S. auriculatus*
Calico rockfish	*S. dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*S. phillipsi*
Chilipepper	*S. goodei*
China rockfish	*S. nebulosus*
Copper rockfish	*S. caurinus*
Cowcod	*S. levis*
Darkblotched rockfish	*S. crameri*
Dusky rockfish	*S. ciliatus*
Dwarf-red rockfish	*S. rufinanus*
Flag rockfish	*S. rubrivinctus*
Freckled rockfish	*S lentiginosus*
Gopher rockfish	*S. carnatus*
Grass rockfish	*S. rastrelliger*
Greenblotched rockfish	*S. rosenblatti*
Greenspotted rockfish	*S. chlorostictus*
Greenstriped rockfish	*S. elongatus*
Halfbanded rockfish	*S. semicinctus*

Appendix A – Common and scientific names of species included in this Fisheries Management Plan.	
Common Name	**Scientific Name**
Harlequin rockfish	*S. variegatus*
Honeycomb rockfish	*S. umbrosus*
Kelp rockfish	*S. atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*S. serranoides*
Pink rockfish	*S. eos*
Pinkrose rockfish	*S. simulator*
Pygmy rockfish	*S. wilsoni*
Pacific ocean perch	*S. alutus*
Quillback rockfish	*S. maliger*
Redbanded rockfish	*S. babcocki*
Redstripe rockfish	*S. proriger*
Rosethorn rockfish	*S. helvomaculatus*
Rosy rockfish	*S. rosaceus*
Rougheye rockfish	*S. aleutianus*
Sharpchin rockfish	*S. zacentrus*
Shortbelly rockfish	*S. jordani*
Shortraker rockfish	*S. borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*S. ovalis*
Splitnose rockfish	*S. diploproa*
Squarespot rockfish	*S. hopkinsi*
Starry rockfish	*S. constellatus*
Stripetail rockfish	*S. saxicola*
Swordspine rockfish	*S. ensifer*
Tiger rockfish	*S. nigrocinctus*
Treefish	*S. serriceps*
Vermilion rockfish	*S. miniatus*
Widow rockfish	*S. entomelas*
Yelloweye rockfish	*S. ruberimus*
Yellowmouth rockfish	*S. reedi*
Yellowtail rockfish	*S. flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Arrowtooth Flounder	Atheresthes stomias
Aurora Rockfish	Sebastes aurora
Bank Rockfish	Sebastes rufus
Bigmouth Sole	Hippoglossina stomata
Black Rockfish	Sebastes melanops
Black and Yellow Rockfish	Sebastes chrysomelas
Blackgill Rockfish	Sebastes melanostomus
Blue Rockfish	Sebastes mystinus
Bocaccio Rockfish	Sebastes paucispinus
Bronzespotted Rockfish	Sebastes gilli
Brown Rockfish	Sebastes auriculatus
Butter Sole	Pleuronectes isolepis
C-O (C-O Turbot) Sole	Pleuronichthys coenosus
Calico Rockfish	Sebastes dalli
California Halibut	Paralichthys californicus
Canary Rockfish	Sebastes pinniger
Chameleon Rockfish	Sebastes phillipsi
Chilipepper Rockfish	Sebastes goodei
China Rockfish	Sebastes nebulosus
Common/Giant Pacific Octopus	Enteroctopus dofleini
Copper Rockfish	Sebastes caurinus
Cowcod Rockfish	Sebastes levis
Curlfin Turbot	Pleuronichthys decurrens
Darkblotched Rockfish	Sebastes crameri
Deepsea Sole	Embassichthys bathybius
Diamond Turbot	Hypsopsetta guttulata
Dover Sole	Microstomus pacificus
Dwarf-red Rockfish	Sebastes rufianus
English Sole	Pleuronectes vetulus
Fantail Sole	Xystreurys liolepis
Flag Rockfish	Sebastes rubrivinctus
Flatfish Unid	Pleuronectiformes
Flathead Sole	Hippoglossoides elassodon
Freckled Rockfish	Sebastes lentiginosus
Giant Grenadier	Albatrossia pectoralis
Gopher Rockfish	Sebastes carnatus
Grass Rockfish	Sebastes rastrelliger
Green Sturgeon	Acipenser medirostris
Greenblotched Rockfish	Sebastes rosenblatti
Greenland Turbot	Reinhardtius hippoglossoides
Greenspotted Rockfish	Sebastes chlorostictus
Greenstriped Rockfish	Sebastes elongates
Grenadier Unid	Macrouridae
Halfbanded Rockfish	Sebastes semicinctus
Harlequin Rockfish	Sebastes variegatus
Honeycomb Rockfish	Sebastes umbrosus
Hornyhead Turbot	Pleuronichthys verticalis
Hybrid Sole	Inopsetta ischyra
Kelp Rockfish	Sebastes atrovirens
Lingcod	Ophiodon elongatus

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Longfin Sanddab	Citharichthys xanthostigma
Longspine Thornyhead	Sebastolobus altivelis
Mexican Rockfish	Sebastes macdonaldi
Northern Rockfish	Sebastes polyspinis
Octopus Unid	Octopoda
Olive Rockfish	Sebastes serranoides
Pacific Cod	Gadus macrocephalus
Pacific Grenadier	Coryphaenoides acrolepis
Pacific Ocean Perch Rockfish	Sebastes alutus
Pacific Sanddab	Citharichthys sordidus
Petrale Sole	Eopsetta jordani
Pink Rockfish	Sebastes eos
Pinkrose Rockfish	Sebastes simulator
Popeye Grenadier	Coryphaenoides cinereus
Puget Sound Rockfish	Sebastes emphaeus
Pygmy Rockfish	Sebastes wilsoni
Quillback Rockfish	Sebastes maliger
Ray Unid	Myliobatoidea
Redbanded Rockfish	Sebastes babcocki
Redstripe Rockfish	Sebastes proriger
Rex Sole	Errex zachirus
Rock Sole	Pleuronectes bilineatus
Rockfish Unid	Sebastes
Rosethorn Rockfish	Sebastes helvomaculatus
Rosy Rockfish	Sebastes rosaceus
Rougheye Rockfish	Sebastes aleutianus
Roughscale Sole	Clidoderma asperrimum
Sablefish	Anoplopoma fimbria
Sand Sole	Psettichthys melanostictus
Sanddab Unid	Citharichthys
Semaphore Rockfish	Sebastes melanosema
Shark Unid	Squaliformes
Sharpchin Rockfish	Sebastes zacentrus
Shortbelly Rockfish	Sebastes jordani
Shortraker Rockfish	Sebastes borealis
Shortraker/Rougheye Rockfish	Sebastes Shortraker/Rougheye
Shortspine Thornyhead	Sebastolobus alascanus
Shortspine/ Longspine Thornyhead	Sebastolobus
Silvergray Rockfish	Sebastes brevispinus
Skate Unid	Rajidae
Slender Sole	Eopsetta exilis
Soupfin Shark	Galeorhinus galeus
Speckled Rockfish	Sebastes ovalis
Speckled Sanddab	Citharichthys stigmaeus
Spiny Dogfish Shark	Squalus acanthias
Splitnose Rockfish	Sebastes diploproa
Spotted Turbot	Pleuronichthys ritteri
Squarespot Rockfish	Sebastes hopkinsi
Starry Flounder	Platichthys stellatus
Starry Rockfish	Sebastes constellatus

Appendix B – Landed Species	
COMMON NAME	**SCIENTIFIC NAME**
Stripetail Rockfish	Sebastes saxicola
Swordspine Rockfish	Sebastes ensifer
Tiger Rockfish	Sebastes nigrocinctus
Treefish Rockfish	Sebastes serriceps
Vermilion Rockfish	Sebastes miniatus
Walleye Pollock	Theragra chalcogramma
White Croaker	Genyonemus lineatus
Widow Rockfish	Sebastes entomelas
Wolf-eel	Anarrhichthys ocellatus
Yelloweye Rockfish	Sebastes ruberrimus
Yellowmouth Rockfish	Sebastes reedi
Yellowtail Rockfish	Sebastes flavidus

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
American Shad	Alosa sapidissima
Anemone Unid	Actiniaria
Angulatus Tanner Crab	Chionoecetes angulatus
Armored Box Crab	Mursia gaudichaudi
Arrowtooth Flounder	Atheresthes stomias
Aurora Rockfish	Sebastes aurora
Bat Ray	Myliobatis californica
Big Skate	Raja binoculata
Bigfin Eelpout	Lycodes cortezianus
Black Rockfish	Sebastes melanops
Black Skate	Bathyraja trachura
Blackgill Rockfish	Sebastes melanostomus
Bocaccio Rockfish	Sebastes paucispinus
Brittle/Basket Star Unid	Ophiuroidea
Brown Box Crab	Lopholithodes foraminatus
Brown Cat Shark	Apristurus brunneus
Brown Smoothhound Shark	Mustelus henlei
Butter Sole	Pleuronectes isolepis
California Grenadier	Nezumia stelgidolepis
California Halibut	Paralichthys californicus
California Skate	Raja inornata
California Slickhead	Alepocephalus tenebrosus
Canary Rockfish	Sebastes pinniger
Cat Unid Shark	Scyliorhinidae
Chilipepper Rockfish	Sebastes goodei
Corals Unid	Alyconaria
Cowcod Rockfish	Sebastes levis
Curlfin Turbot	Pleuronichthys decurrens
Darkblotched Rockfish	Sebastes crameri
Decomposed Fish	Decomposed fish
Deepsea Sole	Embassichthys bathybius
Dogfish Unid Shark	Squalus sp.
Dover Sole	Microstomus pacificus
Dungeness Crab	Cancer magister

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Eelpout Unid	Zoarcidae gnn.
Egg case Unid	Egg case unid
English Sole	Pleuronectes vetulus
Filetail Cat Shark	Parmaturus xaniurus
Flatfish Unid	Pleuronectiformes
Flathead Sole	Hippoglossoides elassodon
Garbage/ Trash	Cans, bottles, old line, etc.
Giant Grenadier	Albatrossia pectoralis
Green Sturgeon	Acipenser medirostris
Greenspotted Rockfish	Sebastes chlorostictus
Greenstriped Rockfish	Sebastes elongates
Grenadier Unid	Macrouridae
Hornyhead Turbot	Pleuronichthys verticalis
Invertebrate Unid	Animalia
Irregular Echinoids	Echinoidea
Jellyfish Unid	Scyphozoa
Kelp, Rocks, Wood, etc Mud	Mud
King (Chinook) Salmon	Oncorhynchus tshawytscha
Leopard Shark	Triakis semifasciata
Lingcod	Ophiodon elongatus
Longnose Cat Shark	Apristurus kampae
Longnose Skate	Raja rhina
Longspine Combfish	Zaniolepis latipinnis
Longspine Thornyhead	Sebastolobus altivelis
Octopus Unid	Octopoda
Pacific Cod	Gadus macrocephalus
Pacific Electric Ray	Torpedo californica
Pacific Flatnose	Antimora microlepis
Pacific Grenadier	Coryphaenoides acrolepis
Pacific Hake	Merluccius productus
Pacific Halibut	Hippoglossus stenolepis
Pacific Ocean Perch Rockfish	Sebastes alutus
Pacific Sanddab	Citharichthys sordidus
Pacific Sleeper Shark	Somniosus pacificus
Petrale Sole	Eopsetta jordani
Pink Surfperch	Zalembius rosaceus
Plainfin Midshipman	Porichthys notatus
Popeye Grenadier	Coryphaenoides cinereus
Ragfish	Icosteus aenigmaticus
Red Rock Crab	Cancer productus
Redbanded Rockfish	Sebastes babcocki
Redstripe Rockfish	Sebastes proriger
Rex Sole	Errex zachirus
Rock Sole	Pleuronectes bilineatus
Rosethorn Rockfish	Sebastes helvomaculatus
Rougheye Rockfish	Sebastes aleutianus
Sablefish	Anoplopoma fimbria
Sand Sole	Psettichthys melanostictus
Sanddab Unid	Citharichthys
Sandpaper Skate	Bathyraja kincaidii

Appendix C – Discarded Species	
COMMON NAME	**SCIENTIFIC NAME**
Sculpin Unid	Cottidae
Sea Cucumber Unid	Holothuroidea
Sea Pen/Whip Unid	Pennatulacea
Sea Snail Unid	Gastropoda
Sea Star Unid	Asteroidea
Sharpchin Rockfish	Sebastes zacentrus
Shortbelly Rockfish	Sebastes jordani
Shortraker Rockfish	Sebastes borealis
Shortraker/Rougheye Rockfish	Sebastes Shortraker/Rougheye
Shortspine Thornyhead	Sebastolobus alascanus
Shortspine/Longspine Thornyhead	Sebastolobus
Silvergray Rockfish	Sebastes brevispinus
Skate Unid	Rajidae
Slender Sole	Eopsetta exilis
Slickhead Unid	Alepocephalidae
Snailfish Unid	Liparis
Spiny Dogfish Shark	Squalus acanthias
Splitnose Rockfish	Sebastes diploproa
Sponge Unid	Porifera
Spotted Ratfish	Hydrolagus colliei
Squid Unid	Teuthoidea
Starry Flounder	Platichthys stellatus
Starry Skate	Raja stellulata
Striped Bass	Morone saxatilis
Stripetail Rockfish	Sebastes saxicola
Tanner Unid Crab	Chionoecetes spp.
Tanneri Tanner Crab	Chionoecetes tanneri
Threadfin Sculpin	Icelinus filamentosus
Twoline Eelpout	Bothrocara brunneum
Urchin Unid	Echinoidea
Walleye Pollock	Theragra chalcogramma
White Croaker	Genyonemus lineatus
Widow Rockfish	Sebastes entomelas
Wolf-eel	Anarrhichthys ocellatus
Yelloweye Rockfish	Sebastes ruberrimus
Yellowtail Rockfish	Sebastes flavidus

SOUTHWEST FISHERIES SCIENCE CENTER

North Pacific Albacore Troll Observer Program
Pacific Albacore Troll Fishery
California/Oregon Drift Gilllnet Fishery
California Coastal Pelagic Species Observer Program
California Coastal Purse Seine Fishery
California Pelagic Longline Fishery
California Pelagic Longline Observer Program
Southern California Small Mesh Drift Gillnet Observer Program

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

North Pacific Albacore Troll Observer Program

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Troll Lines

5.2. Number of active vessels by gear and size category

800

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically one week or one month long. Fishing occurs from May through November. Shorter trips fish coastally, longer trips fish on the high seas.

5.4. Number of ports and distribution of vessels and trips among ports

All ports of California, Oregon, and Washington.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: Albacore. Major Bycatch: None. Critical Bycatch: None.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

Highly Migratory Species (HMS) Fishery Management Plan

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present
Logbooks: 1961 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes: Fishing Logbook data set includes: Date, Latitude and Longitude, Gear Characteristics, Catch and Disposition of Catch

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle
Logbooks: MS Access

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Day Fished

9.3. ***How were the sampling frames established?***

9.3.1 ***Primary Sampling Level (e.g., yearly list of active vessels by gear/size)***

Albacore troll gear endorsement on HMS permit

9.3.2 Secondary Sampling Level (trips)

XXXXXXXXX

9.3.3 Other pertinent details

XXXXXXXXX

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Ad-hoc

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire Trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

1 % of days fished

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random);

Census

9.9.5 Sample allocation of trips in time and space

Opportunistic sampling of trips.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Census

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

XXXXXXXXX

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

XXXXXXXXX

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

XXXXXXXXX

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1 Is the list of active vessels complete and up-to-date?

Yes

12.1.2 Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes - Small vessels with no space for observers.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Small vessels with no space for observers.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Yes

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

No

12.6. Is there any basis for believing that the estimators employed may result in a bias?

XXXXXXXXX

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  On-board observer program is at pilot stage. Fleet is large and obtaining a significant sample size using on-board observers would be expensive.

Vessel Monitoring Systems (VMS)

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

XXXXXXXXX

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

Pacific Albacore Troll Fishery

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Troll Lines

5.2. Number of active vessels by gear and size category

800

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically one week or one month long. Fishing occurs from May through November. Shorter trips fish coastally, longer trips fish on the high seas.

5.4. Number of ports and distribution of vessels and trips among ports

All ports of California, Oregon, and Washington.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: Albacore. Major Bycatch: None. Critical Bycatch: None.

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

HMS FMP

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes:

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Day Fished

9.3. ***How were the sampling frames established?***

9.3.1 ***Primary Sampling Level (e.g., yearly list of active vessels by gear/size)***

Albacore troll gear endorsement on HMS permit

9.3.2 ***Secondary Sampling Level (trips)***

9.3.3 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Ad-hoc

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire Trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

1 % of days fished

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Census

9.9.5 Sample allocation of trips in time and space

Opportunistic sampling of trips.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

All

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes - Small vessels with no space for observers.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Small vessels with no space for observers.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Yes

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

No

12.6. Is there any basis for believing that the estimators employed may result in a bias?

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore]***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

California/Oregon Drift Gilllnet Fishery

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Drift Gillnet (mesh size >= 14")

5.2. Number of active vessels by gear and size category

40

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically 7 to 10 days long. The fishery is closed within 200 miles of the coast of California and Oregon from February 1 to April 30. From May 1 to August 14 the closure changes to 75 miles offshore. Most fishing occurs between August 15 and January 31, when closure restrictions are lifted. The majority of fishing effort takes place from October through December.

5.4. Number of ports and distribution of vessels and trips among ports

5 to 7 Southern and Central California ports, occasionally trips depart from Washington. Most trips leave from San Diego.

6. ***What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?***

Target: Swordfish and Thresher Shark. Major Bycatch: Blue Shark and Common Mola. Critical Bycatch: Sea Turtles and Endangered Marine Mammals.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MMPA Category I, Highly Migratory Species (HMS) Fishery Management Plan (FMP)

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes:

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Annual list of MMAP permitted drift gillnet vessels.

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

Vessels are required to notify contractor prior to planned departure.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

Each observable vessel is sampled at slightly higher than 20% of its trips.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire trip (5 set minimum)

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

20% of sets

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Census

9.9.5 Sample allocation of trips in time and space

Directly proportional to fishing effort.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

All

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes - Small vessels with no space for observers.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Small vessels with no space for observers.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

- ***Vessel Monitoring Systems (VMS)***

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial*** *fishery; Are the surveys limited to daytime tows/sets?)*

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

California Coastal Pelagic Species Observer Program

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Purse Seine

5.2. Number of active vessels by gear and size category

70

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically 1 to 2 days long. Fishing occurs all year. Tuna fishing occurs during summer months.

5.4. Number of ports and distribution of vessels and trips among ports

11 ports, most trips depart from Los Angeles, Monterey/Moss Landing, and Ventura.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: Squid, Sardine, Mackerel, Anchovy, Tunas. Major Bycatch: None. Critical Bycatch: Endangered Salmon (none observed).

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MMPA Category II, Coastal Pelagic Species (CPS) Fishery Management Plan, Highly Migratory Species (HMS) Fishery Management Plan

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes: Fishing Logbook data set includes: Date, Latitude and Longitude, Gear Characteristics, Catch and Disposition of Catch

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Annual list of MMAP permitted vessels, CPS limited entry permits, purse seine gear endorsement on HMS permit.

9.3.2 Secondary Sampling Level (trips)

XXXXXXXXX

9.3.3 Other pertinent details

Vessels are required to notify contractor prior to planned departure.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

100% of tuna trips are observed. 10% of all other trips per vessel are observed.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire Trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

100% of tuna sets, 10% of all other sets

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Census

9.9.5 Sample allocation of trips in time and space

Directly proportional to fishing effort.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Census

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

XXXXXXXXX

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

XXXXXXXXX

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

XXXXXXXXX

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1 Is the list of active vessels complete and up-to-date?

Yes

12.1.2 Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Low vessel call-in compliance.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Yes - tuna trips, No - other trips

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

XXXXXXXXX

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

XXXXXXXXX

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey***

sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  Observer program is in the pilot stage. Do not yet know if observed sets are representative of total effort.

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  Observer program is in the pilot stage. Do not yet know if observed sets are representative of total effort.

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

California Coastal Purse Seine Fishery

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Purse Seine

5.2. Number of active vessels by gear and size category

70

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically 1 to 2 days long. Fishing occurs all year. Tuna fishing occurs during summer months.

5.4. Number of ports and distribution of vessels and trips among ports

11 ports, most trips depart from Los Angeles, Monterey/Moss Landing, and Ventura.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: Squid, Sardine, Mackerel, Anchovy, Tunas. Major Bycatch: None. Critical Bycatch: Endangered Salmon (none observed).

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MMPA Category II, Coastal Pelagic Species (CPS) FMP, HMS FMP

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes:

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Annual list of MMAP permitted vessels, CPS limited entry permits, tuna purse seine gear endorsement on HMS permit.

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

Vessels are required to notify contractor prior to planned departure.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

100% of tuna trips are observed. 10% of all other trips per vessel are observed.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire Trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

100% of tuna sets, 10% of all other sets

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Census

9.9.5 Sample allocation of trips in time and space

Directly proportional to fishing effort.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

All

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Low vessel call-in compliance.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

Yes - tuna target, No - other target

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore]***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

California Pelagic Longline Fishery

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Pelagic Longline

5.2. Number of active vessels by gear and size category

1

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically 30 days long. The majority of the fishing effort takes place from September through May. Year-round the fishery is closed within 200 miles of the U.S. West Coast.

5.4. Number of ports and distribution of vessels and trips among ports

Los Angeles and Ventura

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: Tunas. Major Bycatch: Blue Shark. Critical Bycatch: Sea Turtles.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MMPA Category II, HMS FMP

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes:

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Annual list of MMAP permitted longline vessels, longline gear endorsement on HMS permit

9.3.2 Secondary Sampling Level (trips)

100% of trips are observed.

9.3.3 Other pertinent details

Vessels are required to notify contractor prior to planned departure.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

100% of trips are observed.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire Trip

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

100% of sets

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Census

9.9.5 Sample allocation of trips in time and space

100% of trips are observed.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

All

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

None

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore]***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Lyle Enriquez, Fishery Biologist

2. What is the name of your Observer Program?

California Pelagic Longline Observer Program

3. In which NOAA Region is it implemented?

Southwest

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below).

Document the incidental take of marine mammals, sea turtles, seabirds, target and non-target fish species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Pelagic Longline

5.2. Number of active vessels by gear and size category:

1

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips are typically 30 days long. The majority of the fishing effort takes place from September through May. Year-round the fishery is closed within 200 miles of the U.S. West Coast.

5.4. Number of ports and distribution of vessels and trips among ports

Los Angeles and Ventura

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target: Tunas. Major Bycatch: Blue Shark. Critical Bycatch: Sea Turtles.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

MMPA Category II, Highly Migratory Species Fishery Management Plan

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks, Landing Receipts

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Landings: 1981 to present
Logbooks: 1991 to present

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

Landings data set includes: Vessel ID, Vessel Type, Vessel Length, Vessel Weight, Gear Type, Days Fished, Area Fished, Date Landed, Port Landed, Weight Landed by Species, Ex-Vessel Value. Fishing Logbook data set includes: Fishing Logbook data set includes: Date, Latitude and Longitude, Gear Characteristics, Catch and Disposition of Catch

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Landings: Oracle, Logbooks: MS Access

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

Vessels, Trips

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

Annual list of MMAP permitted longline vessels, longline gear endorsement on HMS permit

9.3.2 Secondary Sampling Level (trips)

100% of trips are observed.

9.3.3 Other pertinent details

Vessels are required to notify contractor prior to planned departure.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

No

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

100% of trips are observed.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

1

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Entire Trip

9.9. Provide details of primary and secondary sample selection guidelines:

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

100% of sets

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

N/A

9.9.3 Sample allocation of vessels and trips by gear/size group

N/A

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Census

9.9.5 Sample allocation of trips in time and space

100% of trips are observed.

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Census

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

N/A

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

XXXXXXXXX

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

Estimates of protected species bycatch derived from ratio estimators, life history data for specimens (age, sex, length, sexual maturity, genetic stock identification)

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

XXXXXXXXX

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1 Is the list of active vessels complete and up-to-date?

Yes

12.1.2 Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

No

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that What is the level of compliance (proportion of selected vessels/trips that take observers)?

100%

12.3. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

No

12.4. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.5. Is there any basis for believing that the estimators employed may result in a bias?

No

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

XXXXXXXXX

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

XXXXXXXXX

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. ***Your name and title:***

   Lyle Enriquez, Fishery Biologist

2. ***What is the name of your Observer Program?***

   Southern California Small Mesh Drift Gillnet Observer Program

3. ***In which NOAA Region is it implemented?***

   Southwest

4. ***List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below):***

   Fishery is no longer observed.

5. ***Provide a general description of the fleet to which the program is applied***

   5.1. Gear type(s)

   5.2. Number of active vessels by gear and size category

   5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

   5.4. Number of ports and distribution of vessels and trips among ports

6. ***What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?***

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)***

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.***

   8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

   8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

   8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for

individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

8.4. Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability

9. Describe the Design of Your Observer Program

9.1. What are the primary and secondary sampling units (e.g., vessels; trips)

9.2. What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

9.7. Number of observers per trip?

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

9.9.3 Sample allocation of vessels and trips by gear/size group

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

9.9.5 Sample allocation of trips in time and space

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A ≤ 20%)

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

12.6. Is there any basis for believing that the estimators employed may result in a bias?

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***
- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***
- ***Vessel Monitoring Systems (VMS)***
- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***
- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***
- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***
- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***
- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***
- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

NATIONAL MARINE FISHERIES SERVICE,
PACIFIC ISLAND REGIONAL OFFICE

Hawaii Bottomfish
Hawaii Longline

Request for Information Needed to Evaluate Vessel Selection Bias in NOAA Observer programs

1. Your name and title:

Marti McCracken (Mathematical Statistician, PIFSC) and Jeremy Willson (Biologist, PIRO)

2. What is the name of your Observer Program?

Hawaii Bottomfish

3. In which NOAA Region is it implemented?

Pacific Island Region

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below)

The goal of the program is to document any incidental take of protected species and the rate of protected species interactions with bottomfishing operations. The program objectives are to obtain reliable information about interactions with the Hawaiian Monk Seal and other protected species, collect data on fishing effort, record composition of species caught, record retention and discard of catch, and collect basic biological information on the catch.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

The gear types include hook and line deployed near the bottom of the ocean at anchored or drifting stations. Trolling is done while moving between fishing grounds.

5.2. Number of active vessels by gear and size category

There are 9 bottomfishing boats and the size range is 40-50 feet.

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trips range in length from short trips 8-12 days to longer trips 20-30 days. Trips are distributed through the year with little seasonal changes. Historically there were around 150 trips per year.

5.4. Number of ports and distribution of vessels and trips among ports

Most vessels port on Oahu with two boats on Kauai and one on Maui.

6. ***What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?***

The major target species are Hapu'u'pu'u, opakapaka, onaga, and uku is the target trolling species. Major by-catch are kakala, ehu, and grouper species.

7. ***Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II):***

MMPA category III

8. ***In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data***

8.1. ***Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)***

Logbooks

8.2. ***Number of years of catch, landings, and effort data, and the consistency of data among years***

Since 1995 this data has been collected consistently.

8.3. ***Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other***

This data is available at the set level.

8.4. ***Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability***

Available as an ASCII or DBF file.

9. ***Describe the Design of Your Observer Program***

9.1. ***What are the primary and secondary sampling units (e.g., vessels; trips)***

The sampling unit is the trip

9.2. ***What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?***

Set

9.3. How were the sampling frames established?

9.3.1 Primary Sampling Level (e.g., yearly list of active vessels by gear/size)

A list of vessels with a permit.

9.3.2 Secondary Sampling Level (trips)

9.3.3 Other pertinent details

Historical logbook records were used to determine the historical activity level of each vessel.

9.4. Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?

The vessel is the strata and a set of trips for each vessel are selected randomly.

9.5. How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)

For each vessel, historical records were used to determine a rough estimate of the expected number of trips for the coming year. An equal probability sample of call-in numbers (the sample size is computed to provide approximately 20% coverage per vessel) is then selected between the number one and the expected number of trips for that vessel. Vessels are required to call-in 72 hours prior to departure. For each vessel these call-ins are recorded systematically and compared to the randomly selected call-in numbers with observers being placed on trips corresponding to the selected call-ins. If a vessel is more active than anticipated, a second set of numbers is drawn from the expected number plus one to twice the expected number. In essence, this represents a stratified sample, (the two strata defined by the two sets of numbers drawn) but for practical purposes it will likely not be treated as such.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers will stay with the fishing vessel the entire selected trip. Duties include recording the location of fishing operations, species caught and size, effort trolling, and observations of any protected species. After completing the trip the observer will return to port for debriefing and enter their data.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

20%

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

20% per vessel

9.9.3 Sample allocation of vessels and trips by gear/size group

20% per vessel

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

Not applicable

9.9.5 Sample allocation of trips in time and space

No

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

Not applicable

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

Not applicable

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

Historical logbook records are examined for each vessel's historical level activity.

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The primary objective is incidental take estimates of protected species. To date there has not been an observed incidental take of a turtle or marine mammal and there has been no formal estimation of takes for protected species. Since no incidental takes were recorded the point estimates for total take are zero; however, there has been no formal estimation of these takes. To estimate the uncertainty in these estimates will require some assumptions concerning the statistical distribution of the counts, such as being Poisson distributed.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

The estimates are used primarily to monitor the incidental take of monk seals

12. Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection

12.1. Regarding completeness of sampling frames

12.1.1. Is the list of active vessels complete and up-to-date?

Yes

12.1.2. Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?

Yes, there is one vessel considered unsuitable for an observer.

12.2. Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?

Availability of observers that are trained for the bottomfish fleet.

12.3. What is the level of compliance (proportion of selected vessels/trips that take observers)?

They are required to take the observer. If they cancel a trip after calling it in and an observer is suppose to be on the trip, an observer will be assigned to their next trip.

12.4. Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?

In the first year of the program there was a problem with the lack of trained observers for bottomfish and there were periods where several selected samples were missed.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Theoretically, they should be.

12.6. Is there any basis for believing that the estimators employed may result in a bias?

If the one vessel not subject to being sampled fishes in a manner more prone to interact with protected species, bias could be a problem although this is thought not to be the situation.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

To quantify the performance of the sampling protocol year 2005 data is required but is unavailable until later in year 2006.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Logbooks could be useful although misreporting, intentional and unintentional, can occur in the logbooks.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners.***

  This could be useful for the one vessel not in the sampling frame.

- ***Vessel Monitoring Systems (VMS)***

  Not available

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  It is difficult to closely mimic the commercial boats over time and space.

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Limited use.

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  Logbooks could be useful.

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  Could be useful to determine if the vessel not sampled behaves differently than the others.

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  Not appropriate for protected species.

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  Not appropriate for protected species but might be helpful for target species

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

  This could be useful when evaluating target species, but would likely not be useful for protected species.

Request for Information Needed to Evaluate Vessel Selection Bias in *NOAA Observer programs*

1. Your name and title:

Marti McCracken (Mathematical Statistician, PIFSC) and Jeremy Willson (Biologist, PIRO)

2. What is the name of your Observer Program?

Hawaii Longline

3. In which NOAA Region is it implemented?

Pacific Islands Region

4. List the primary general goals and objectives of the program (specific observer program design goals, such as percentage of vessels observed, will be addressed below)

The Primary goal is to obtain reliable information about the incidental interaction of sea turtles and other protected seabirds and marine mammals. Objectives also include recording accurate fishing effort, numbers of fishes kept and discarded, and collecting biological information from selected species.

5. Provide a general description of the fleet to which the program is applied

5.1. Gear type(s)

Tuna and swordfish gear both comprise of pelagic monofilament mainline with multiple hooks attached to monofilament or similar dropper lines. The differences between gear types are the depth hooks are set, types of hooks set, area fished, and predominant species caught.

5.2. Number of active vessels by gear and size category

The number of active vessels fishing for tuna is123, swordfish is 32, and 28 vessels fish for both tuna and swordfish. The smallest vessel fishing for tuna is 40 feet and the largest is 98 feet, and the smallest vessel fishing for swordfish is 62 feet and the largest is 85 feet. There are some differences in gear required to fish for swordfish, but any vessel could potentially fish for either species. This data is summarized from fishing effort from January 2005 until early November 2005.

5.3. Mode of operations (e.g., typical frequency of trips, length and timing of trips, seasonal distribution of trips)

Trip lengths are typically 15 to 25 days for tuna trips and 25 to 35 for swordfish trips. Historically, the tuna fleet has been most active from October through December and least active in July and August. The swordfishing fleet has historically been more active from March to June and less active from September to December. Year 2005 is the first complete year under new regulations for the longlining fleet (swordfishing re-opened mid-year 2004) and as year 2005 is still ongoing we are unable to summarize the distributions of trips. In 2004 there were 1332 longline tuna trips. Concerning recent observer coverage, observed fishing effort for tuna seems to increase through spring and summer. All trips fishing for swordfish are observed.

5.4. Number of ports and distribution of vessels and trips among ports

Honolulu, Oahu is the typical port of both fleets, occasionally other ports are used on Kauai, Hawaii, and California.

6. What are the target species of the fishery, the major by-catch species, and the critical by-catch issues?

Target species are Tuna and Swordfish with the major by-catch being sharks and dolphinfish. Critical by-catch issues for both fleets are protected species (turtles, seabirds and marine mammals).

7. Describe the authority or other basis under which your observer program operates (e.g., MSA, ESA, MMPA category I or II)

MMPA category I

8. In order to evaluate the sources, level, and implications of vessel selection bias in your observer program, details of the fishery to which it is applied must be known. Describe the type and characteristics of available data on the fishery other than observer data.

8.1. Source of data (e.g., log-books, trip-reports, dealer reports, port sampling)

Logbooks and Market data

8.2. Number of years of catch, landings, and effort data, and the consistency of data among years

First complete year was 1991 since then it has been consistent

8.3. Details included in annual catch, landings, and effort data sets, such as: vessel and/or vessel size category, trip, gear type, time interval (i.e., daily, monthly, quarterly, seasonal); catch information for individual tow or hauls?; spatial location of tows/sets (i.e., latitude-longitude, grid [10 min x 10 min] harvest area); other

All these categories are available at the set level.

8.4. *Format of the data (e.g., Oracle database; SAS datasets, Excel spreadsheets) and its availability Oracle database*

Raw data is available upon signing confidentiality and other forms.

9. *Describe the Design of Your Observer Program*

The swordfishing sector of the fleet has 100% observer coverage; therefore, the questions below are only answered for the tuna sector of the fleet.

9.1. *What are the primary and secondary sampling units (e.g., vessels; trips)*

The call-in number. The trip that corresponds to the call-in number that has been selected by a random process is sampled.

9.2. *What is the ultimate sampling unit (e.g., tow/set) from which observers collects data?*

Set.

9.3. *How were the sampling frames established?*

9.3.1 *Primary Sampling Level (e.g., yearly list of active vessels by gear/size)*

Each vessel is required to call-in 72 hours prior to departure. These calls are numbered sequentially as they are heard. From herein, this number is referred to as the call-in number. Prior to each quarter a random sample of call-in numbers is selected.

9.3.2 *Secondary Sampling Level (trips)*

The trips corresponding to the call-in numbers are assigned an observer. All sets during the trip are then observed.

9.3.3 *Other pertinent details*

9.4. *Is stratification employed in selecting vessels and trips (e.g., by vessel size & gear type, by geographical location, by time [e.g., season, quarter, month])?*

Quarter. Samples are drawn quarterly to allow flexibility in adjusting the coverage level.

9.5. *How vessels and trips are selected (ad-hoc, census, systematic, random?) (Please provide a detailed description of your procedures)*

Prior to the start of the quarter, a systematic sample is generated. Typically, the target is for 20% coverage and the following description is for this level of coverage; although, it is very easy to adjust for different coverage goals. This systematic sample is generated by drawing five integers from 1 to 33 with equal probability (this is for a systematic sample with approximately15% coverage). From these five starting numbers, every 33rd call-in number is drawn to be sampled. Because observers are limited and unable to be on two boats at the same time, a systematic sample designed for 20% coverage is not practical. The other 5% of trips sampled are selected when all systematic samples have had an observer assigned and there are observers ready to be deployed. To draw the vessel a call-in number from the resent call-ins is selected with equal probability. The trips selected by this method are referred to as the day sample as it is typically drawn from all call-ins received that day. A record of all call-ins is kept and the trips drawn by the systematic sample and day sampled are identified.

9.6. Is it mandatory that selected vessels accept observers for the selected trips?

Yes

9.7. Number of observers per trip?

One

9.8. Describe the work requirements of the observer on the selected trips (e.g., do the observer(s) stay for the entire selected trip)?

Observers stay with the vessel for the entire trip and record set and haul information such as locations, times, and amount of gear set. Observers are required to observe the first hour of each set for protected species interactions. Every haul is watched in its entirety with every fish being recorded and biological information collected on selected species. The number one priority is to obtain reliable information about sea turtle and other protected species interactions. After completing the trip the observer will return to port for debriefing and enter their data.

9.9. Provide details of primary and secondary sample selection guidelines

9.9.1 Target sample sizes (vessels, trips) by stratum (if applicable)

20% coverage on a yearly basis

9.9.2 Coverage (proportion of vessels & trips observed) by stratum (if applicable)

Coverage between and within quarters can fluctuate due to a limited number of observers and the demands of 100% coverage in the swordfishing fleet.

9.9.3 Sample allocation of vessels and trips by gear/size group.

Random

9.9.4 Methods for selecting tows or sets within trips (census, ad-hoc, systematic, random)

not applicable

9.9.5 Sample allocation of trips in time and space

random

9.9.6 Daily selection of tows/sets within trips (census, ad-hoc, systematic, random)

not applicable

9.9.7 Allocation of sampling effort within trips between night and day (if applicable)

not applicable

9.9.8 Detailed description of any metrics that are used in establishing target sample sizes at each sampling-stage (e.g., RSE of estimated total by-catch of species A $\leq$ 20%)

None

10. List the key parameters derived from your observer program and the statistical estimators used in quantifying those parameters, such as: by-catch of non-target species (e.g., ratio-estimators [by-catch rates expanded to total catch or effort]); incidental takes of protected species such as mammals and turtles (e.g., ratio-estimators [incidental takes per unit of effort expanded to total effort], regression estimators w/auxiliary data), catch, biological attributes (e.g., age-length, diet studies), other.

The observer data is used in many different ways but the primary objective is to estimate the annual incidental take of protected species (by species). To estimate the annual takes the Horvitz-Thompson estimator is used with the sampling probabilities estimated using sampling records.

11. How are the estimates derived from your observer program data used in management (e.g., attainment of TAC or quota, documentation of total by-catch of species of interest)

The incidental take estimates are compared to the annual allowable takes to see if the allowable take was exceeded. The allowable takes also uses the observer data, but these are computed independently of the incidental take estimates and involves more extensive modeling.

12. *Certain information can serve as diagnostics to identify potential sources of bias in estimates that may be associated with vessel selection*

12.1. *Regarding completeness of sampling frames*

12.1.1. *Is the list of active vessels complete and up-to-date?*

Because the sample is selected from call-in numbers it automatically adjusts itself to the activity of each individual vessel. At the end of the year, we have a complete record of call-ins and how each trip was selected to be sampled (systematic or day scheme). All vessels and all trips are subject to being sampled and the Horvitz-Thompson estimator adjusts for the fluctuations in the coverage level.

12.1.2. *Are there fleet components that cannot be observed (e.g., small vessels with no space for observers)?*

No

12.2. *Regarding vessel and trip selection: What are the logistical constraints in the selection of vessels or trips (e.g., factors that constrains representative sampling)?*

Observer availability. The Horvitz-Thompson estimator does not assume a constant coverage level over time and space; therefore, as long as all trips have a probability of being sampled the Horvitz-Thompson estimator will adjust for the fluctuation in the coverage levels in terms of space and time.

12.3. *What is the level of compliance (proportion of selected vessels/trips that take observers)?*

If a trip that has been selected to have an observer onboard and does not depart an observer is placed on the vessel's next trip. This discourages vessels from cancelling a trip and calling in again with the hope of not being selected.

12.4. *Are there recognizable disparities between target and achieved primary and secondary sample sizes or coverage levels?*

The largest disparity has occurred at the end of a contract with the contractor managing the observers. NMFS has twice (years 2003 and 2004) called the contractor and advise them not to send out observers until the contract has been awarded. Other disparities are due to practical considerations and are difficult to avoid. Such as, (1) coverage tends to go up after a training course and then slowly drop until the next training course and (2) coverage tends to drop slightly when observers are needed to cover the swordfishing fleet (100% coverage) or the tuna fleet is very active but then it will typically rise when the fleet is less activity. The sampling design and the estimator used takes into account these fluctuations in coverage, but it does not accommodate the periods where there is no sampling.

12.5. Are the sampled trips distributed over the season in a manner that covers the spatial and temporal distribution of catch and effort in the fishery?

Yes

12.6. Is there any basis for believing that the estimators employed may result in a bias?

The Horvitz-Thompson estimator is an unbiased estimator and if only the systematic sample was used in the estimation the estimator would be unbiased, but when it is necessary to select a trip through the day-scheme some of the information that the Horvitz-Thompson estimator requires is approximated and thus some bias is likely introduced. It is felt this bias is less than the bias that would be introduced if an equal probability sample was assumed.

13. In discussions prior to this information request being developed, several sources of potentially relevant information and means of quantifying level of bias were discussed among the work group. Please review this listing and provide your view on which of these information sources and/or approaches to quantifying potential bias (and/or others not listed) may be appropriate for your own observer program, and why you believe they may be most appropriate.

Potential data sources:

- ***Fisheries-dependent self reporting data through log-books; trip-reports, dealer reports, port-sampling***

  Logbooks: potentially used to compare behavior when an observer is onboard versus when they are not. Market records to check if there are any inconsistencies in identification of fish species.

- ***At-sea observations other than observer data, such as digital video cameras; digital observers such as scanners***

  If trustworthy these could be used in addition to or instead of observers, but the quality would need to be good enough to identify species.

- ***Vessel Monitoring Systems (VMS)***

  This data exist but is not available due to a confidentiality agreement.

- ***Fisheries-independent survey data (How closely does the survey sampling gear mimic the commercial gears in the fishery? What is the spatial and seasonal overlap between surveys and the commercial fishery; Are the surveys limited to daytime tows/sets?)***

  Not practical

- ***Assessment of bycatch by roving surveys (particularly for near-shore component of the fleet that cannon take observers)***

  Not needed

Potential useful analytical approaches based on observer data and auxiliary fisheries-dependent data:

- ***Compare spatial overlap of observed tows/sets with reported fishing locations by the general fleet (e.g., by depth and latitude, lat-long, quadrate, stratum)***

  The logbook data could be usual for this, but it could be biased by intentional and unintentional misreporting.

- ***Compare temporal overlap between observed tows/sets with the general fleet (e.g., do selected trips cover the fishing season, or are they allocated to one particular portion of the season?)***

  This is not seen as a problem as the estimator used would adjust for any temporal fluctuation of coverage. It is seldom that the coverage level falls below 15%. Since many of the species we are dealing with move over time, it is important that spatial and temporal overlap with observed sets is compared as a three dimensional problem.

- ***Calculate ratio of catch for observed tows/sets versus total reported catch for the general fleet by season and area unit·***

  For protected species this would not be useful but for the target species the two could be compared.

- ***Compare catches reported by observed and un-observed vessels (log-books; trip-tickets; port sampling)***

  We have compared catches of some of the target species with market and logbook records. This has helped to identify some identification problems, primarily in the logbooks.

- ***Assess harvest by the component of fleet that cannot be observed relative to the harvest of the observed portion of the fleet (define area of operation [likely to be near-shore])***

  Not applicable.

APPENDIX D

POWER POINT PRESENTATION

Potential biases when management decides the sampling universe and level of coverage

John Carlson
Southeast Fisheries Science Center
Panama City, FL

HISTORY

- Developed in late 1980’s as king mackerel drift gillnet fishery was restricted
  - King mackerel driftnet fishery described in Schaefer et al. (1999)
- Classified as Category II fishery because of similarities with swordfish driftnet fishery

HISTORY

- Initial observer program (1993-1995)
  - Data gathered to meet the mandates of the Atlantic Large Whale Take Reduction Plan (Trent et al. 1997)
  - 52 observed sets
  - 3.2% to 26.8% coverage yr^{-1}
    - No statistical design
- Results
  - Fleet size= 6-11 vessels
  - 2 loggerhead sea turtle takes

HISTORY

During 1996-1997, no observations made.

Where are the marine mammals and sea turtles?
NMFS Atlantic and Gulf of Mexico Marine Mammal Review Group suggested that potential for unobserved fall-out of marine mammals, turtles, and other species may have influenced results

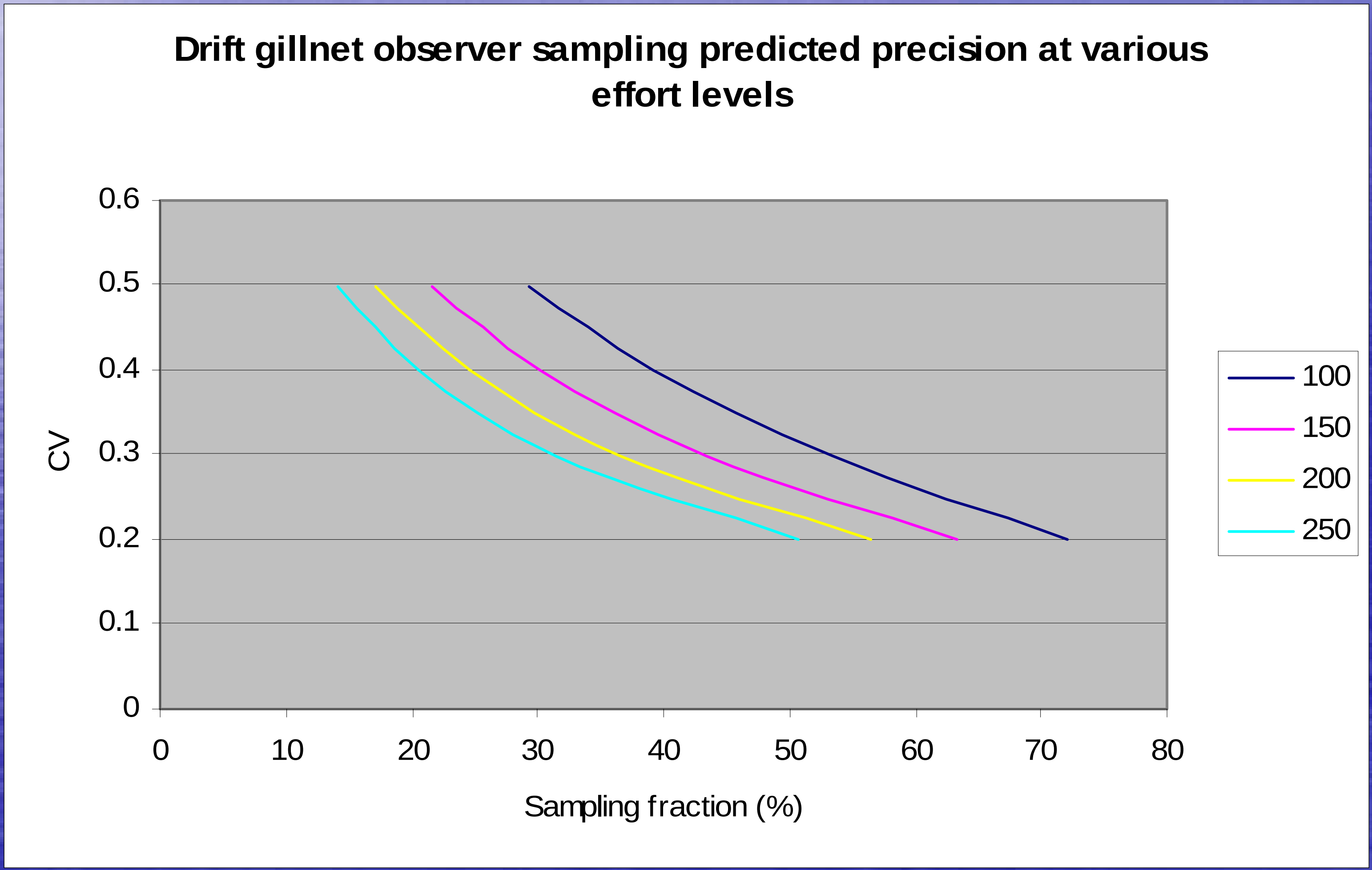

628085N

SAMPLE SIZE ESTIMATES

- **Sample size estimates for catching at least one sea turtle or marine mammal were based on a binomial distribution assuming an infinite population from which the sample is drawn**

$$n = \frac{\dfrac{N}{(1+CV_p^2)N(p_i^2)}}{p_i(1-p_i)}$$

How much coverage is needed?

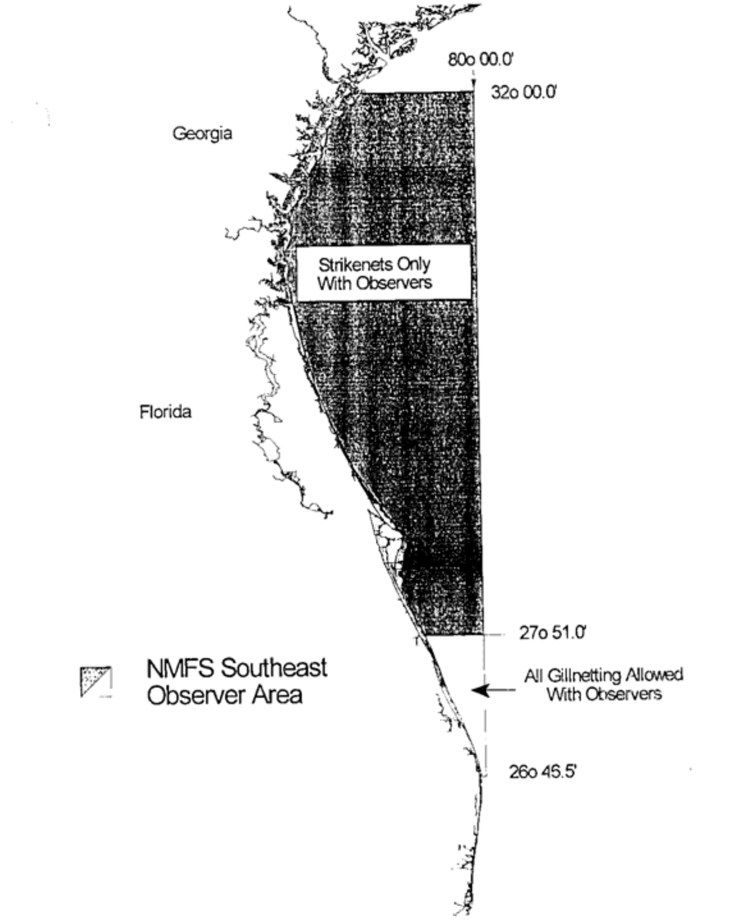


NEW REGULATIONS

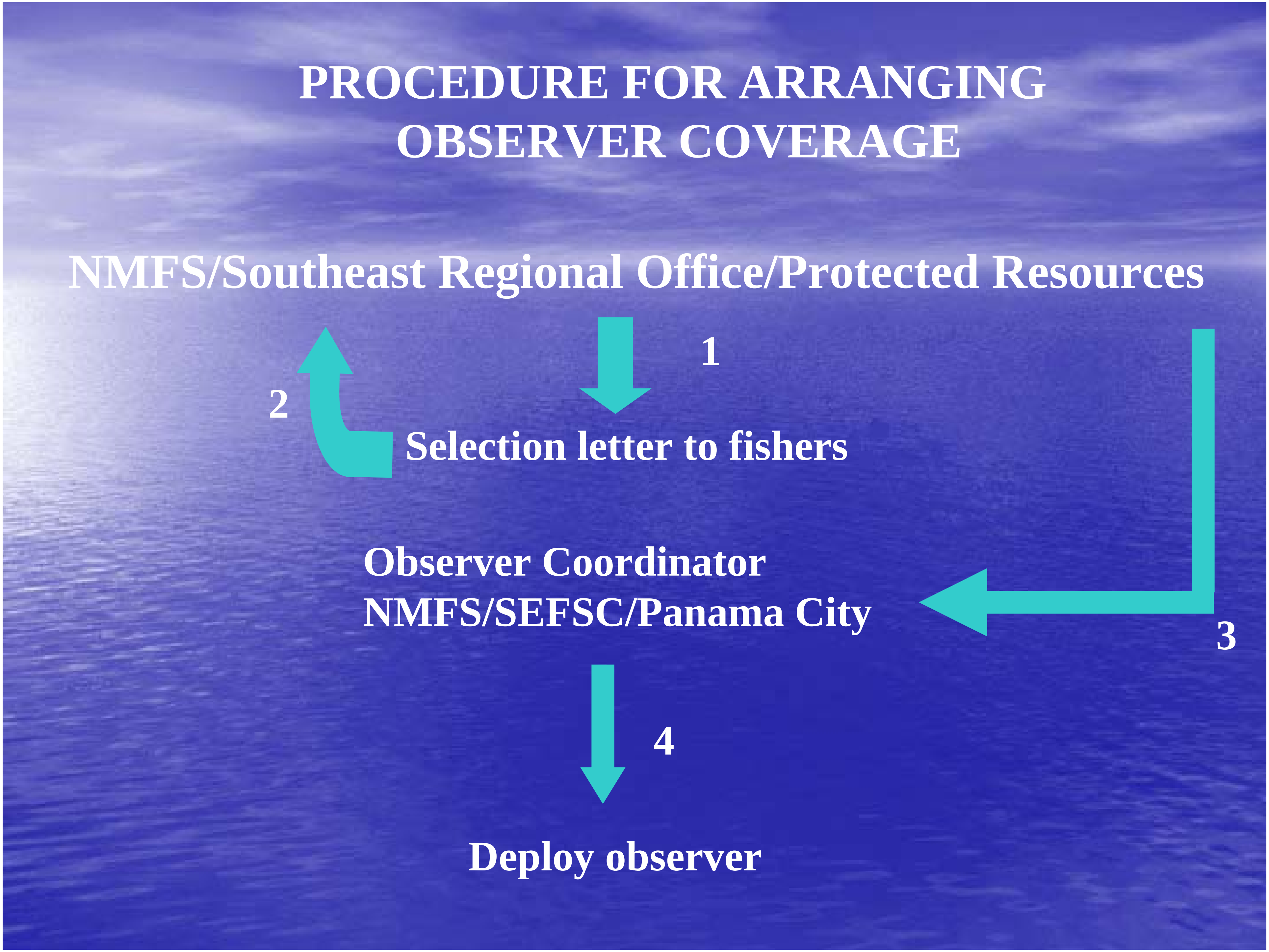
- The Atlantic Large Whale Take Reduction Plan and Biological Opinion under Highly Migratory Species FMP:
- Two seasons:
  - Right whale calving season 100% observer coverage
  - Non-right whale calving season (1 April-14 November)
    - a level of observer coverage equal to that which would attain a sample size needed to provide estimates of sea turtle or marine mammal interactions with an expected coefficient of variation of 0.3.

Why 100% coverage?

- Monitor vessel activities
- Better estimates of bycatch?



November 15 to March 31 Gillnetting Restrictions


PROCEDURE FOR ARRANGING
OBSERVER COVERAGE
NMFS/Southeast Regional Office/Protected Resources
1
2
Selection letter to fishers
Observer Coordinator
NMFS/SEFSC/Panama City
3
4
Deploy observer

PROBLEMS

- LOW BUDGET:
  - $60-80 K allocated
  - estimated cost to achieve objectives was in excess of $250K

MORE "NEW" REGULATIONS or INSULT TO INJURY

- 1999 revised Fishery Management Plan for Highly Migratory Species (HMS-FMP) established a 100% observer coverage requirement for this fishery at all times to improve estimates of catch, effort, bycatch, and bycatch mortality

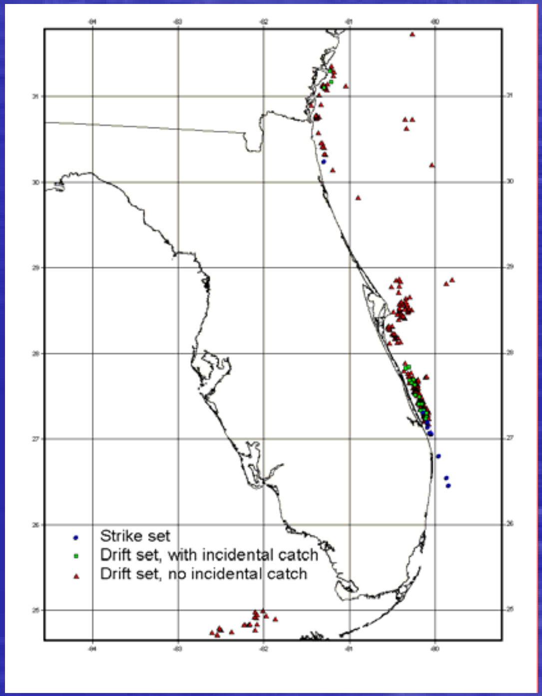
RESULTS

- 2000-2001
  - **Observer coverage limited mostly to right whale calving season:**
    - **For example: 2 Jan-25 February 2000**
  - **Limited coverage remaining year**

CONSEQUENCES OF 100% COVERAGE AND LIMITED UNIVERSE OF VESSELS

- Limited funds
  - Concentration of observer coverage in time and space

64% observed sets: Jan-Mar



OUTCOME

- High estimates of uncertainty in the mortality estimates of fishery on coastal stocks of bottlenose dolphin and sea turtles
  - Annual bottlenose dolphin mortality estimate
    - 43 (11-167 95% C.I.)
  - Annual loggerhead sea turtle mortality estimate
    - 8 (2-42 95% C.I.)

CONCLUSIONS

- Observer programs should be planned by people who know the data, costs, and logistics associated with them

- OTHER ISSUES
  - Other gillnet fisheries overlap with this one
    - Sink, strike
  - Determination of complete universe
  - Assessment of other species
    - Finetooth shark
      - Latest assessment indicates overfishing occurring
      - Landings data-gillnets (60-80%)
      - Observer data-gillnets (20%)

Observer deployment pilot project – a 2003 Gulf of Alaska trawl fishery

NMFS, Alaska Region

Observer coverage in Alaska

- Vessels >= 125 ft. must have 100% observer coverage (approximately 70% - 80% of hauls sampled). This size range is mainly in the Bering Sea/Aleutian Islands
- Vessels > 60 ft. and < 125 must have 30% of vessel days in a quarter and fishery observed (again, approx. 70% - 80% of hauls sampled).
- Vessels < 60 ft. have no observer requirements.
- 30% coverage vessels can choose when and where to take an observer within confines of a quarter and fishery.

Observer deployment pilot project

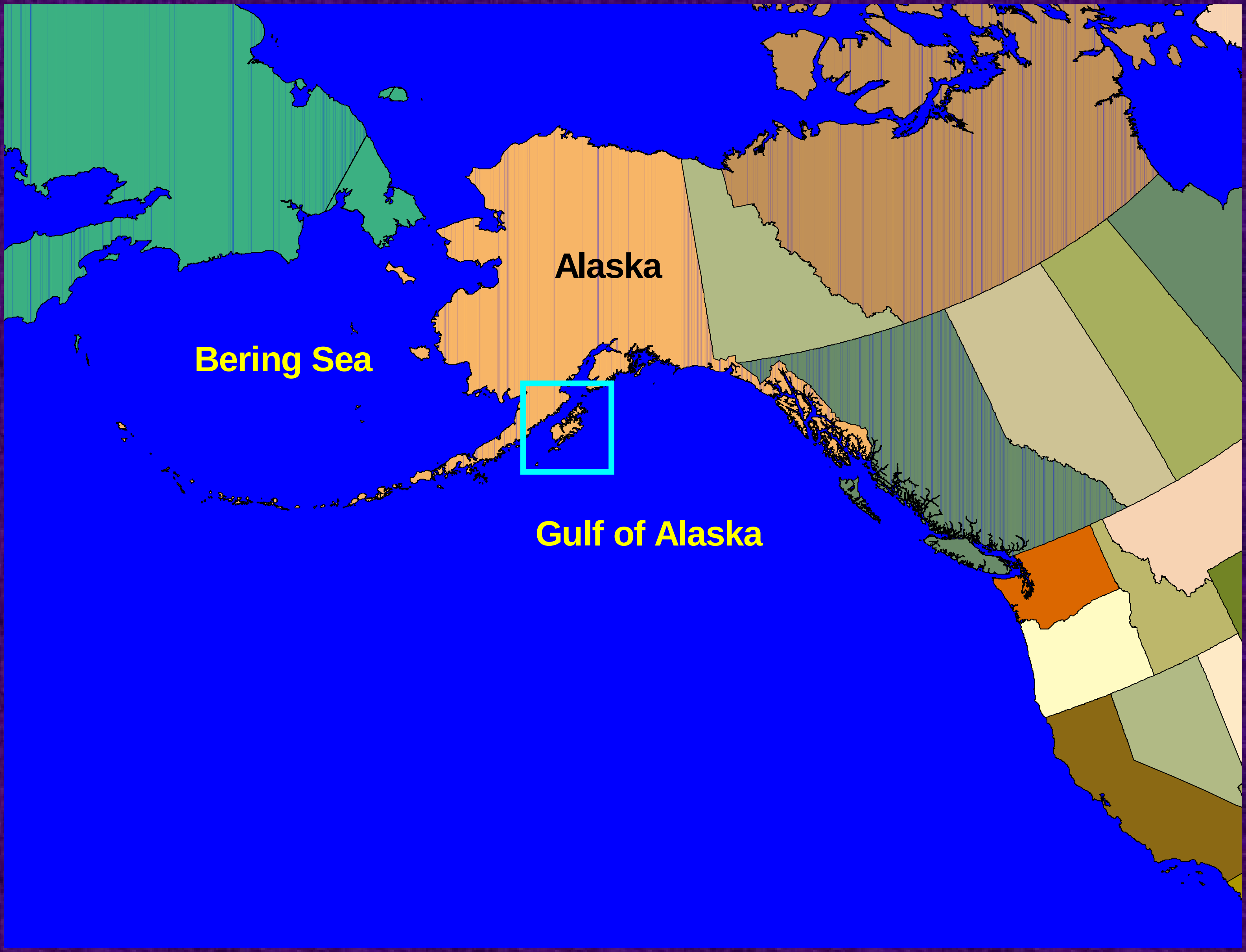
June 29 – August 18, 2003

- Covered a rockfish and flatfish trawl fishery in the central Gulf of Alaska.
- Approximately 25 vessels involved in project.
- Study areas defined by historical fishing patterns and halibut bycatch levels.
- Observers deployed according to simple model – based on area, observers already deployed, and previous observer coverage of vessel.
- Overall goal was to have at least one vessel observed in each study area at any given time.

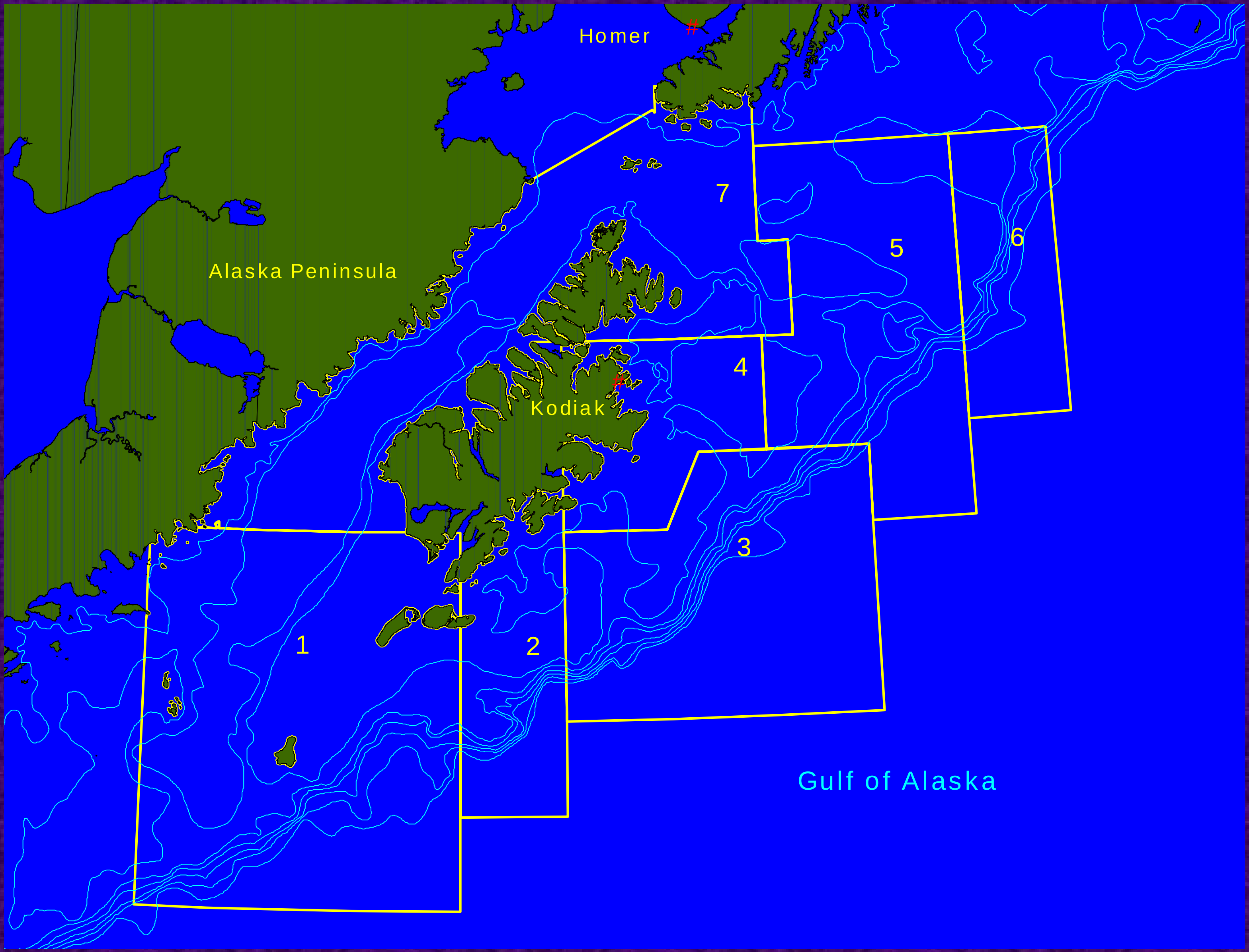
Without cross-validation of spatial data from multiple sources with a GIS, the following problems can go undetected:

- Locations can be misreported.
- Missing data can be difficult to identify.
- Vessel can be incorrectly identified.
- Unrepresentative data can be collected.
- Human error can lead to incorrect data.

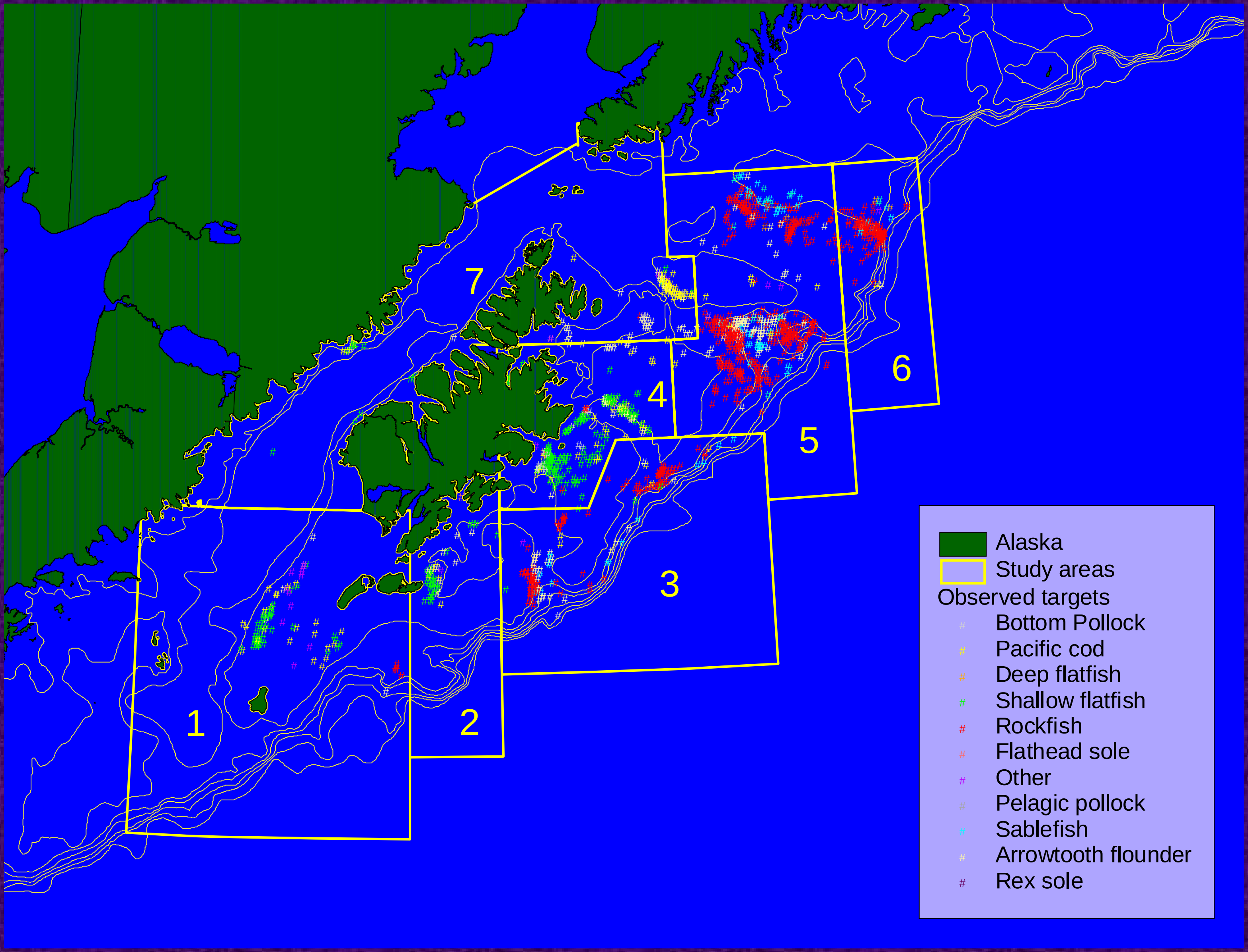
Study area in the Gulf of Alaska



Observer study reporting areas



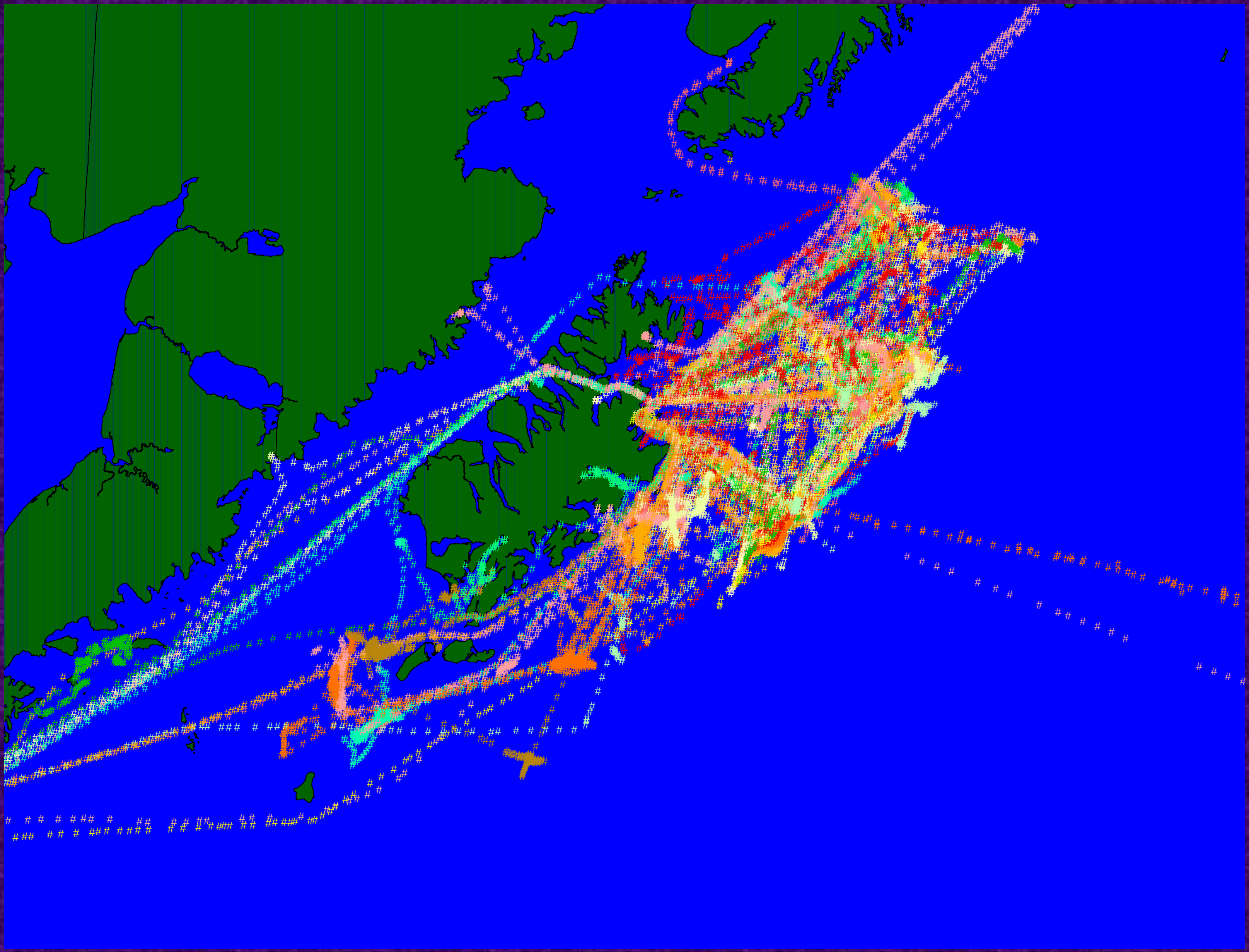
Pre-2003 observed fishing by target.



Distinct spatial data sources

- Vessel Monitoring System (VMS) locations – position and speed, broadcast every 30 minutes.

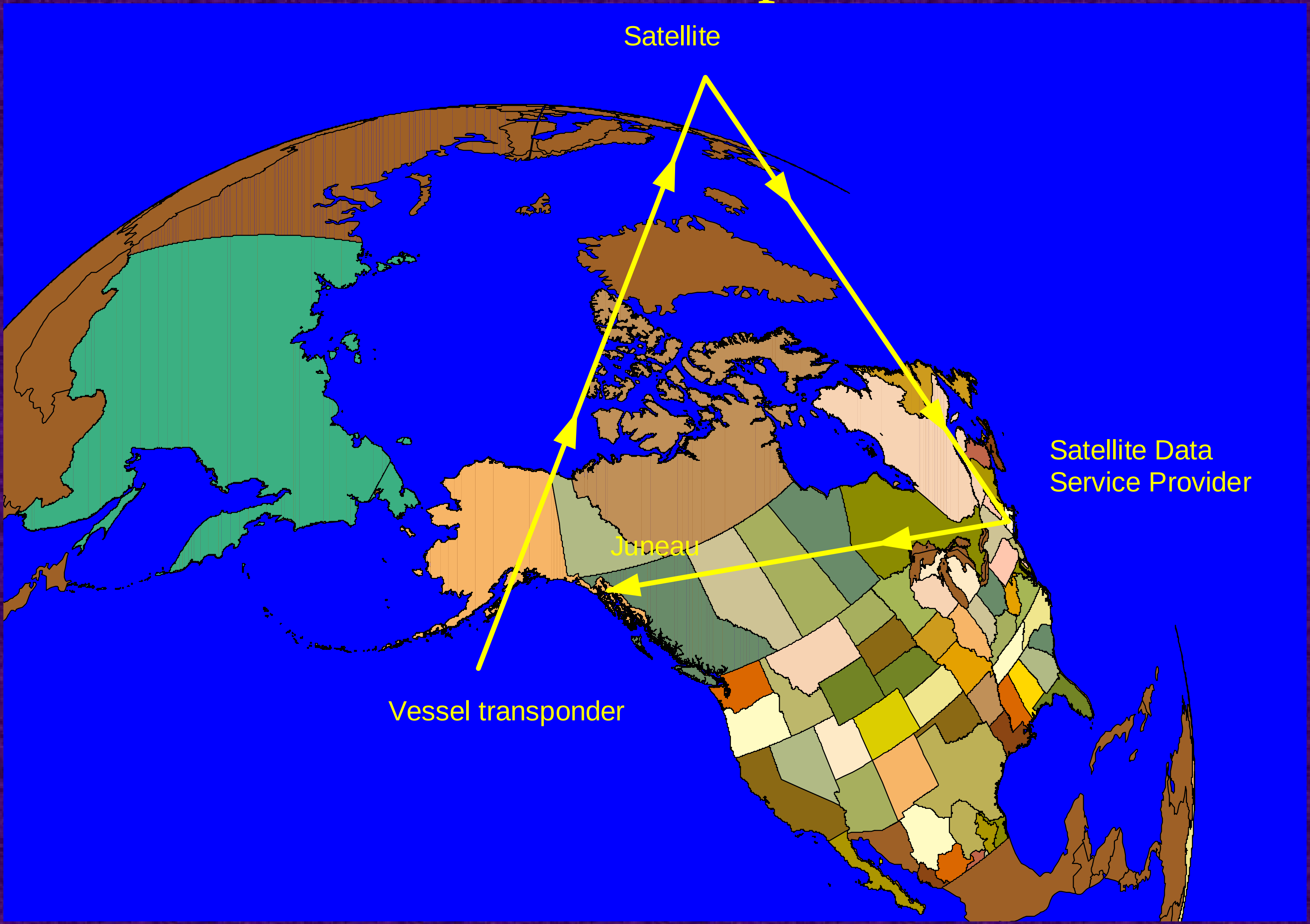
Vessel Monitoring System (VMS) tracks



VMS data

- Latitude
- Longitude
- Speed
- Bearing
- Date and time
- Transponder ID
- Lookup of vessel ID

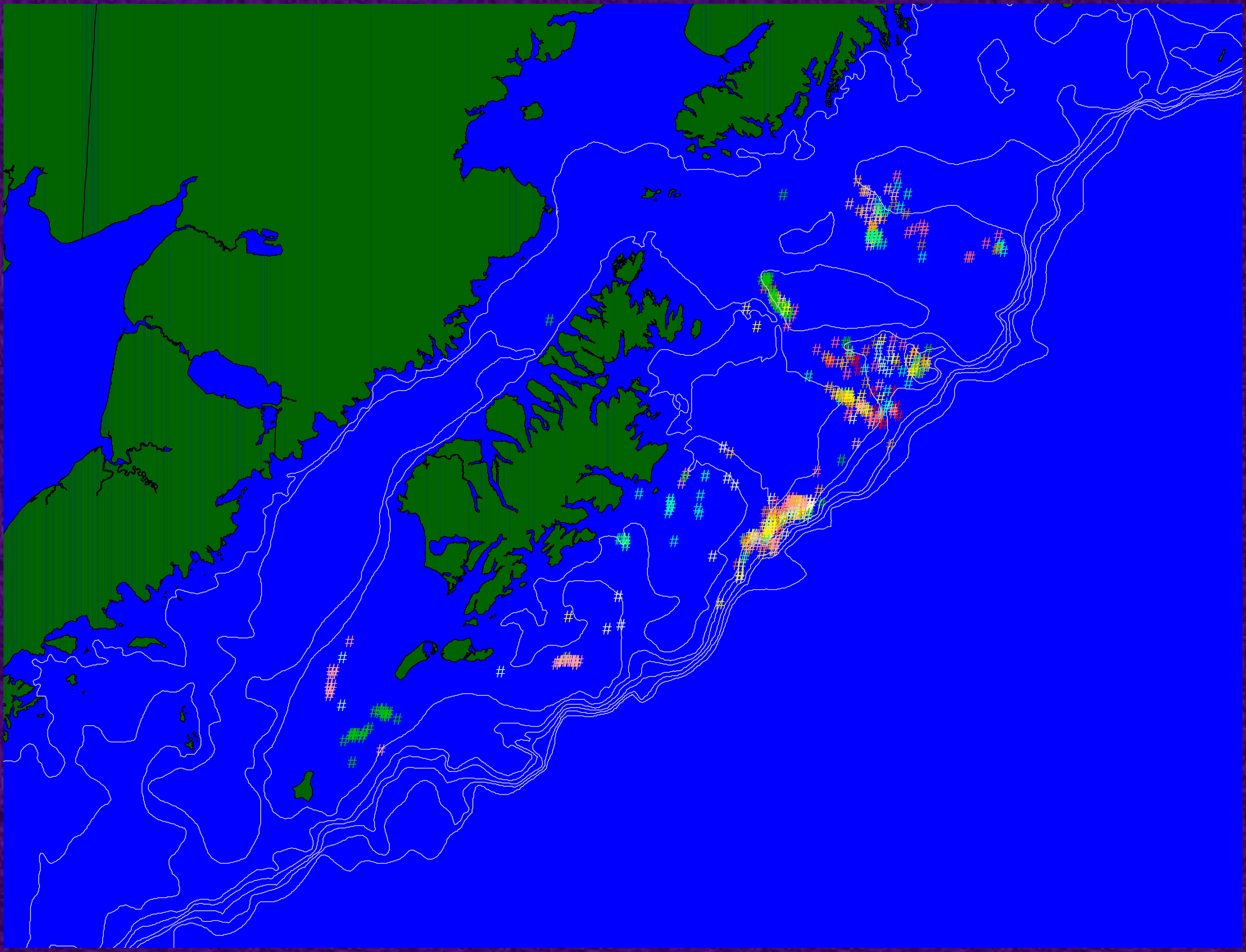
VMS data path



Distinct spatial data sources

- Vessel Monitoring System (VMS) locations – position and speed, broadcast every 30 minutes.
- Observer data – haul catch with deployment and retrieval location.

Observed haul retrieval locations, 2003.



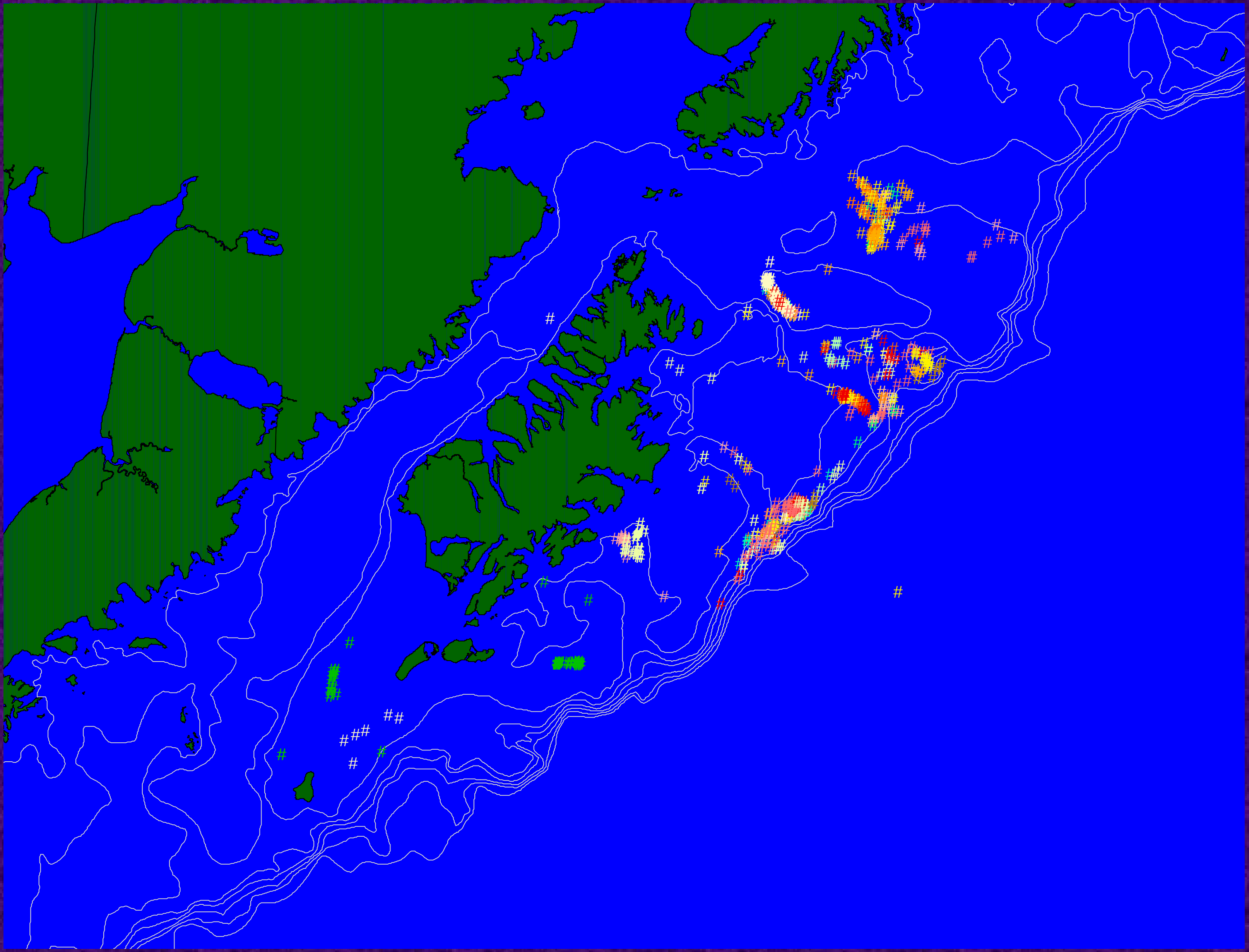
Observer data summary

- Vessel, observer and processor identity.
- Gear and gear performance.
- Location – haul deployment and retrieval, statistical areas.
- Total catch estimates.
- Sampling methods and weights.
- Species composition and weights.

Distinct spatial data sources

- Vessel Monitoring System (VMS) locations – position and speed, broadcast every 30 minutes.
- Observer data – haul catch with deployment and retrieval location.
- Voluntary electronic vessel logbook – haul catch with deployment and retrieval location.

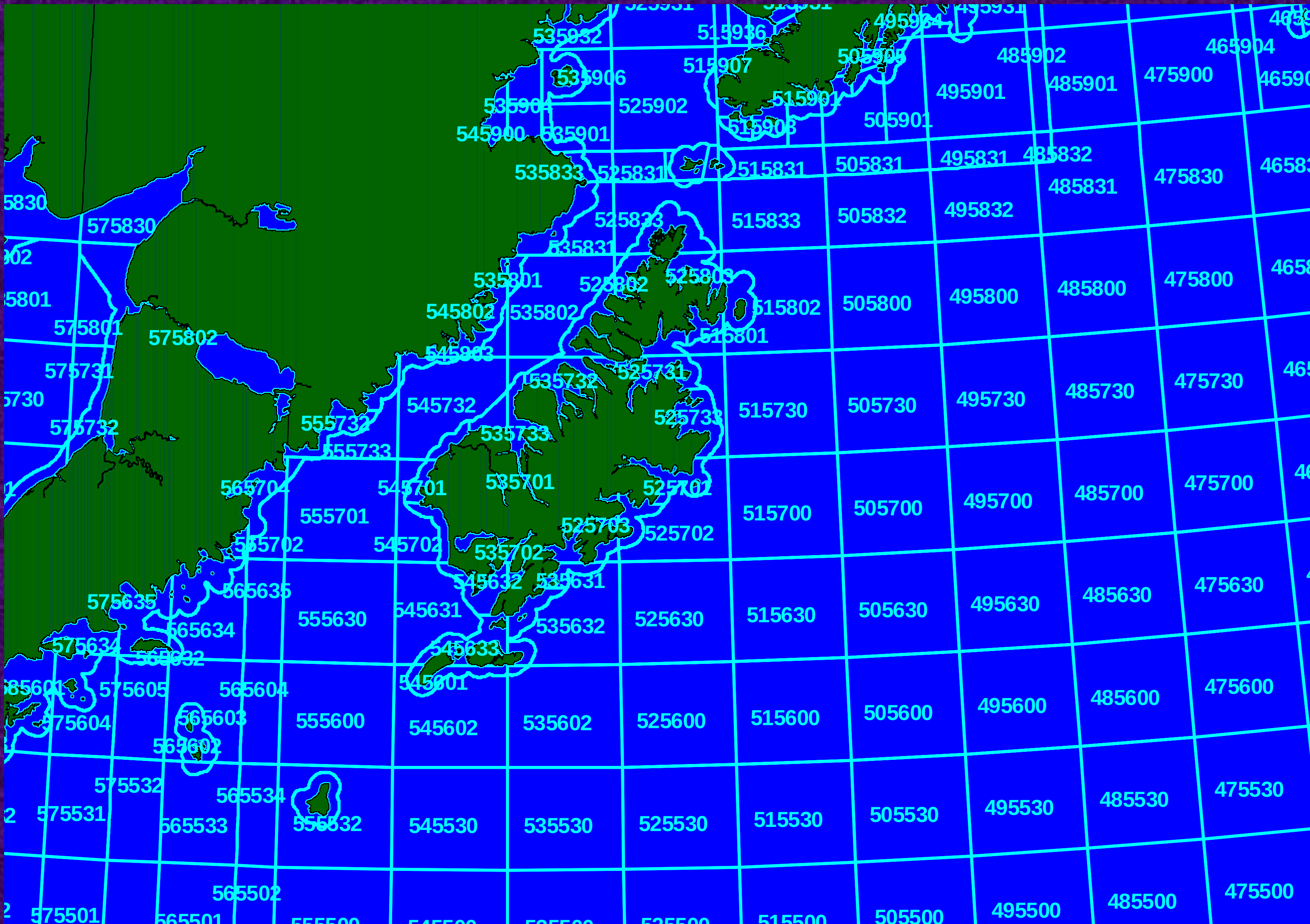
Vessel logbook haul retrieval locations.



Distinct spatial data sources

- Vessel Monitoring System (VMS) locations – position and speed, broadcast every 30 minutes.
- Observer data – haul catch with deployment and retrieval location.
- Voluntary electronic vessel logbook – haul catch with deployment and retrieval location.
- Alaska Department of Fish and Game fish ticket – trip report of statistical area catch.

Alaska Dept. of Fish and Game statistical areas



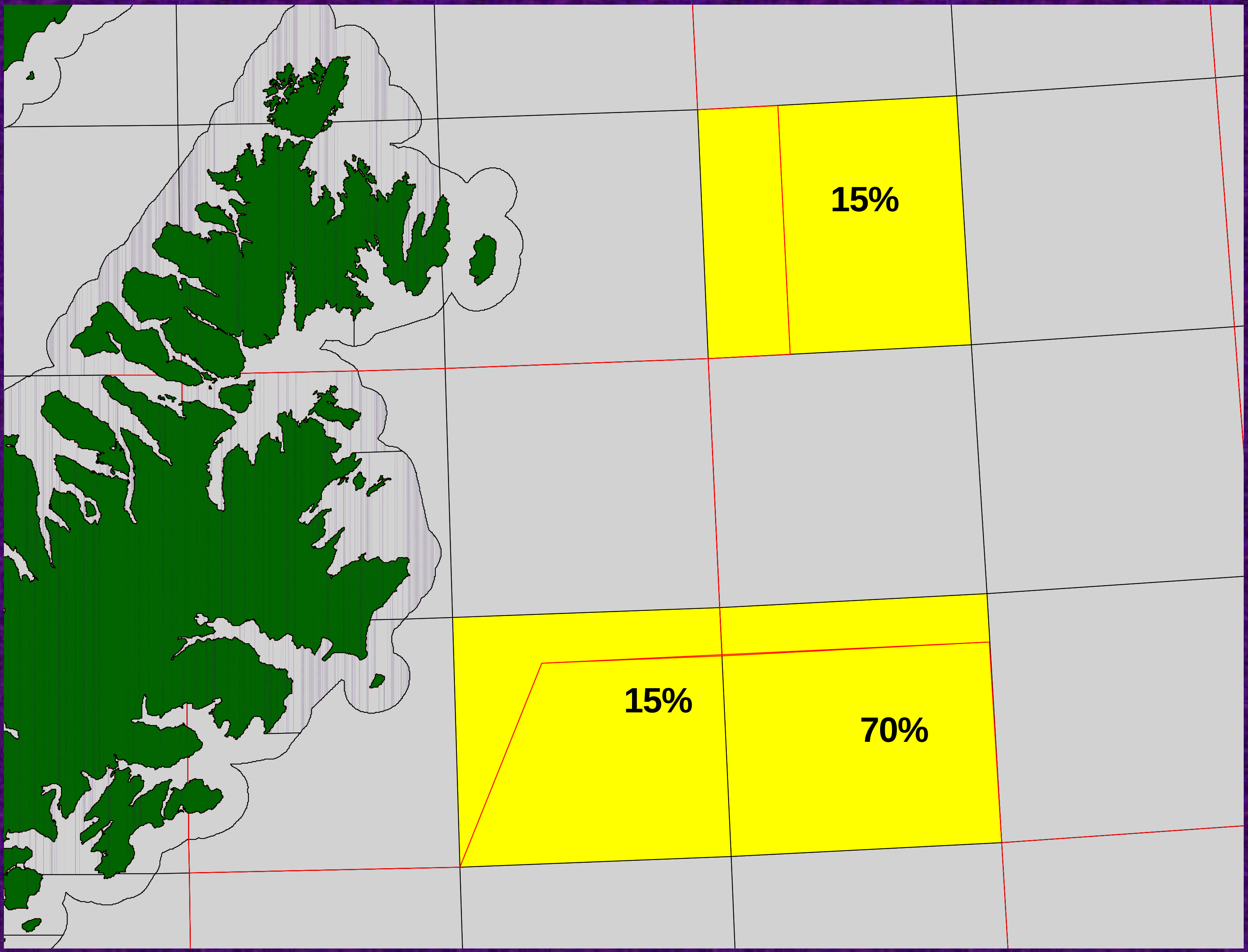
ADF&G fish ticket data summary

- Vessel, port, and processor identity.
- Gear type.
- Statistical area with percent of effort for trip in the area.
- Species.
- Product, product weight, round weight, value.

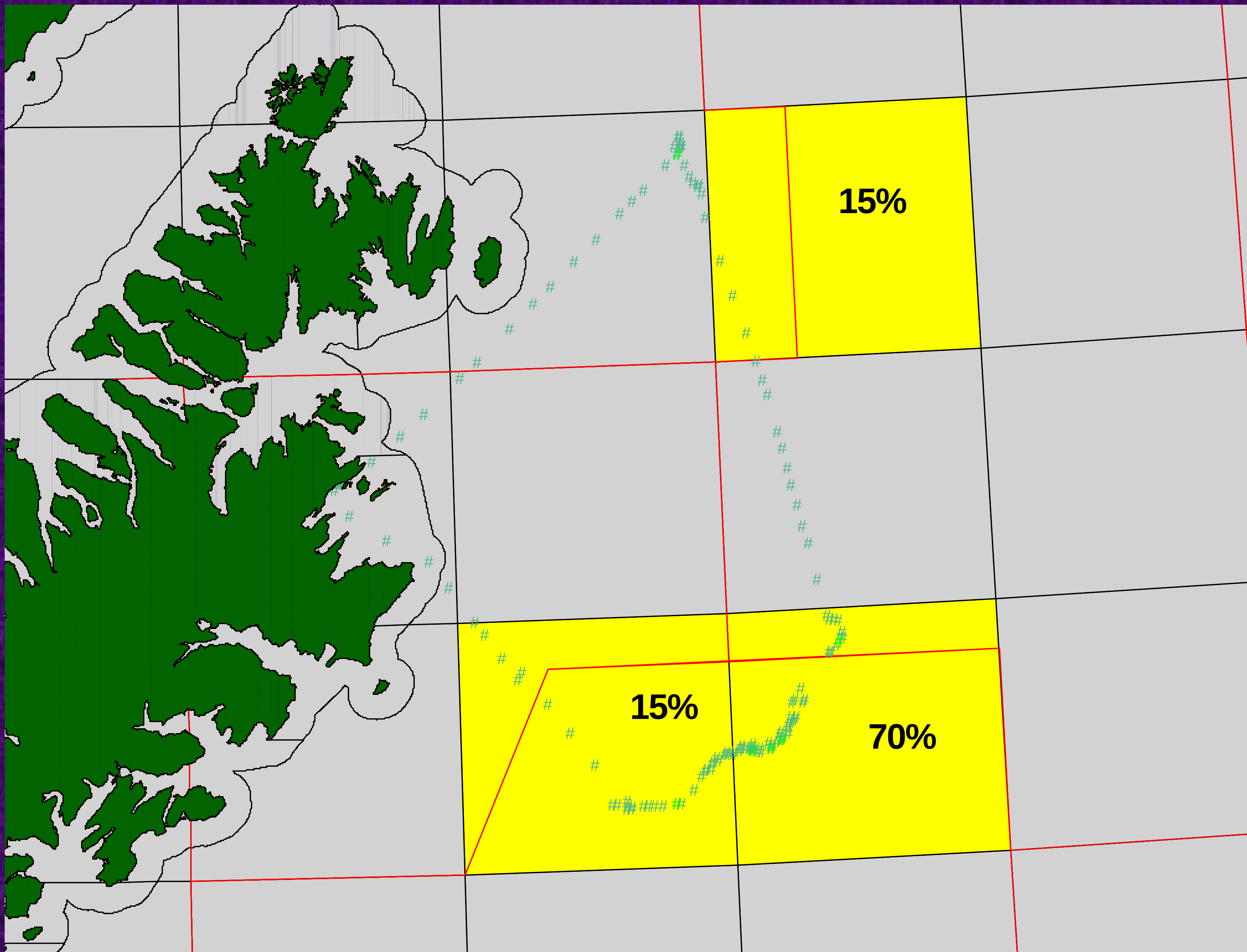
Spatial data comparisons

- VMS and fish tickets.

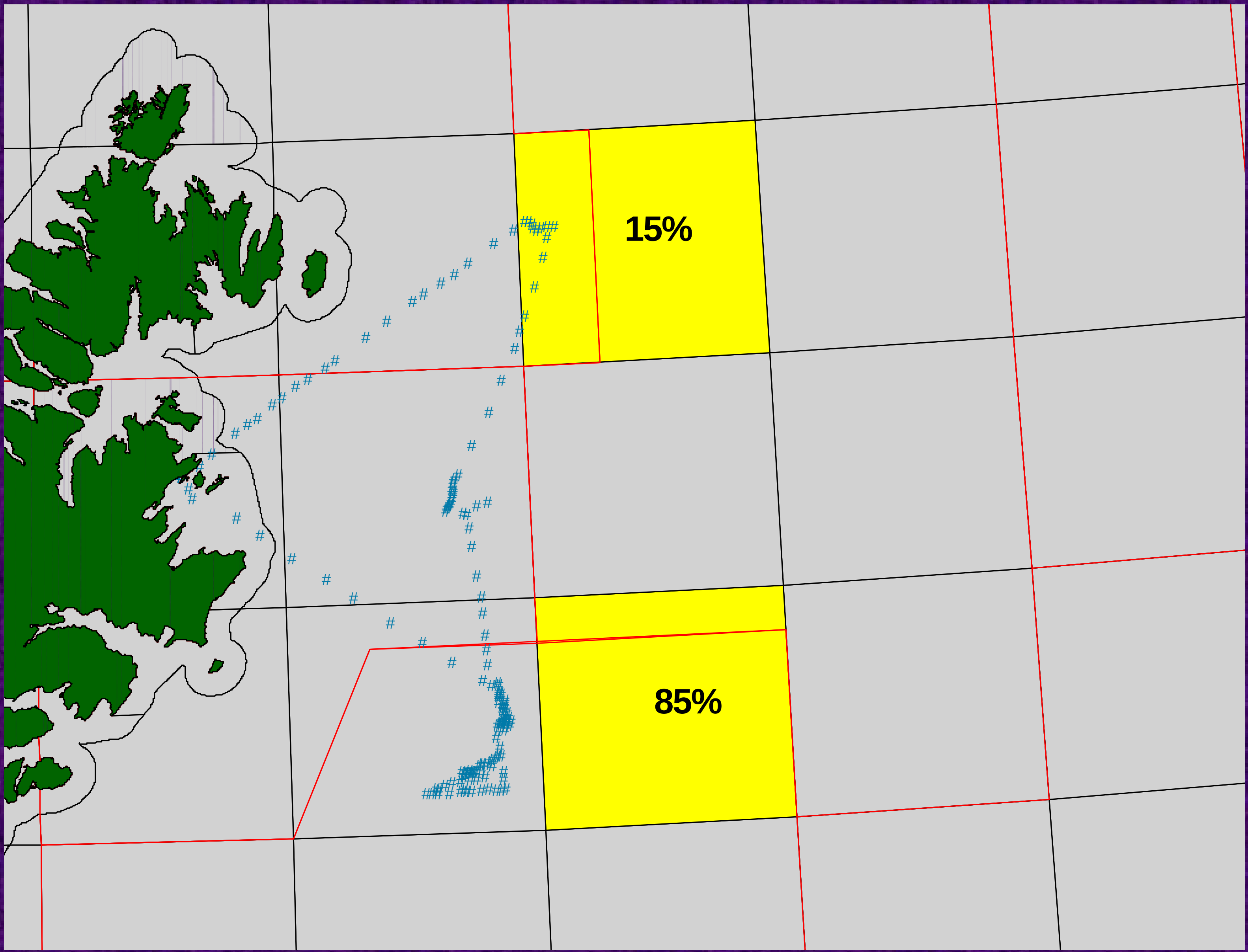
Example - Fish ticket reporting by stat area



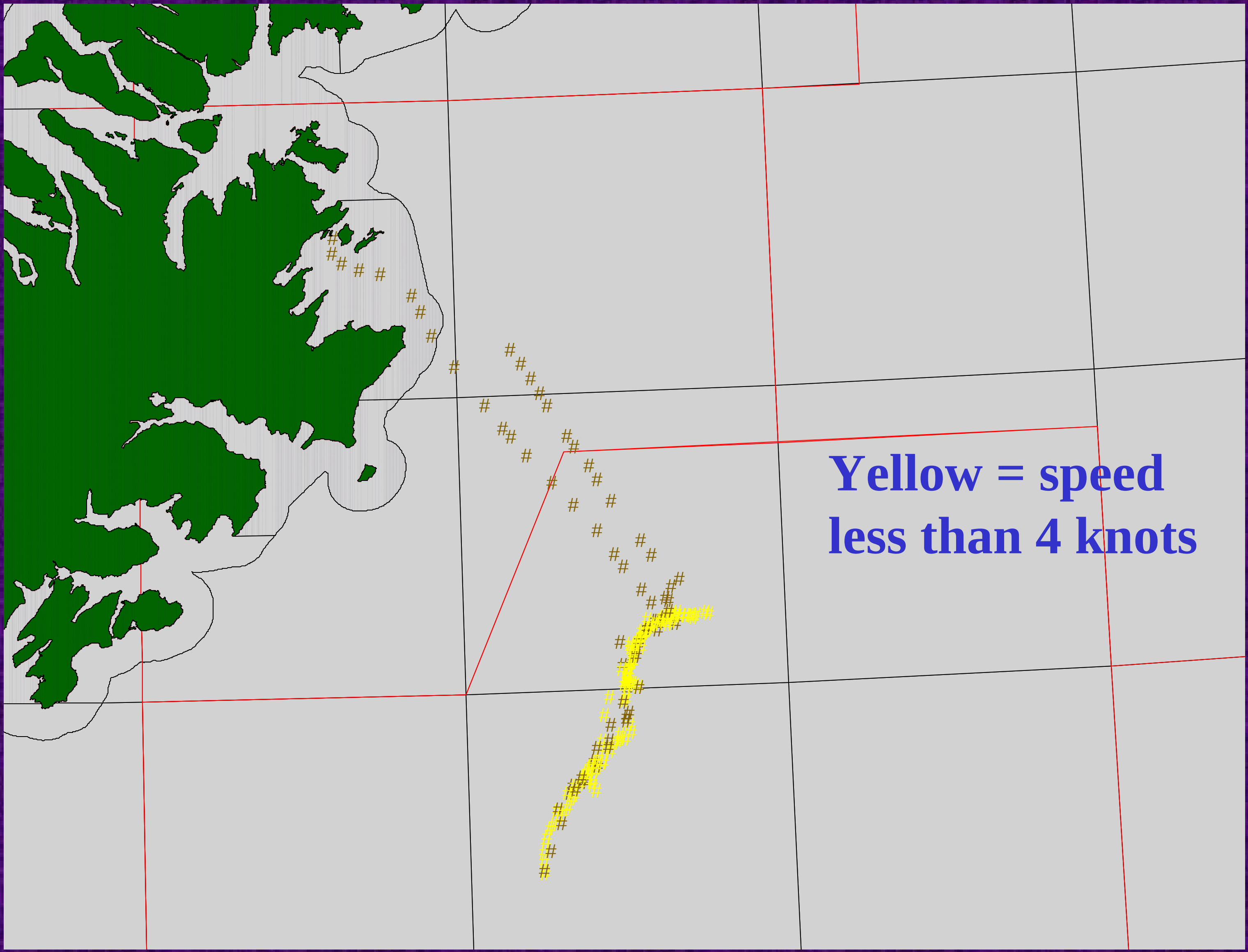
Reported statistical areas – unlike logbook.



Reported statistical areas - unlike VMS tracks.



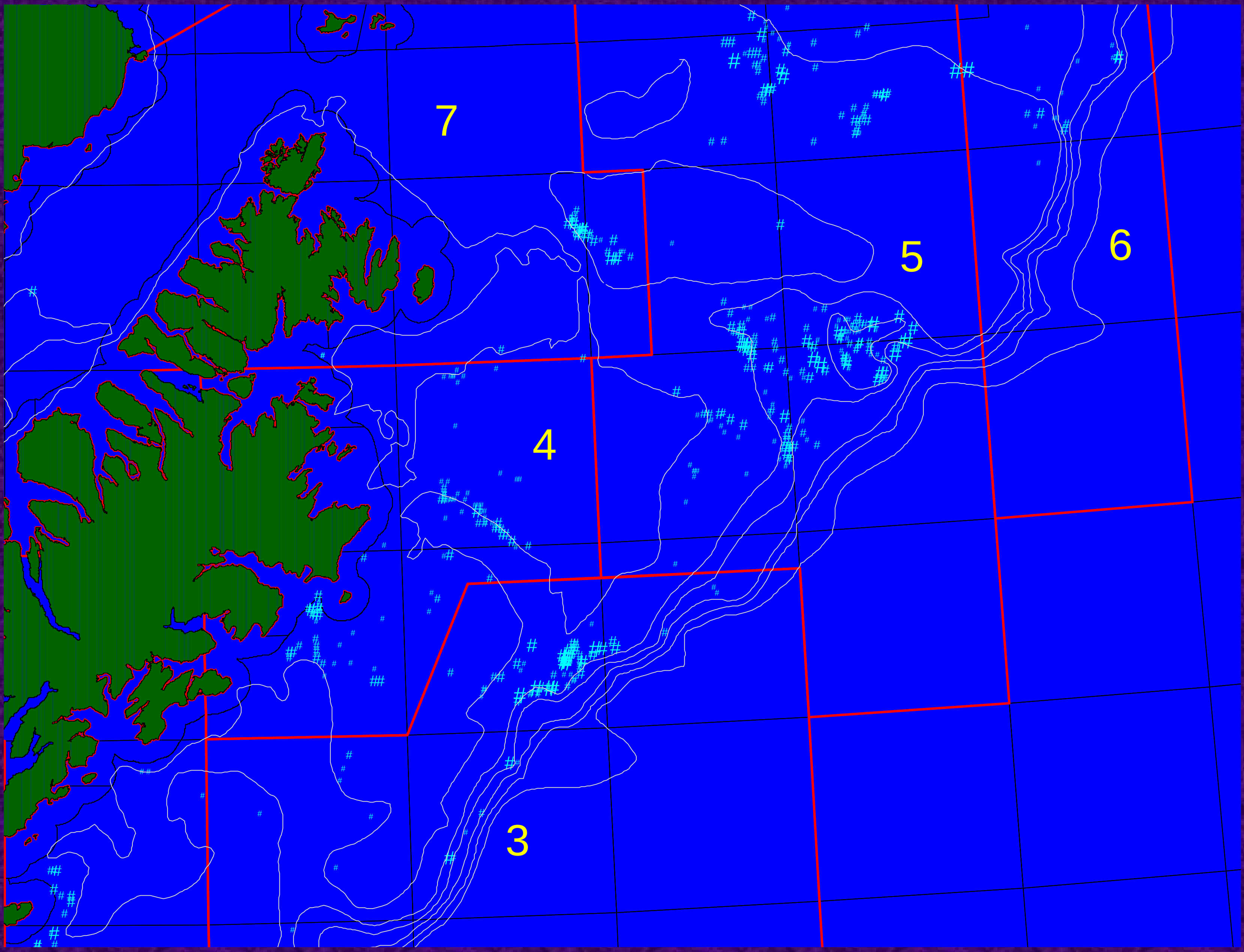
Missing trip report – no fish ticket information.



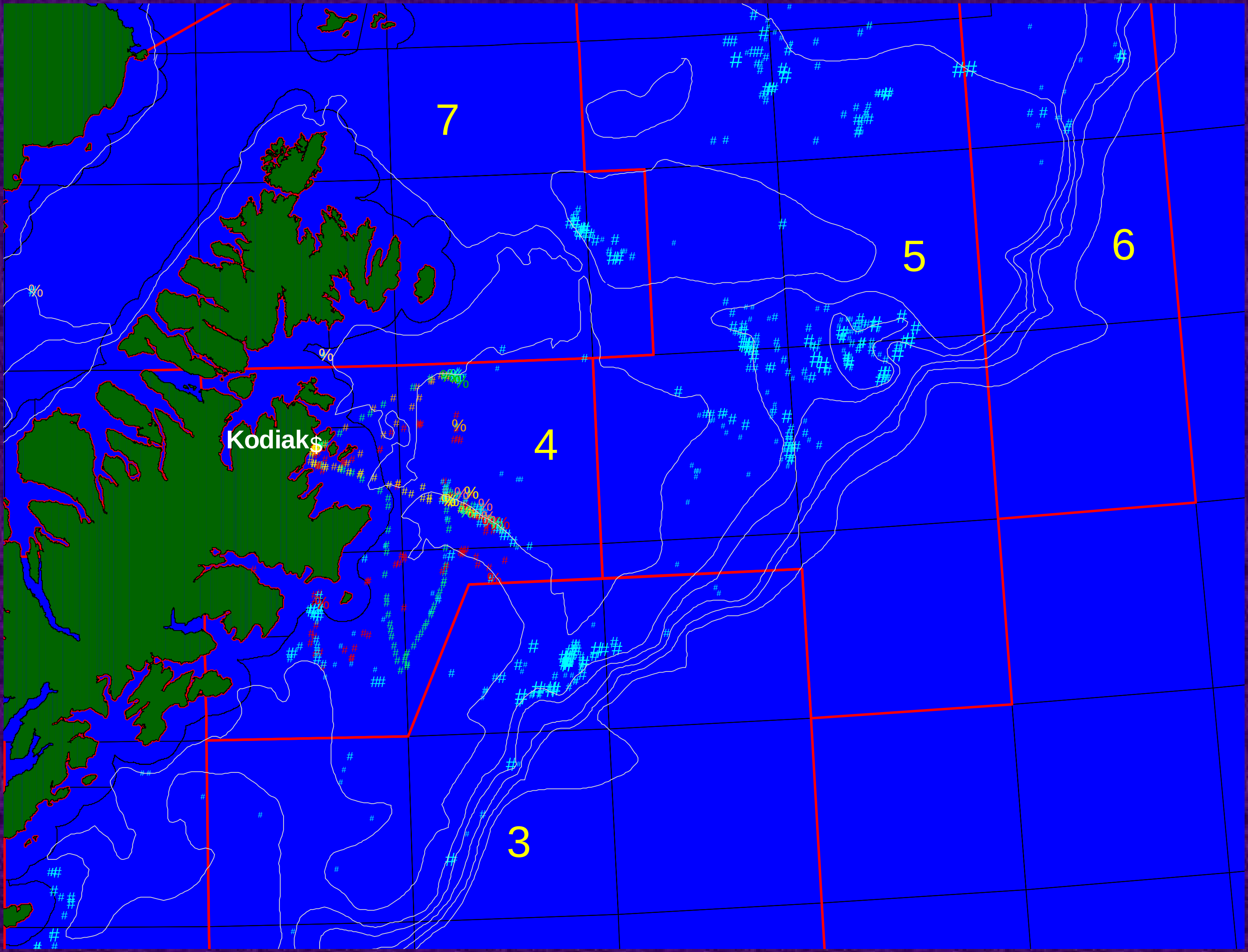
"Observer Hauls": Comparison of 2002 and 2003 patterns.

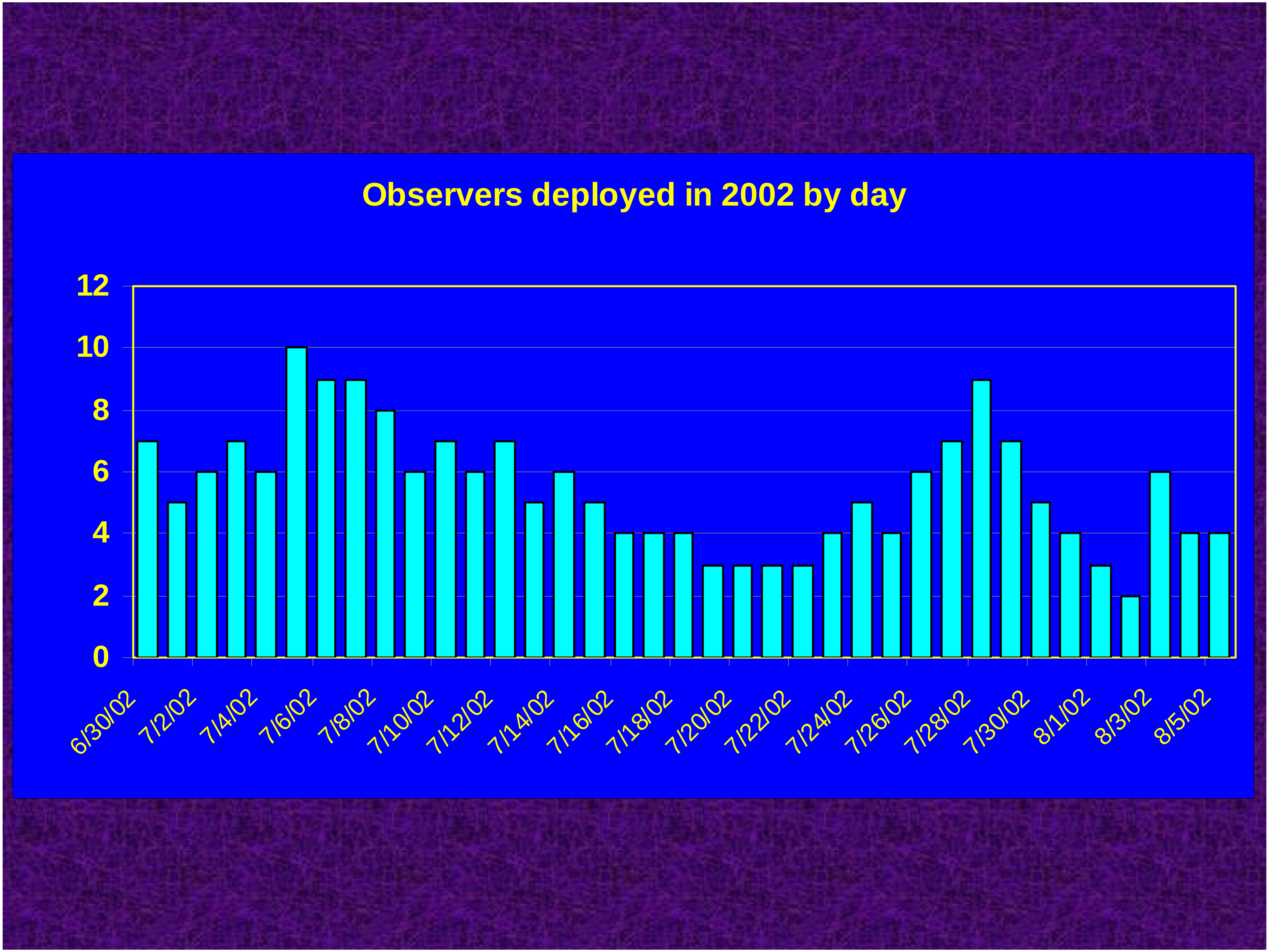
- Common problem in 2002, and any year when vessels choose when to carry an observer: "Observer Hauls".
  - Vessels do not want to carry an observer for more than the minimum required number of days.
  - Typically vessels fish with less than the required number of observer-days and fill in days at the end of the season.
  - These hauls can be non-representative of the fishery.

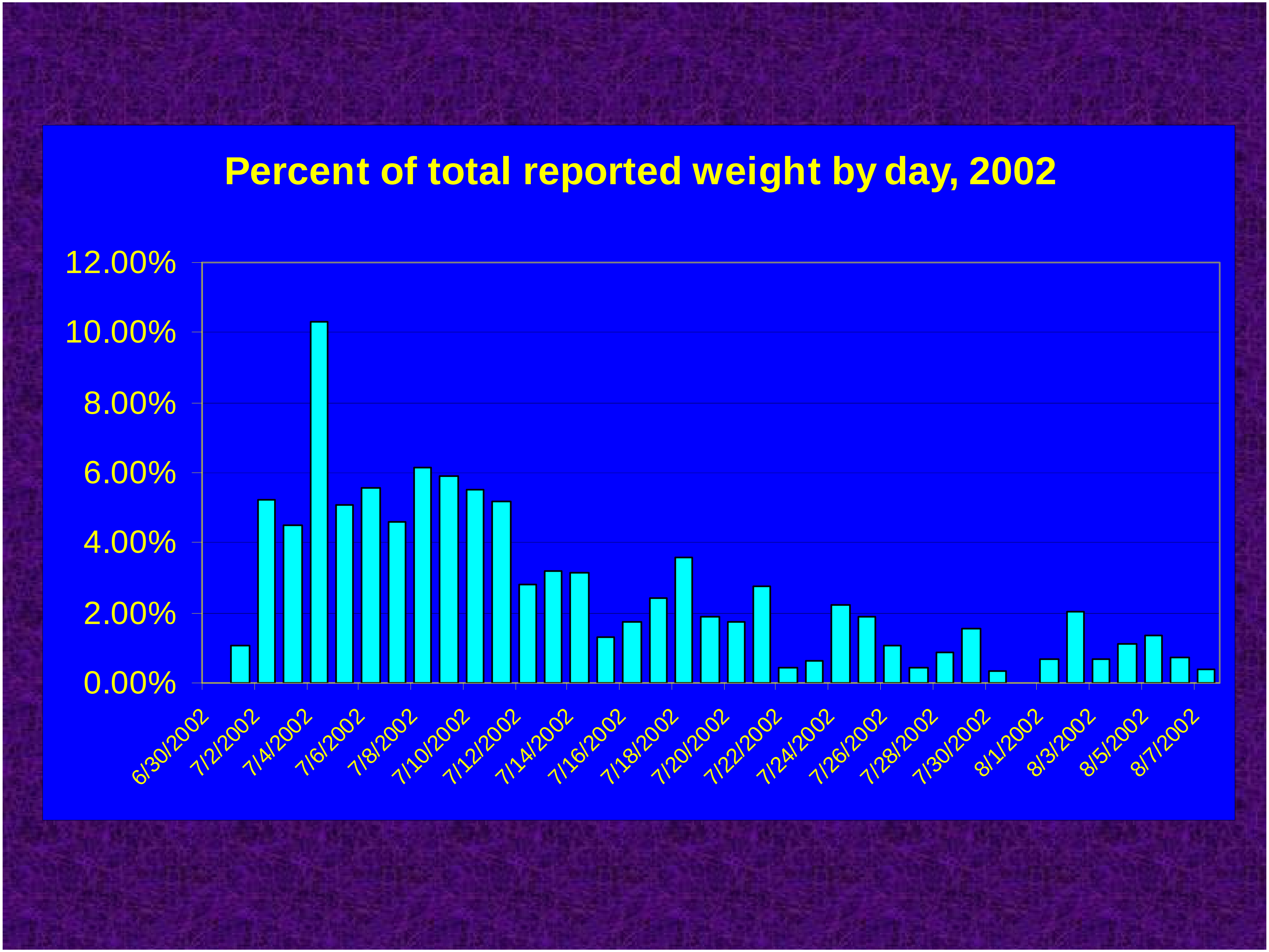
Observed hauls in 2002 – scaled to catch.



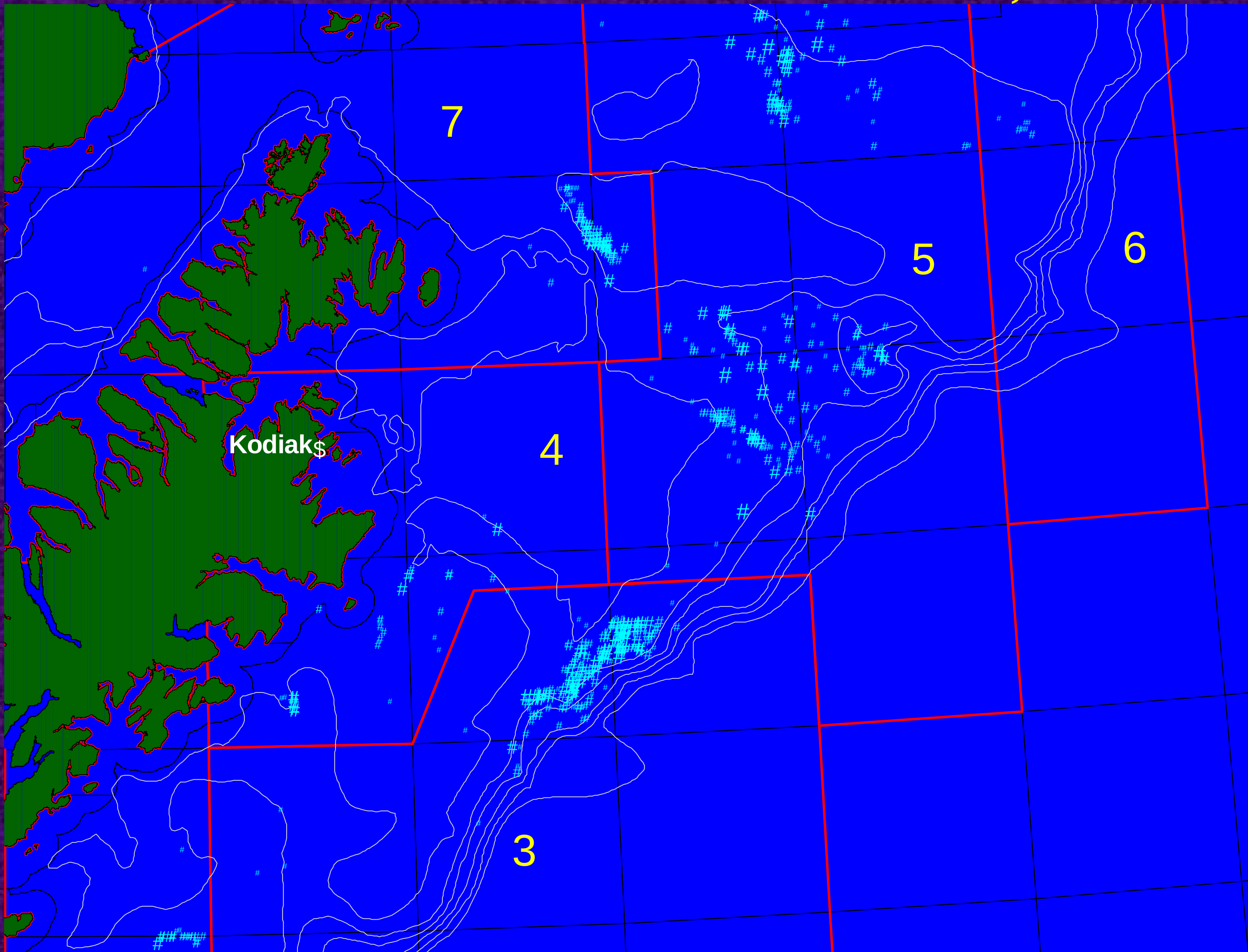
Season-end hauls in 2002 with low catch.

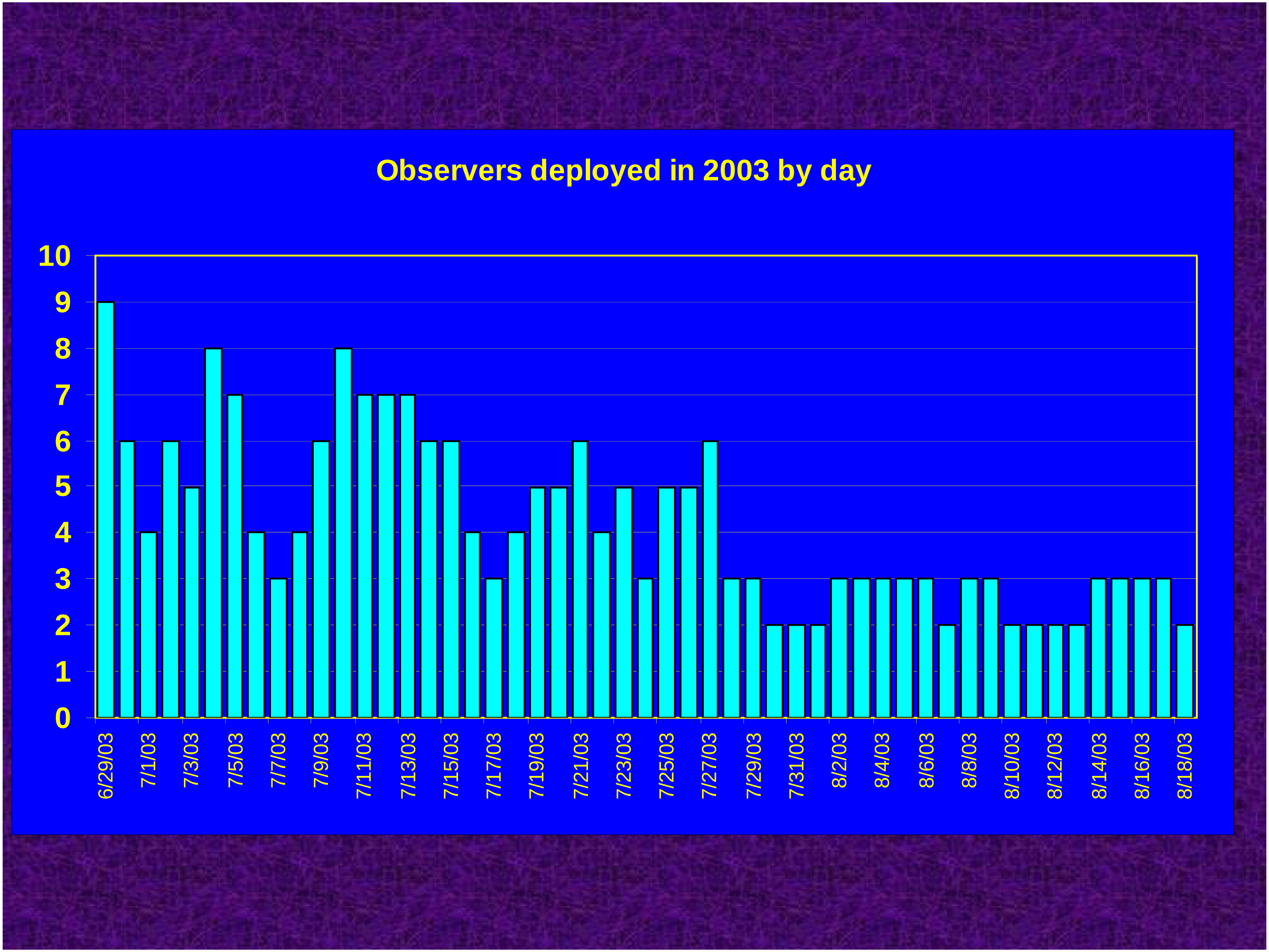



Observers deployed in 2002 by day
12
10
8
6
4
2
0
6/30/02
7/2/02
7/4/02
7/6/02
7/8/02
7/10/02
7/12/02
7/14/02
7/16/02
7/18/02
7/20/02
7/22/02
7/24/02
7/26/02
7/28/02
7/30/02
8/1/02
8/3/02
8/5/02

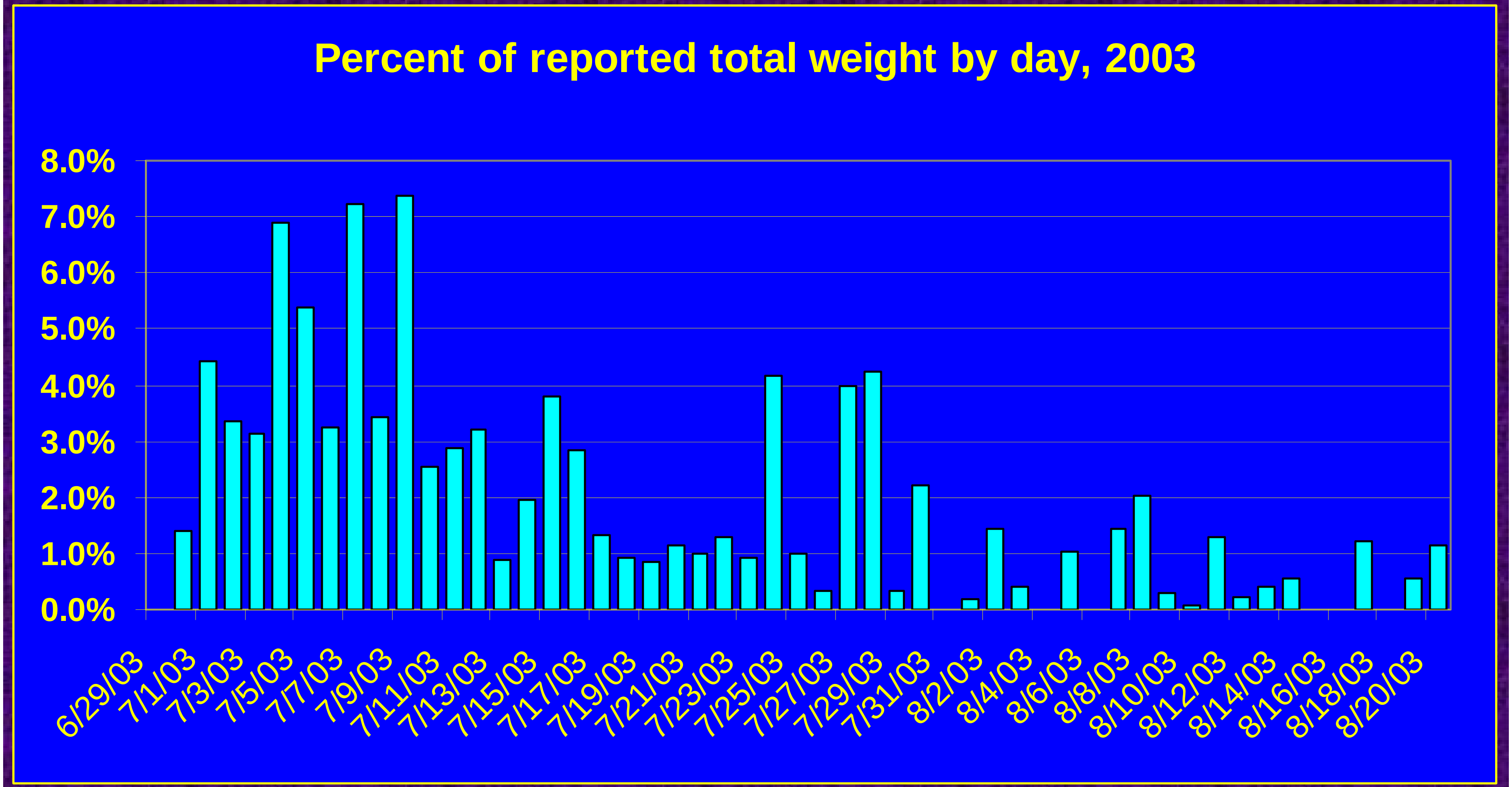

Percent of total reported weight by day, 2002
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
6/30/2002
7/2/2002
7/4/2002
7/6/2002
7/8/2002
7/10/2002
7/12/2002
7/14/2002
7/16/2002
7/18/2002
7/20/2002
7/22/2002
7/24/2002
7/26/2002
7/28/2002
7/30/2002
8/1/2002
8/3/2002
8/5/2002
8/7/2002

Observed haul retrieval locations, 2003.





Observers deployed in 2003 by day
10
9
8
7
6
5
4
3
2
1
0
6/29/03
7/1/03
7/3/03
7/5/03
7/7/03
7/9/03
7/11/03
7/13/03
7/15/03
7/17/03
7/19/03
7/21/03
7/23/03
7/25/03
7/27/03
7/29/03
7/31/03
8/2/03
8/4/03
8/6/03
8/8/03
8/10/03
8/12/03
8/14/03
8/16/03
8/18/03

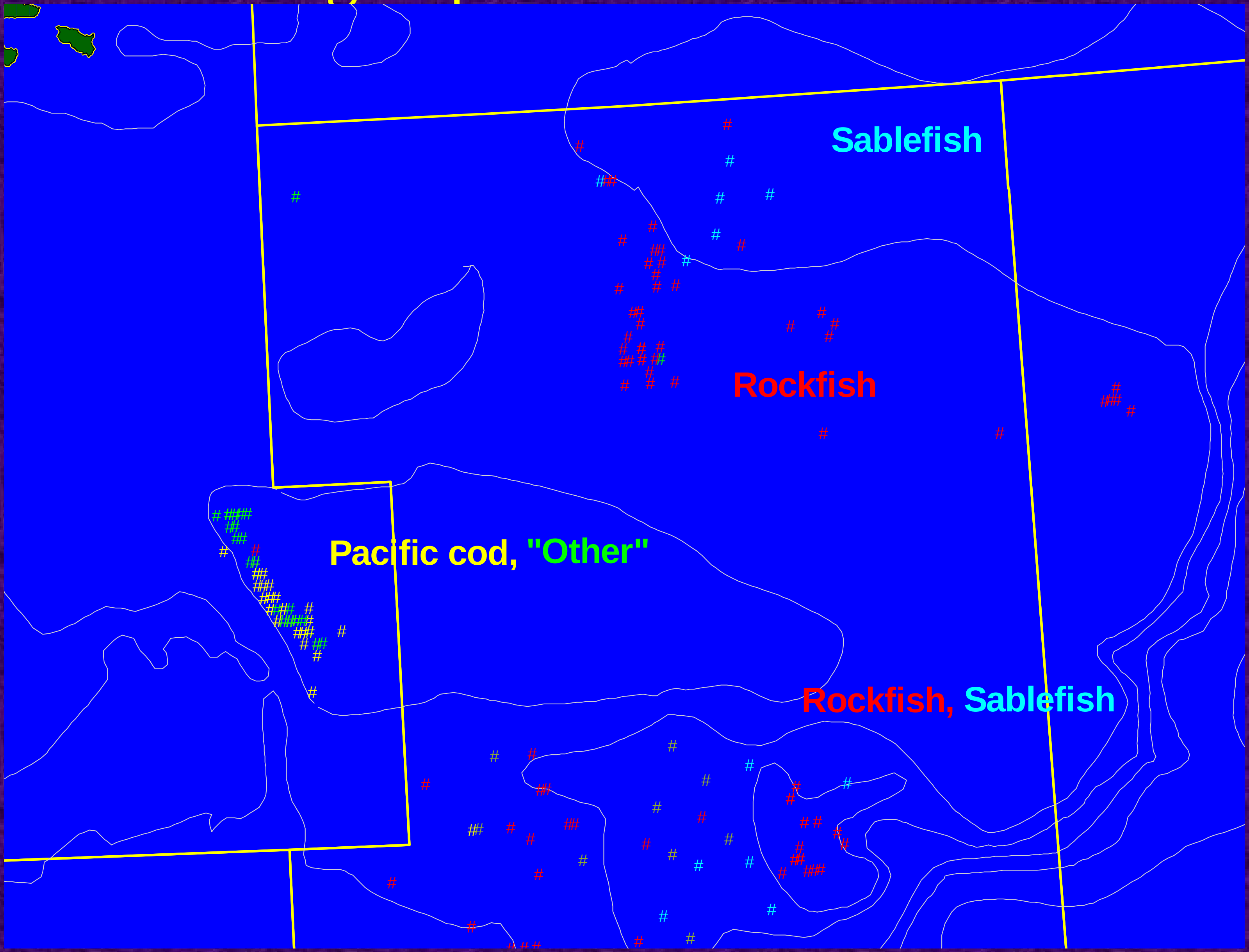


Percent of reported total weight by day, 2003
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
6/29/03
7/1/03
7/3/03
7/5/03
7/7/03
7/9/03
7/11/03
7/13/03
7/15/03
7/17/03
7/19/03
7/21/03
7/23/03
7/25/03
7/27/03
7/29/03
7/31/03
8/2/03
8/4/03
8/6/03
8/8/03
8/10/03
8/12/03
8/14/03
8/16/03
8/18/03
8/20/03

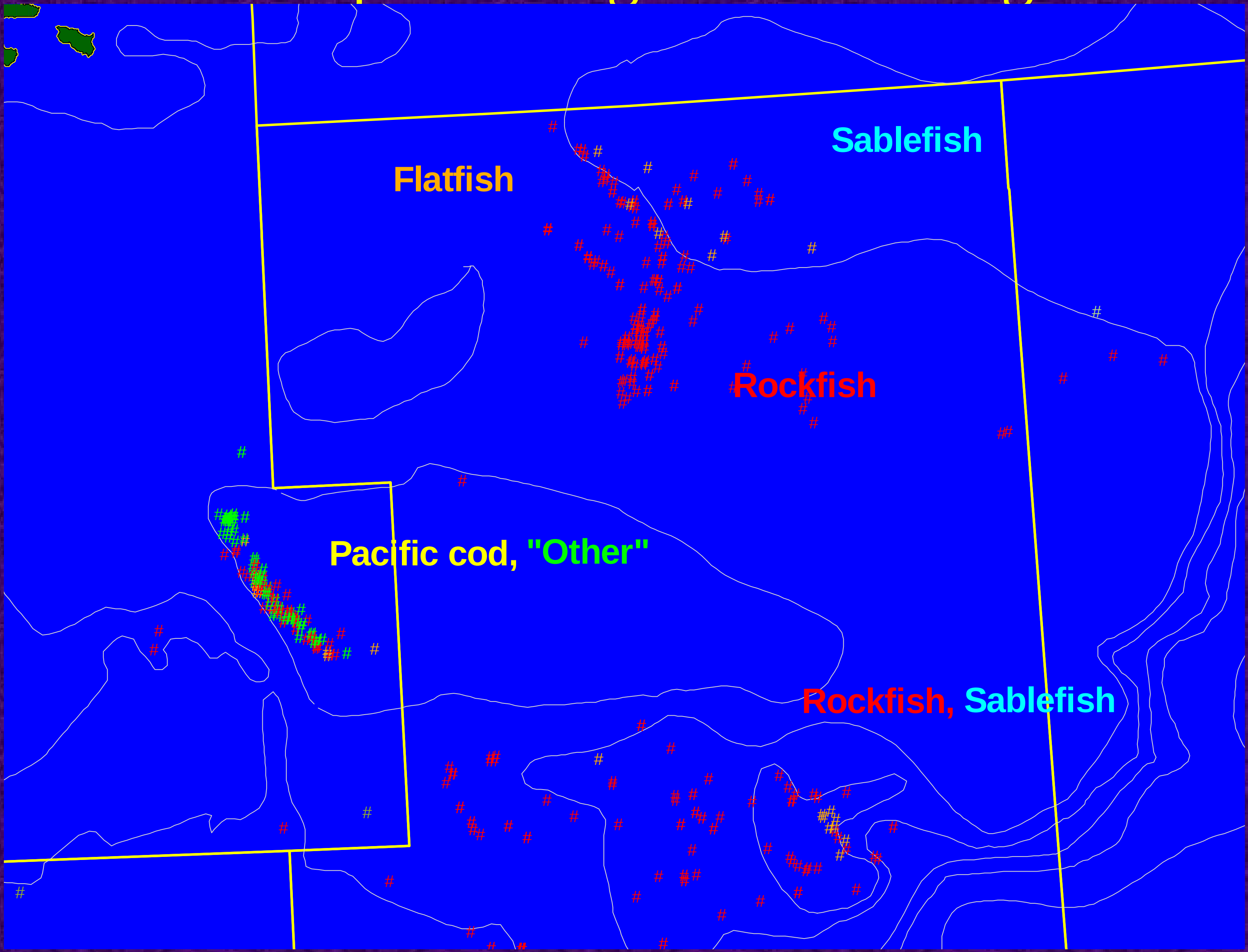
Self-reported data

- Industry perceptions can color how data is reported.
- Comparison of self-reported vessel logbook with observer data.

Target species in observed hauls.



Self reported target in vessel logbook.



Issue of target assignment.

- The only fisheries open are rockfish and/or flatfish.
- Perception that reporting a sablefish haul is wrong.
- Sablefish can be harvested up to the Maximum Retainable Allowance (e.g. 10%), or a weight percentage of the open fishery catch.
- So – a directed haul for a “closed” species can really be OK.

Conclusion

- Observer deployment as in the pilot project led to more representative coverage throughout the season.
- A comparison of various spatial data sets with a GIS reveals problems which are not revealed with normal spatial lookups.
- Several complimentary data sets are necessary to reveal patterns and problems.

Some techniques used to identify potential vessel selection bias in the Northeast Region

By

Susan Wigley
NEFSC
Woods Hole

National Observer Program
Vessel Selection Bias Workshop
May 17-18, 2006

NOAA Fisheries - NEFSC
National Marine Fisheries Service

techniques are taken from …

NEFSC Bycatch Estimation Methodology: Allocation, Precision and Accuracy

By

Paul Rago, Susan Wigley and Mike Fogarty

NEFSC Center Reference Document 05-09

http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0509/

Outline ...

1) Background
   available data sets
   fishery stratification

2) Is the Sampling Frame complete?

3) Are observed vessels representative of fleet?

4) Vessel Selection

Background: Northeast Region Data Sources

1) Dealer (DER) database

- assumed census of all landings
- species pounds and price
  - by vessel, date & grade
  - (no info on area fished or effort)

2) Vessel Trip Report (VTR) database

- self-reported data by vessel
- all federally permitted vessels
- date sail and landed, port,
- species hail weight by gear, mesh & area fished
- effort (# of hauls, average haul duration)

Northeast Region Data Sources (continued)

3) Observer (OB) data

vessel info (hull #, permit, ton class)
trip info (crew size, days absent, port)
gear and mesh characteristics,
species weights by catch disposition,
area fished (lat/lon -> stat area),
haul duration, and other info.
Biological sampling (l-f and age structures)

Level of Observer coverage varies:

Quota-monitoring coverage of
Special Access Programs
non-Quota-monitoring coverage (NE, M-A)

Northeast Region Data Sources (continued)

4) Vessel Monitor System (VMS) database

date/time/lat-lon (polling times varies by fleet),

tracks individual vessels;

VMS is required to participate in SAPs

Access (Closed) Areas

US/CAN Resource Sharing Area

self-reported kept and discarded weight

for some species

There was limited access to these data;

Now we can began to utilize these data more fully.

Background: Data stratification

Different stratifications are used

discard estimation for a stock assessment

sea day allocation for observer coverage

Stratify to describe fisheries/fleets:

use 'physically observable' attributes:

Region, gear type, mesh size, trip duration, quarter

Example: NE Multi-species Groundfish Fishery

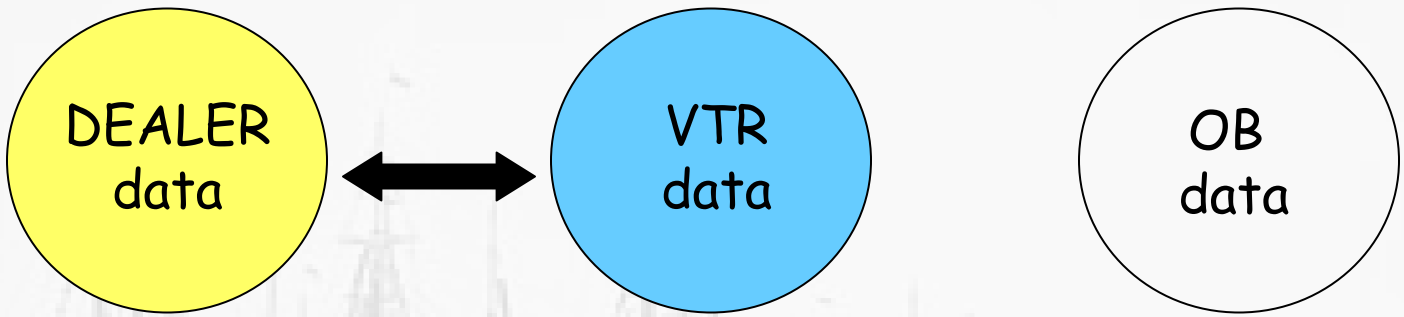
gear types: otter trawl, gillnet, longline

mesh groups: small, medium, large, extra large

trip duration: 1 day and 2+ day

six geographic regions (ME/NH, NMA, SNE, NY/NJ, DE/MD, VA/NC)

Is the Sampling Frame complete?



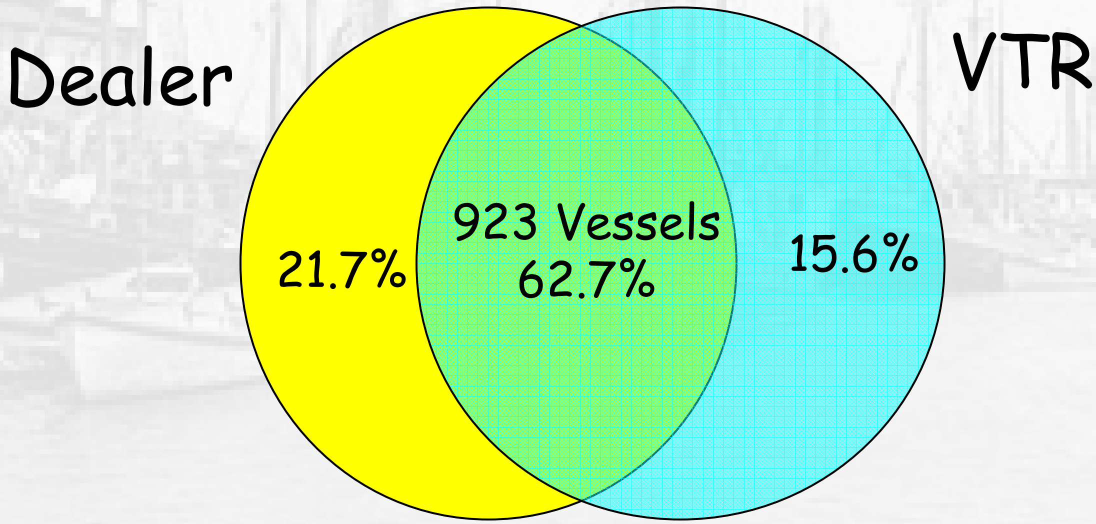
Compare Dealer and VTR data sets:

limited by data elements common to both sets

Sampling Frame (continued)

1) Compare unique vessels

Dealer Data: 1242 vessels sold Groundfish
VTR data: 1152 vessels kept Groundfish



1471 unique vessels
in 2004

Sampling Frame (continued)

Compare Dealer and VTR data using …

2) Kept weight (total and by species)

3) Vessel size (ton class)

4) Geographic location (state or port)

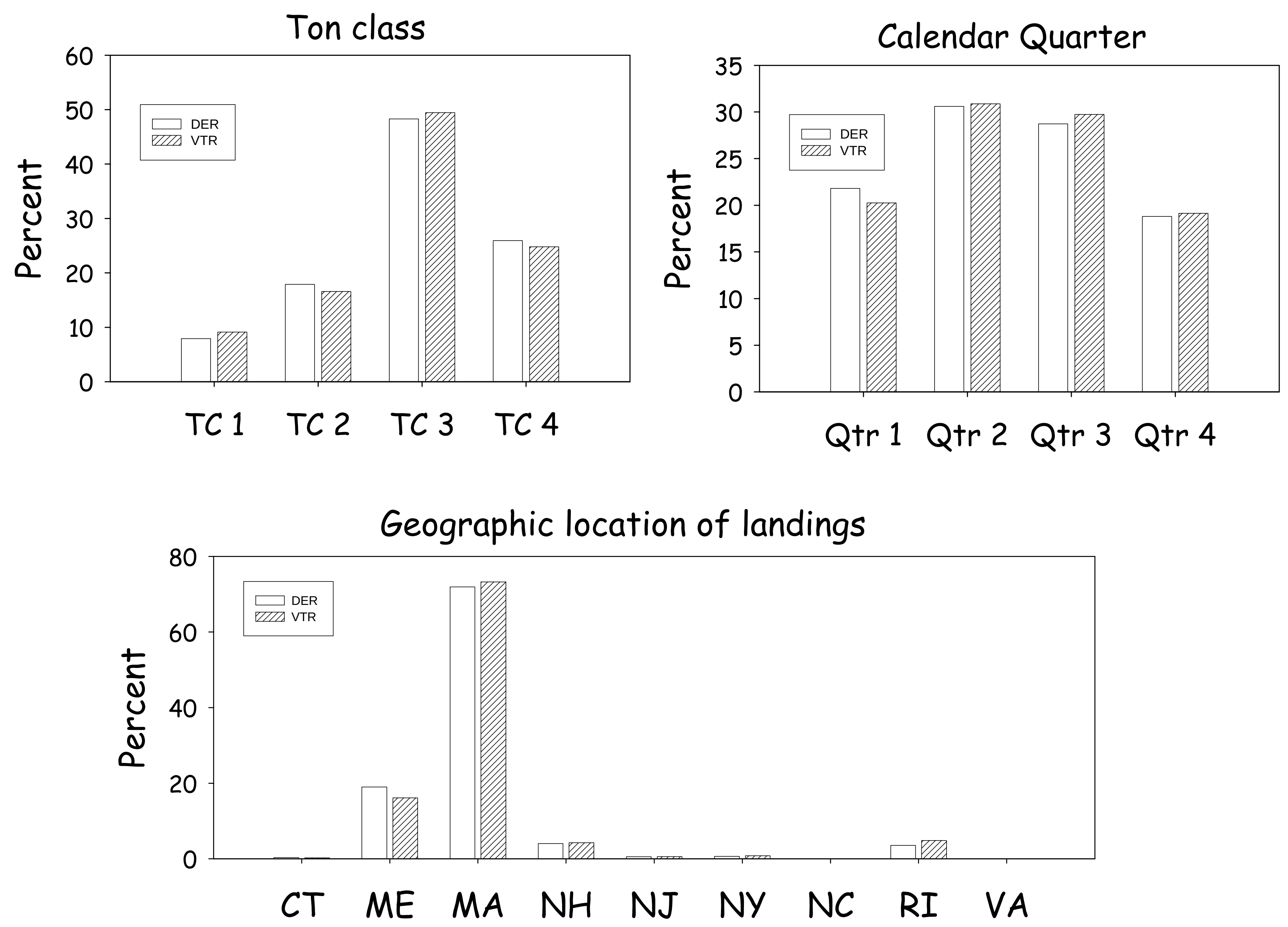
5) Temporal (quarterly or monthly)

Sampling Frame (continued)

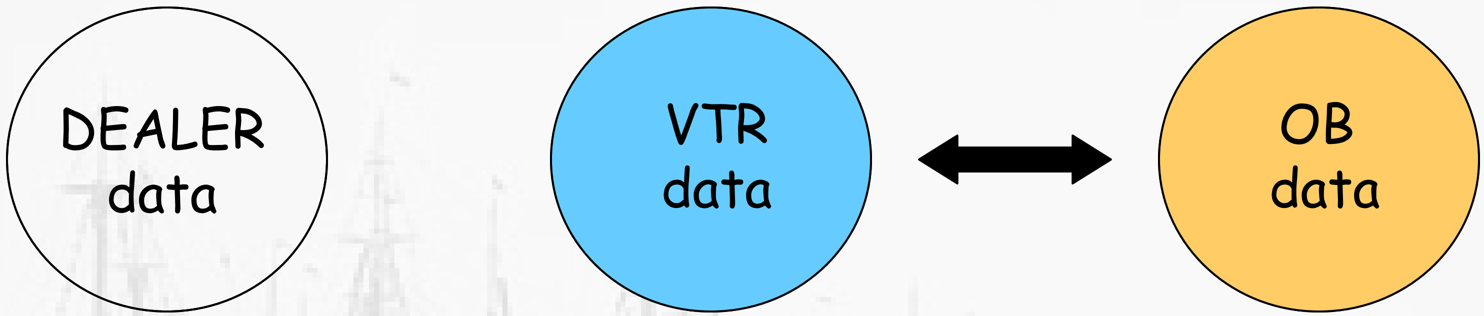
Species	VTR Landings (mt)	Dealer Landings (mt)	Difference (mt)	Percent Difference
Cod	8240	8692	452	5.20%
Winter fld	5321	5714	393	6.90%
Witch fld	2971	3108	137	4.40%
Yellowtail fld	5208	5530	322	5.80%
American Plaice	2204	2415	211	8.70%
Windowpane fld	102	60	-42	-70%
Haddock	5778	5874	96	1.60%
White Hake	2268	3305	1037	31.40%
Halibut	11	13	2	15.40%
Redfish	338	360	22	6.10%
Pollock	3839	4188	349	8.30%
Total	36281	39258	2977	7.60%

Major GF species: cod, haddock, yellowtail fld (1.6 to 5.8%);
few exceptions: Windowpane & Halibut (small relative to total);
White Hake, mis-specified; overall percent difference without White hake ~5.4%

Sampling Frame (continued)



Are observed vessels representative of fleet?



Compare VTR and OB

1) Kept pounds

2) Trip Duration

3) Area fished (using VTR and VMS)

Use percentages, contingency table analysis, paired t-tests, graphical overlays

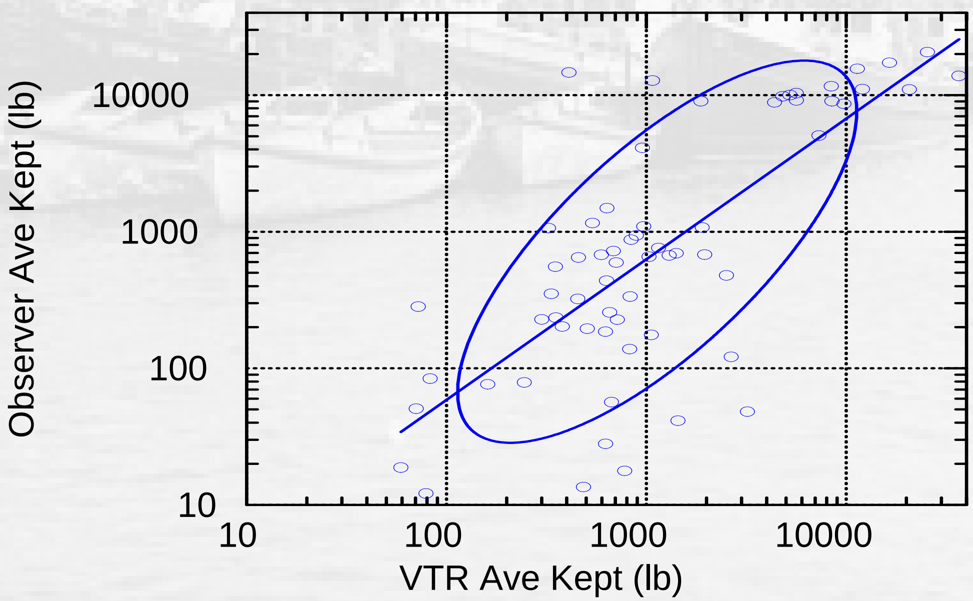
Are vessels representative? (continued)

Compare Average Kept Pounds between VTR & OB

Each dot represents the average kept lbs. of a stratum (region, gear, mesh, trip, qtr)

VTR and OB data compare favorably, following an expected linear relationship

Comparisons of Ave Kept (lb)

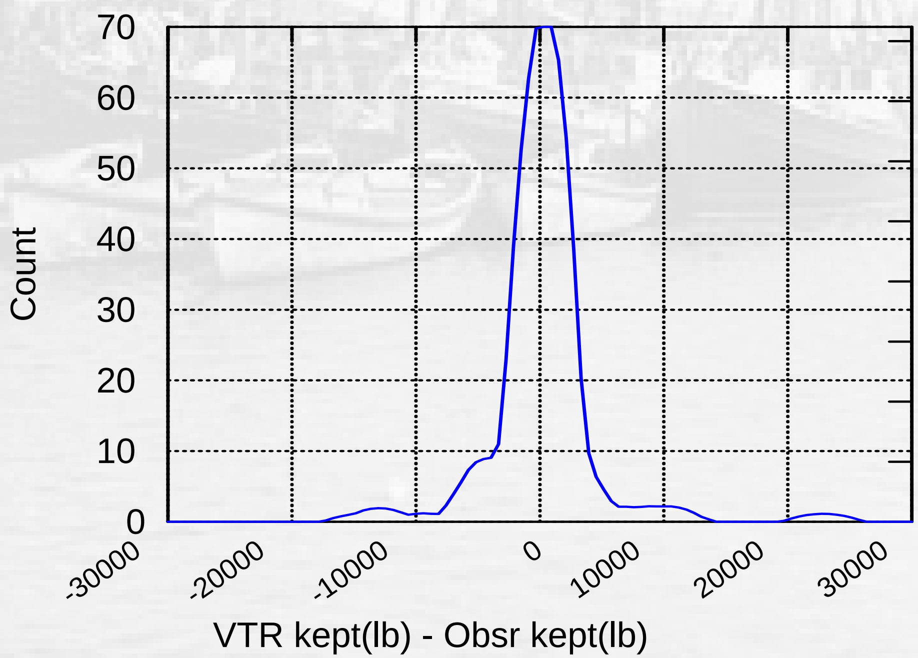


Are vessels representative? (continued)

VTR $_{\text{Avg. Kept}}$ – OB $_{\text{Avg. Kept}}$ (region, gear, mesh, trip, qtr)

Expect no statistical difference if
VTR and OB trips measure the same underlying process

VTR vs Obsrvr Ave Kept Comparison

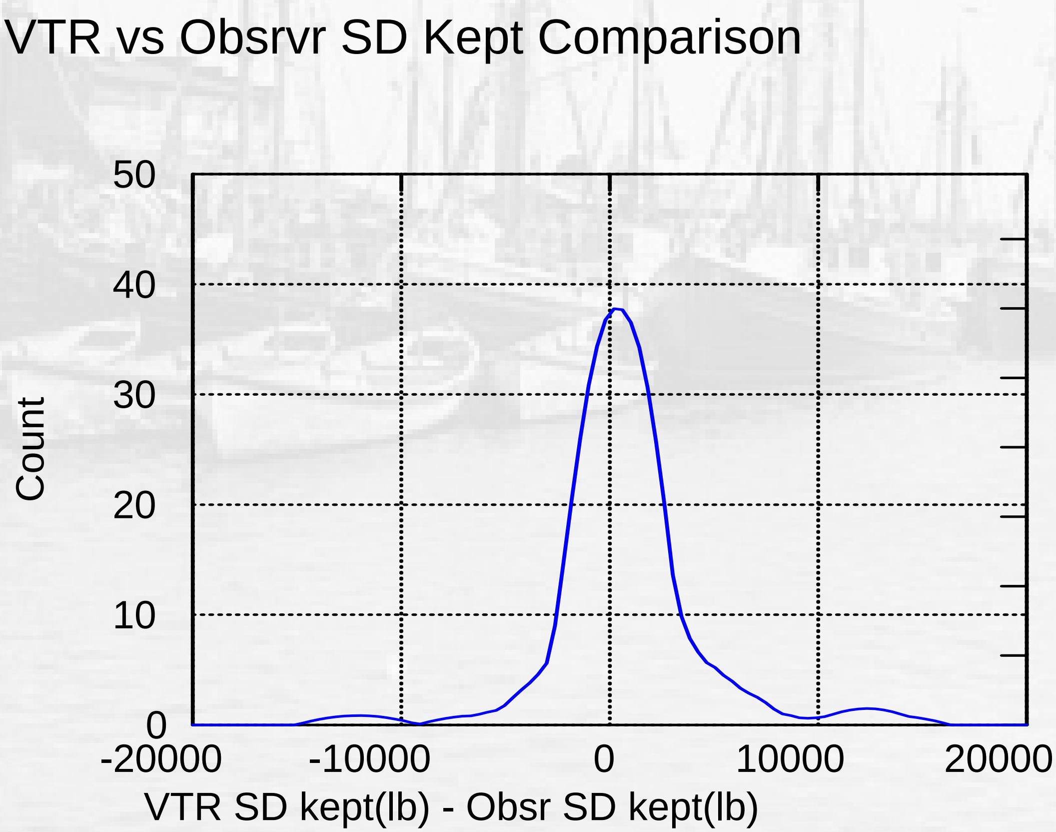


No evidence of systematic bias
Mean difference = 238 pounds

Paired t-test of stratum-specific differences showed no significant difference from zero
(p=0.59, df = 84)

Are vessels representative? (continued)

VTR Std. Dev $_{\text{Avg. Kept}}$ – OB Std. Dev $_{\text{Avg. Kept}}$



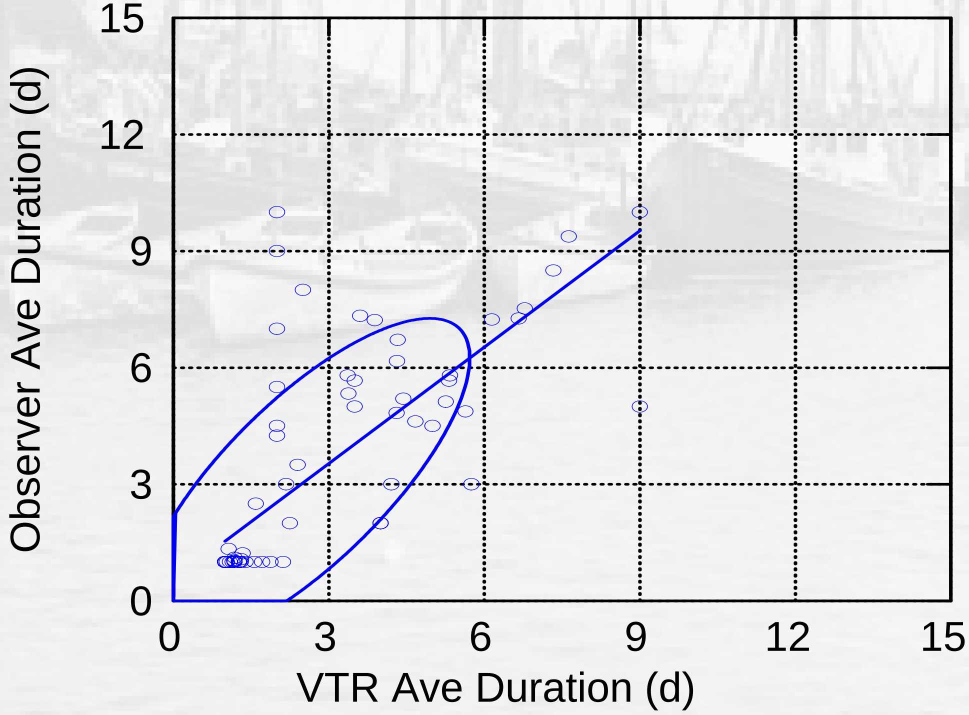
Paired t-test of stratum-specific differences of standard deviations of average kept pounds showed no significant difference from zero (p=0.08)

Are vessels representative? (continued)

Compare Average Trip Duration between VTR & OB

Strong correlation between VTR and OB for average trip duration;

Comparisons of Ave Trip Duration



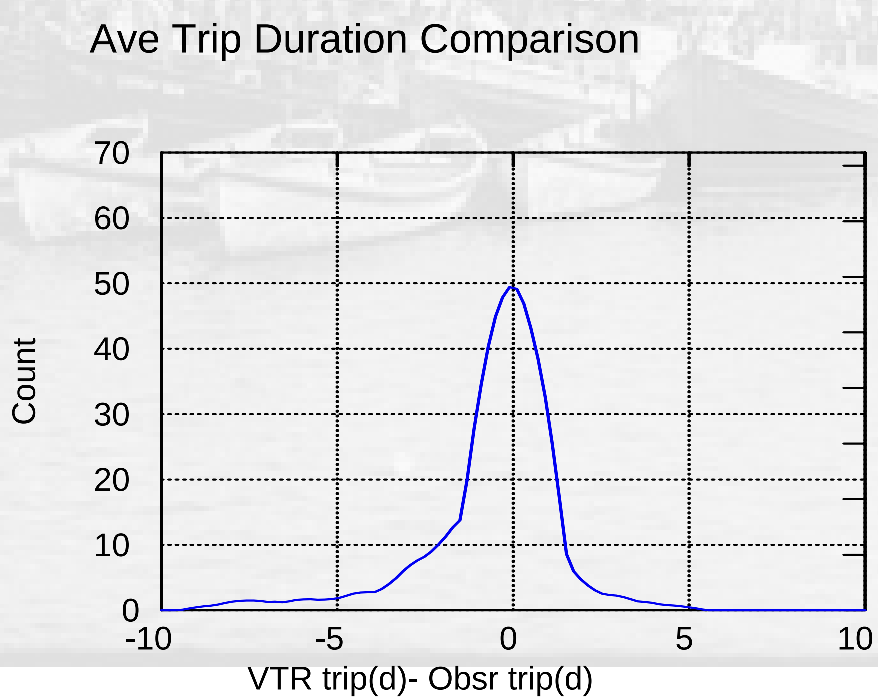
Are vessels representative? (continued)

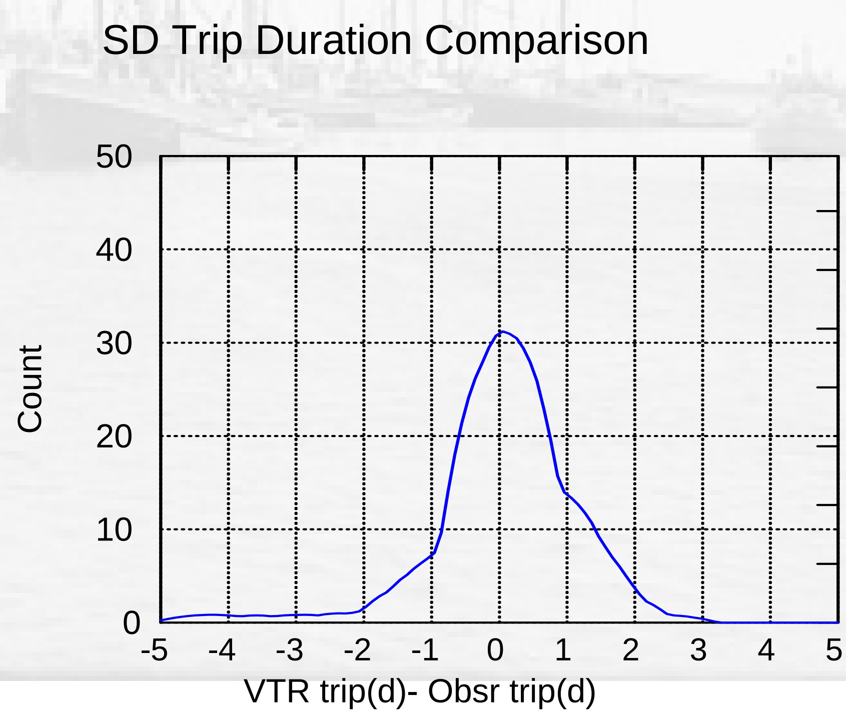
VTR avg. trip duration – OB avg. trip duration

OB trips averaged ~ ½ day longer (p=0.01)

However, difference in stratum-specific std. dev. of average trip duration was not significantly different from zero (p=0.60);

Some skewing is evident, with OB trips being slightly longer ;





Are vessels representative? (continued)

A) Compare Stat. Areas fished of VTR & OB

contingency table analysis was used to compare observed vs expected distributions based on proportions of VTR trips by statistical areas

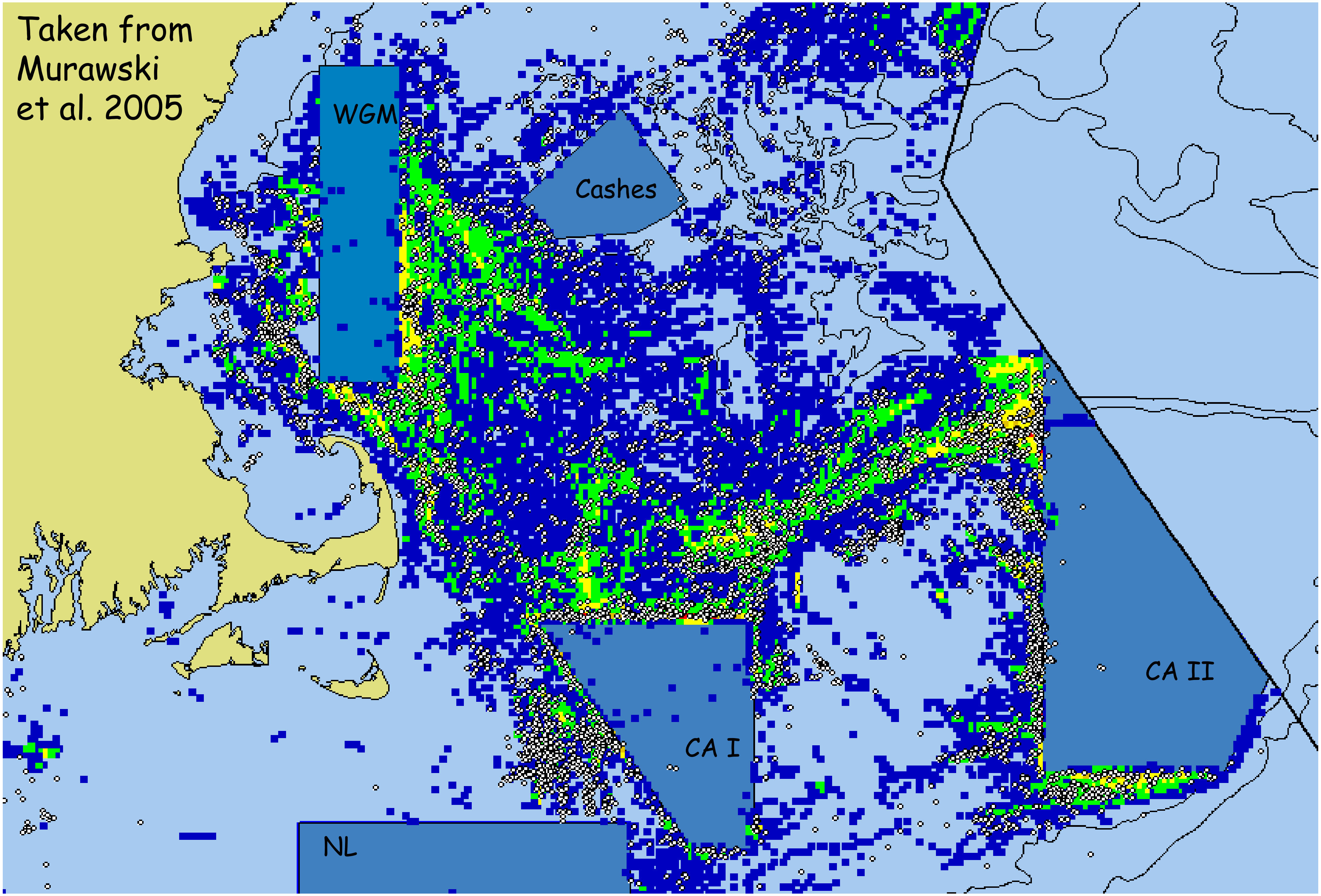
The null hypothesis of equivalent spatial distribution of sampling was rejected in 4 of 50 cases.

Are vessels representative? (continued)

B) Compare VMS and OB
not all vessels are required to have VMS unit
Example: Otter trawlers in 2003

Graphical overlay of OB hauls upon effort summed up by 1' x 1' squares from VMS data

Vessel speed was used to distinguish between fishing and steaming



Locations of otter trawl fishing effort (color squares) from vessels using VMS
Observed otter trawl tows (white circles) in 2003.

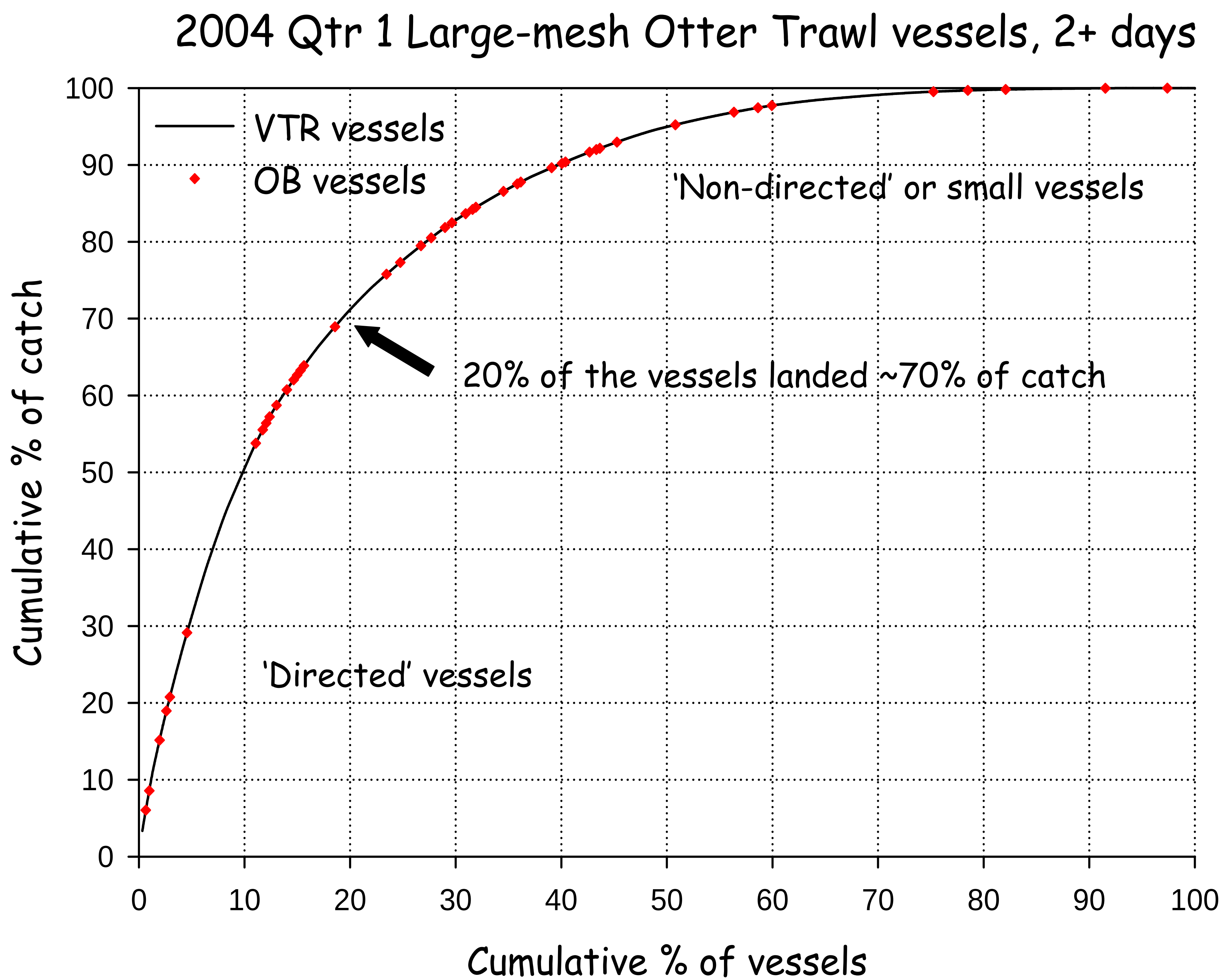
Are vessels representative? (continued)

Still Exploring …

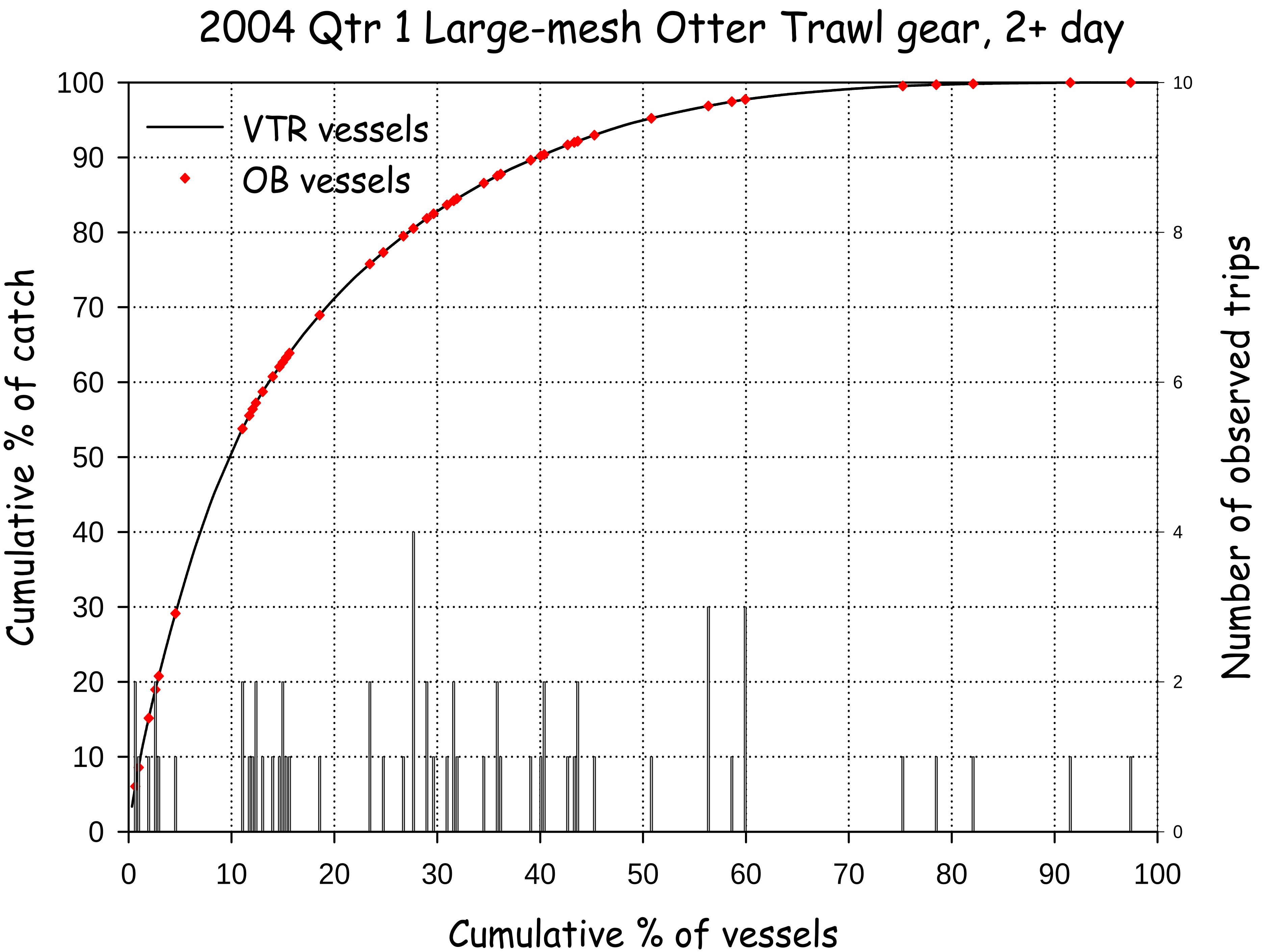
The use of cumulative distributions to evaluate how "concentrated" vessels are within a fleet (stratum)

cumulative distributions of catch or effort

Example: Cumulative groundfish catch by vessels



2004 Qtr 1 Large-mesh Otter Trawl vessels, 2+ days
VTR vessels
OB vessels
'Non-directed' or small vessels
20% of the vessels landed ~70% of catch
'Directed' vessels
Cumulative % of catch
Cumulative % of vessels
0
10
20
30
40
50
60
70
80
90
100



2004 Qtr 1 Large-mesh Otter Trawl gear, 2+ day
VTR vessels
OB vessels
Cumulative % of catch
Number of observed trips
Cumulative % of vessels
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10

Vessel Selection

Sea day schedule is stratified by
region, gear, mesh, trip duration, quarter

Create a vessel list from the VTR data
using same strata:

vessel name, hull number, permit, random number
Also, number of trips within stratum, port

Vessel Selection List: a tool

Excel file with auto-filters

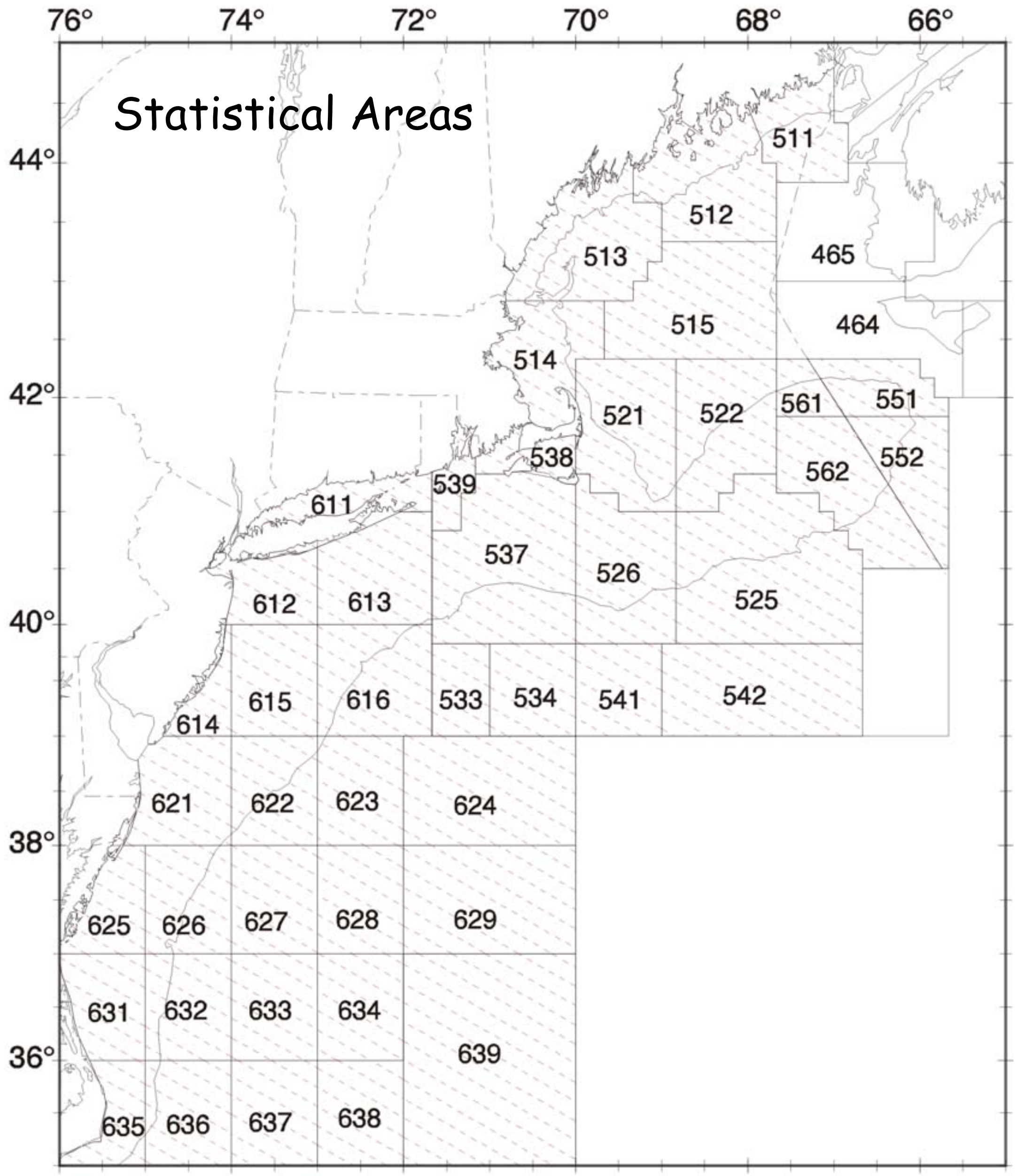
qtr	gear	mesh	region	trp	rtrips	port	portnm	st	ptrips	permit	hull_id	vesname	vtrips	rannu
1	Gillnet	Large	ME_NH	all	90	220101	PORTLAND	ME	26	118724	ME685GG	RACHEL T	3	939
1	Gillnet	Large	ME_NH	all	90	220101	PORTLAND	ME	26	149360	ME10NTF	WEST HEAD	1	555
1	Gillnet	Large	ME_NH	all	90	220101	PORTLAND	ME	26	250527	625108	AVATAR	7	780
1	Gillnet	Large	ME_NH	all	90	220101	PORTLAND	ME	26	250743	651125	CHERYL K	4	144
1	Gillnet	Large	ME_NH	all	90	220101	PORTLAND	ME	26	250833	907344	CELTIC PRIDE	5	550
1	Gillnet	Large	ME_NH	all	90	220101	PORTLAND	ME	26	310453	641336	FIONA A	6	198
1	Gillnet	Large	ME_NH	all	90	220501	CUNDYS HARBOR	ME	2	118724	ME685GG	RACHEL T	2	572
1	Gillnet	Large	ME_NH	all	90	226920	KENNEBUNKPORT	ME	13	147517	ME2724W	HANNAH JO	13	934
1	Gillnet	Large	ME_NH	all	90	320201	PORTSMOUTH	NH	16	146646	ME4189T	RHIANNON RAE I	4	344
1	Gillnet	Large	ME_NH	all	90	320201	PORTSMOUTH	NH	16	147937	ME6146T	ROLLING STONE	2	134
1	Gillnet	Large	ME_NH	all	90	320201	PORTSMOUTH	NH	16	250907	924118	CAROL ANN	8	538
1	Gillnet	Large	ME_NH	all	90	320201	PORTSMOUTH	NH	16	310609	938382	ANN MARIE	2	500
1	Gillnet	Large	ME_NH	all	90	320401	RYE	NH	18	125236	NH2389F	SWEET SCANTUI	2	98
1	Gillnet	Large	ME_NH	all	90	320401	RYE	NH	18	146669	NH3911AZ	BRIDGET LEIGH	16	839
1	Gillnet	Large	ME_NH	all	90	320801	HAMPTON	NH	3	110102	NH9866AL	MISS MAURA	3	475
1	Gillnet	Large	ME_NH	all	90	320901	SEABROOK	NH	12	118675	NH8203D	HELENS PRIDE II	4	194
1	Gillnet	Large	ME_NH	all	90	320901	SEABROOK	NH	12	144354	ME1635X	WENDY LEIGH	8	900
1	Gillnet	Large	NJ/NY	all	1	351135	SHINNECOCK	NY	1	221725	633425	SEA QUEEN	1	398
1	Gillnet	Large	N_MA	all	735	240207	GLOUCESTER	MA	577	114880	MS2844Y	NATIVE SON	25	190

...

Vessel List Strengths /Weaknesses:

‘Tool’ for Area Coordinators

VTR-based (+/-)


Statistical Areas
76°
74°
72°
70°
68°
66°
44°
42°
40°
38°
36°
511
512
513
465
515
464
514
521
522
561
551
538
562
552
539
611
537
526
525
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533
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541
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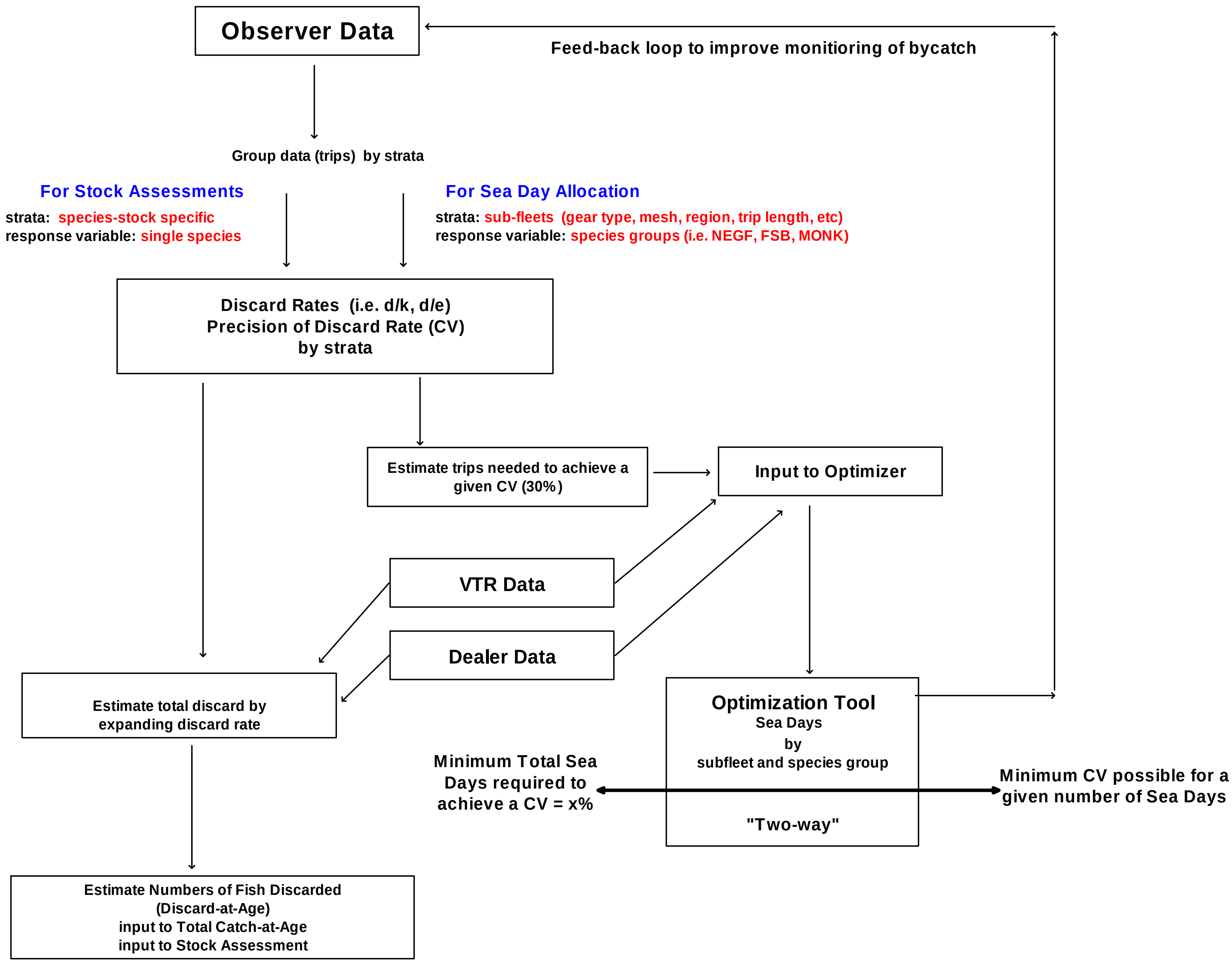
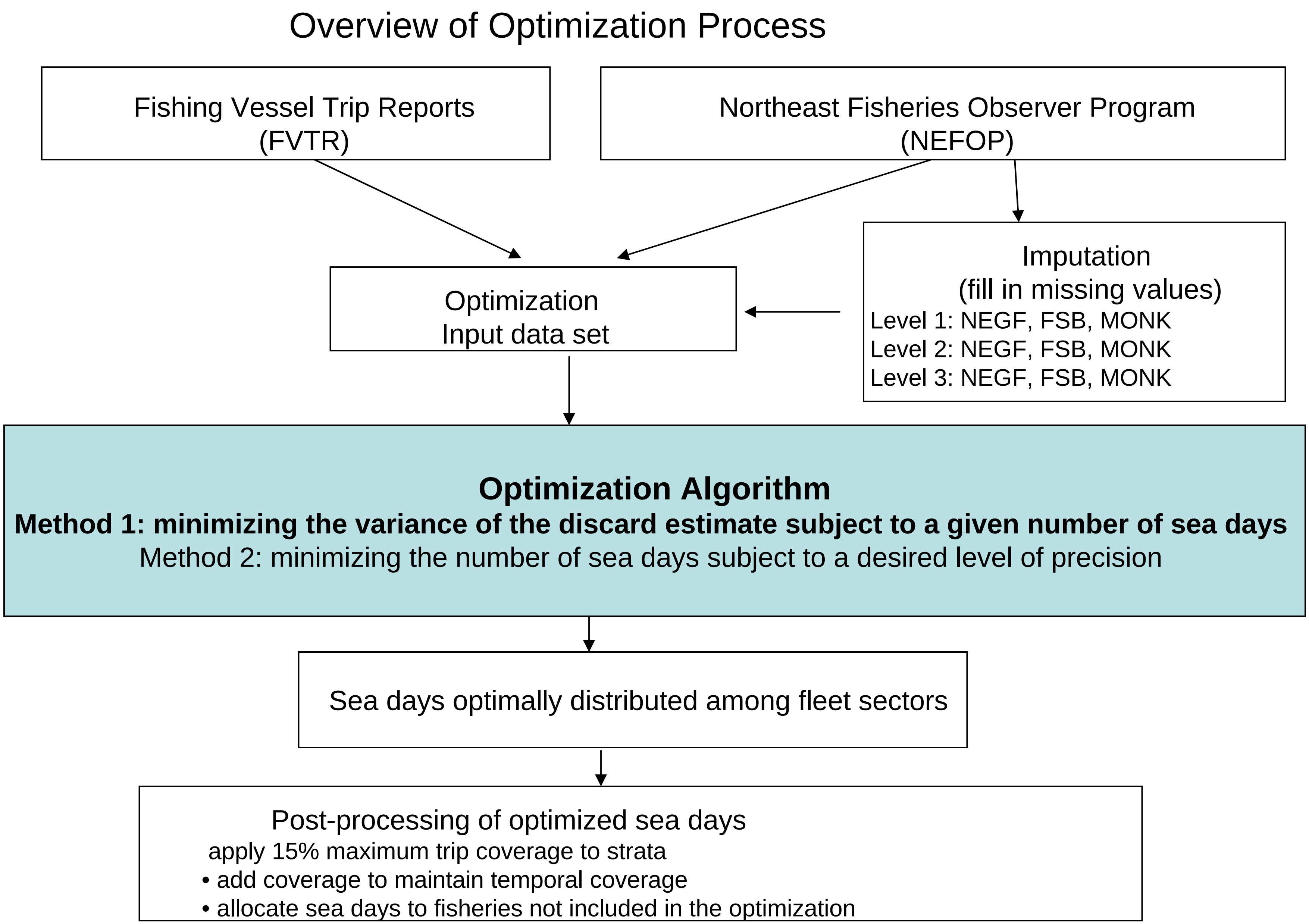
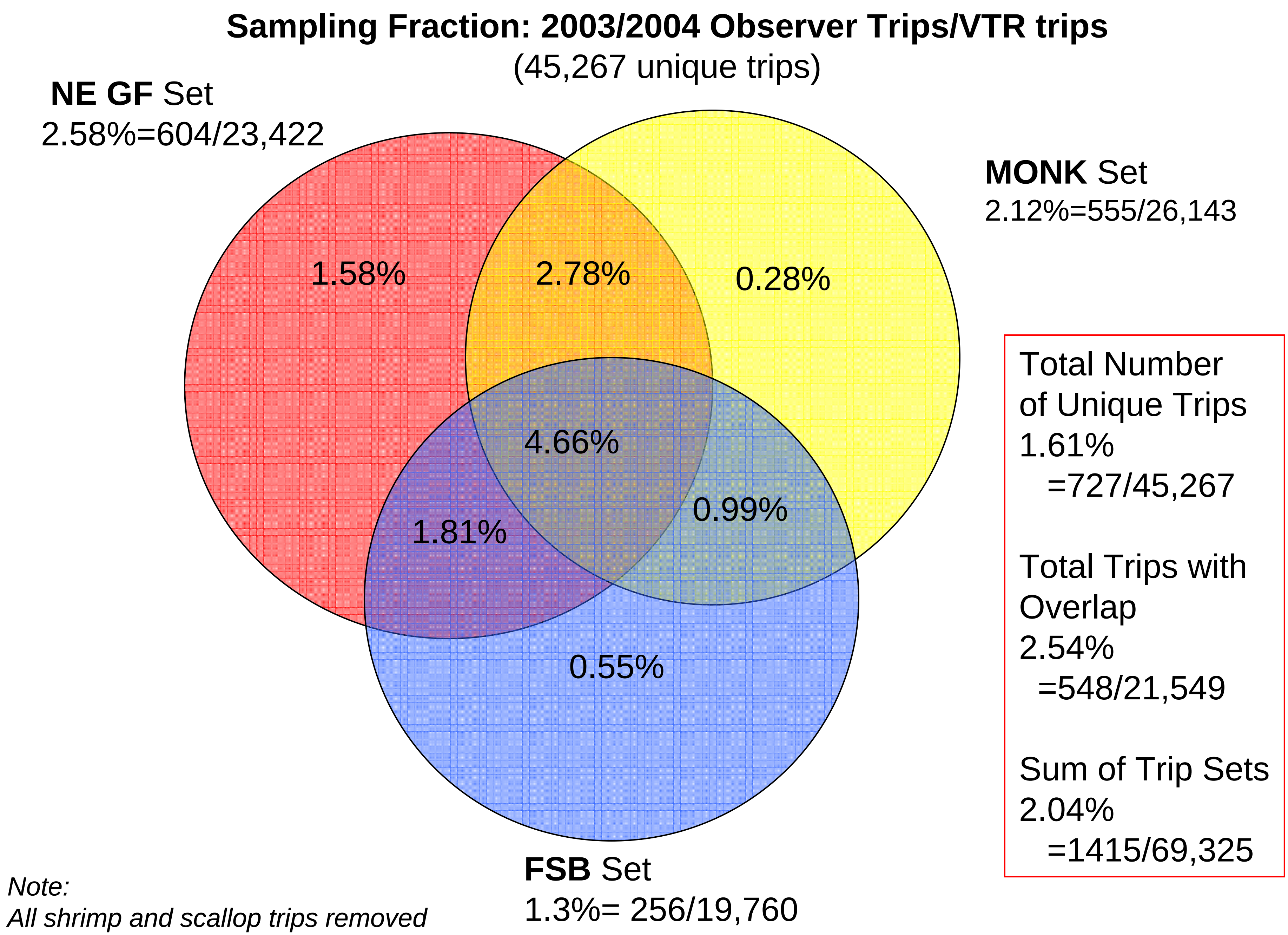
Overview of Stock Assessment and Sea Day Allocation Processes

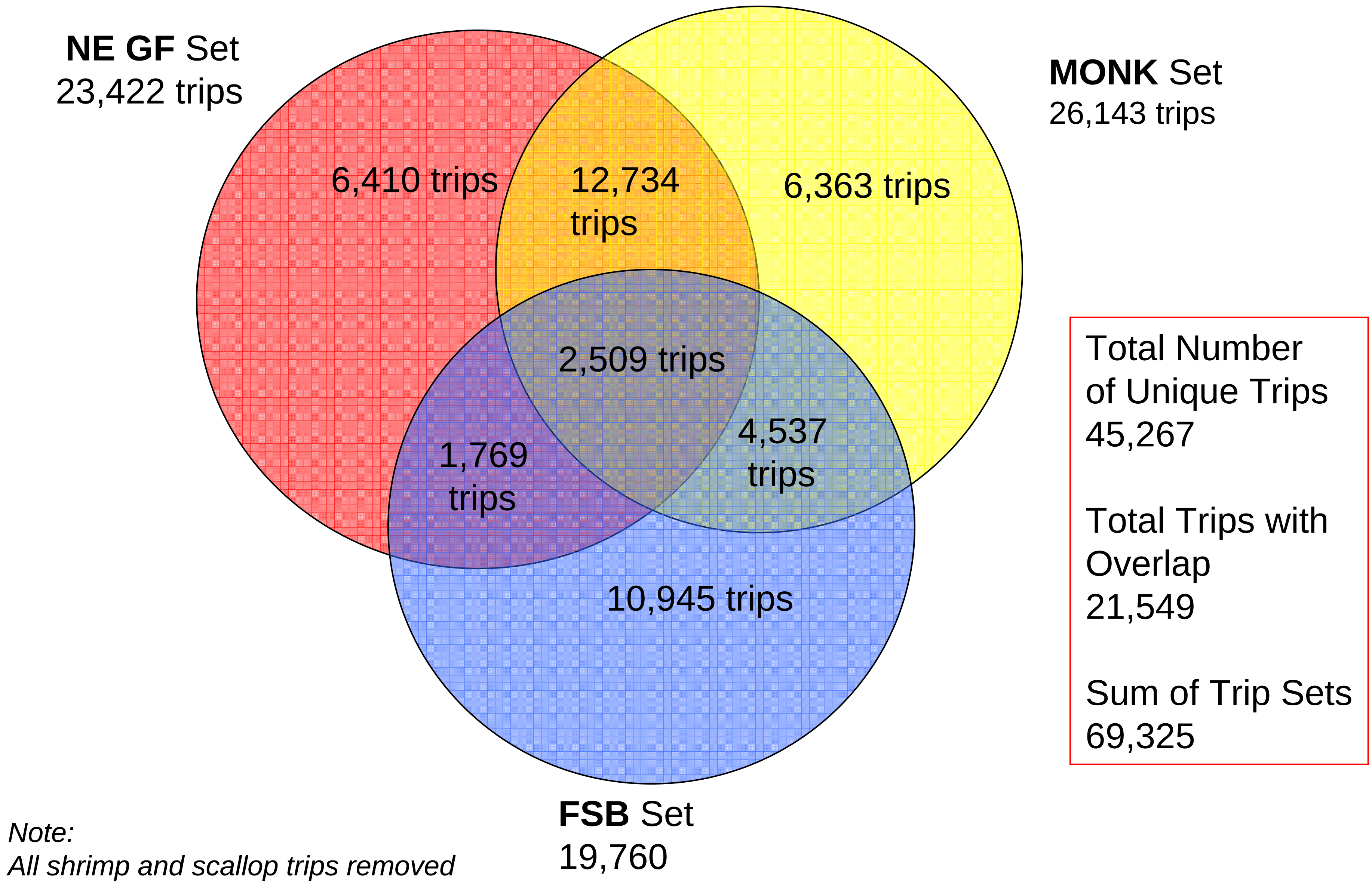




An overview of the optimization process used to allocate sea days to fisheries in the Northeast region.

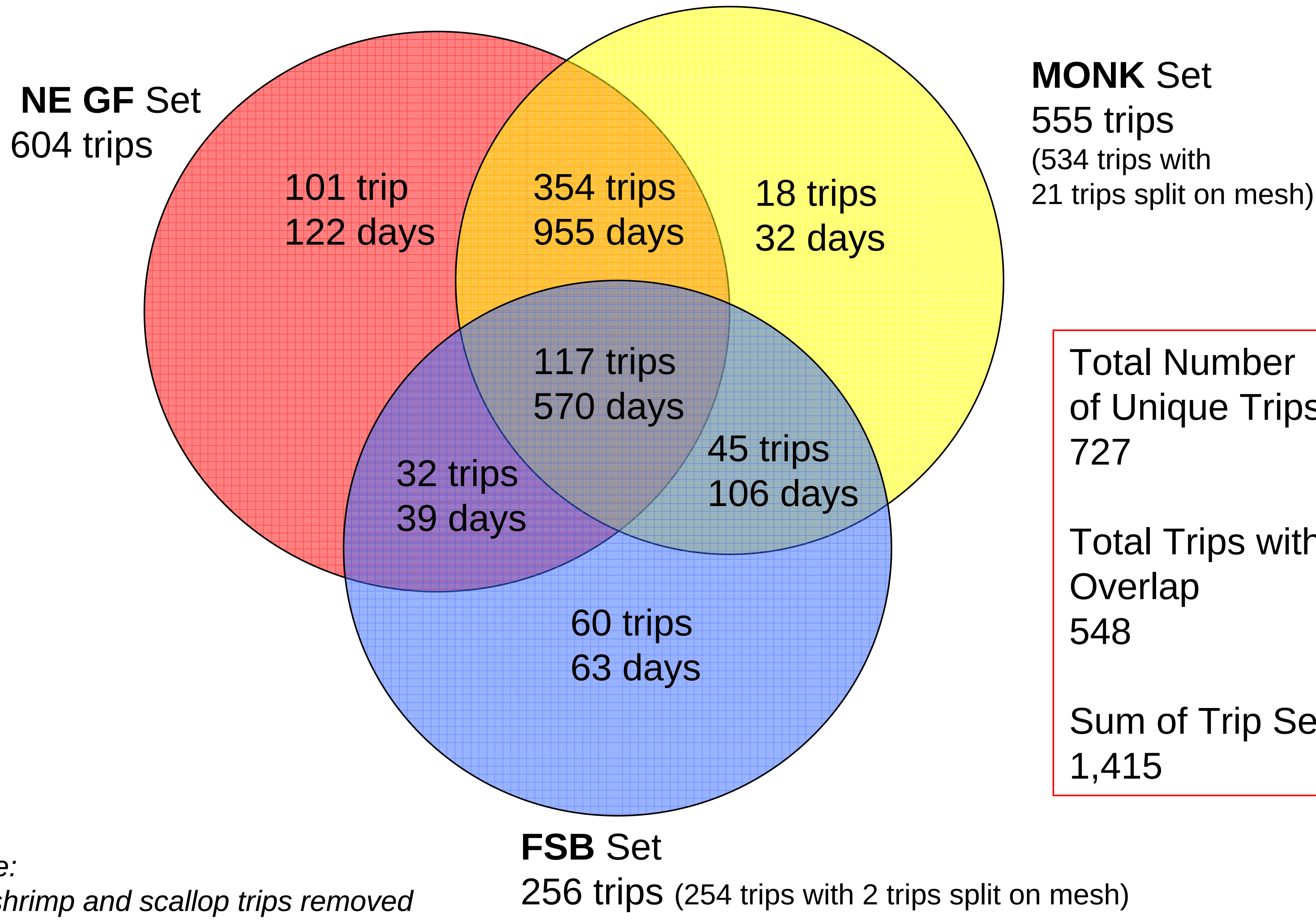

Sampling Fraction: 2003/2004 Observer Trips/VTR trips
(45,267 unique trips)
NE GF Set
2.58%=604/23,422
MONK Set
2.12%=555/26,143
1.58%
2.78%
0.28%
4.66%
1.81%
0.99%
0.55%
FSB Set
1.3%= 256/19,760
Total Number of Unique Trips
1.61%
=727/45,267
Total Trips with Overlap
2.54%
=548/21,549
Sum of Trip Sets
2.04%
=1415/69,325
Note:
All shrimp and scallop trips removed

Number of trips in 2003/2004 VTR data subsets
(45,267 trips)



Number of trips and sea days in the 2003/2004 Observer data subsets

(727 trips and 1887 sea days)

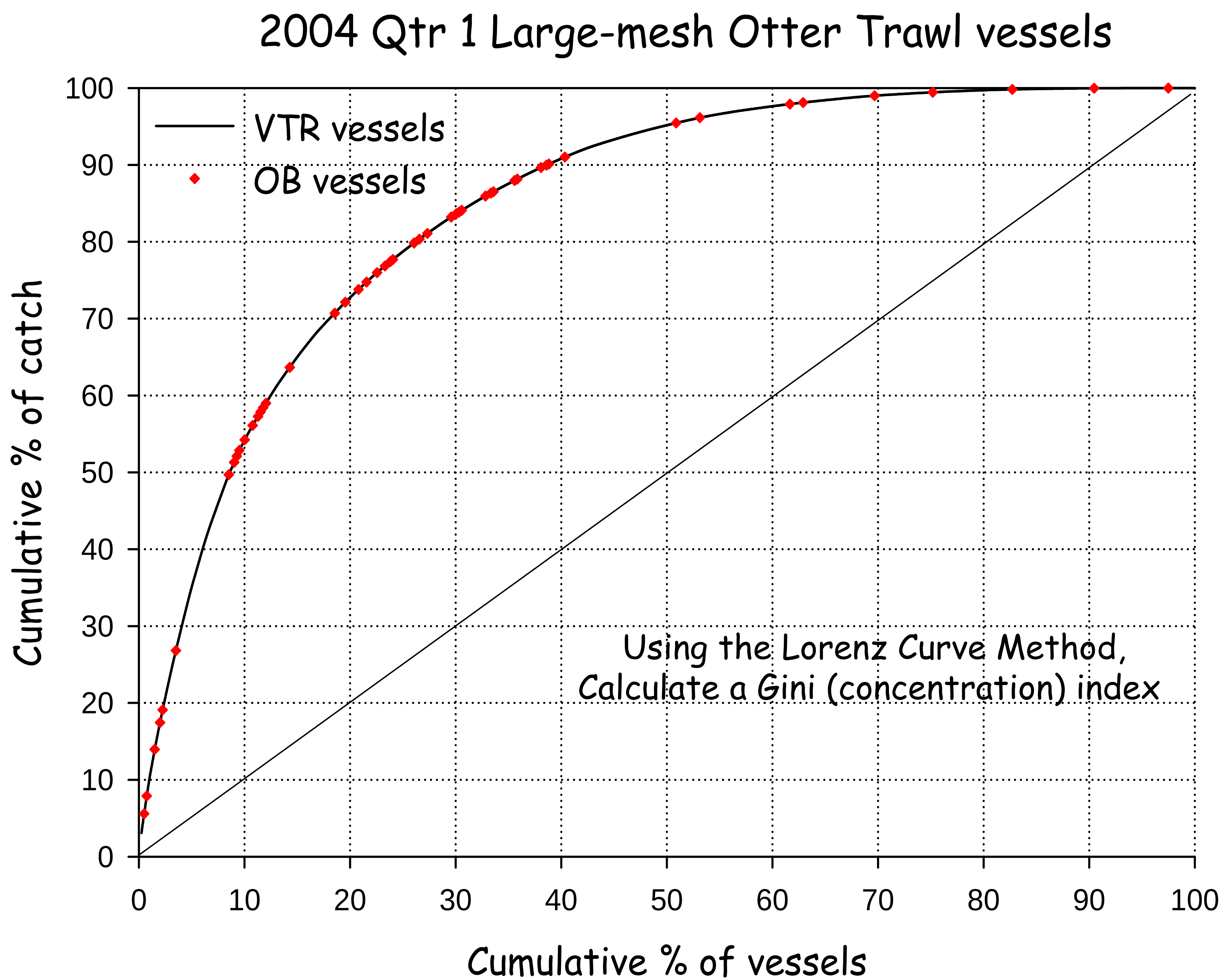


Total Number of Unique Trips
727

Total Trips with Overlap
548

Sum of Trip Sets
1,415

Note:
All shrimp and scallop trips removed


2004 Qtr 1 Large-mesh Otter Trawl vessels
VTR vessels
OB vessels
Cumulative % of catch
Cumulative % of vessels
0
10
20
30
40
50
60
70
80
90
100
Using the Lorenz Curve Method,
Calculate a Gini (concentration) index

Analysis of Vessel Selection Bias – Examples using Limited-Entry Trawl Data from the West Coast

Nancy Gove

West Coast Groundfish Observer Program

Northwest Fisheries Science Center

Today – Examples from Limited-Entry Trawl

- Sampling Design
- Possible methods for analyzing bias
- Analyses using fish ticket data
- Conclusions of analysis
- Comments on data sources and methods

Sampling Frame – Limited-Entry Trawl

- Difficulties: The sampling frame is dynamic.
  - A few of the permits will be switched from one boat to another within a year.
  - Also, it is possible for an inactive permit to start fishing, but this is rare.
  - Boats may not be participating in the fishery when selected.

Reality of Sampling Design vs. Logistics

- Program evaluated by the number of sea days
  - Conflicts with sampling design
  - Favors selecting more boats than we have observers to cover
    - Avoids down time
    - Results in missed trips
- Boats don’t have to fish in port group selected
  - Can’t control fishing behavior
- Number of port groups vs. smaller sample sizes per port group

Sampling

- Selection Cycle
  - Sampling event
    - Time it takes to sample (or “cycle” through) the entire fleet
    - Past cycles 8-12 months long
  - Consists of 2-month periods
  - Number of periods depends on the desired sampling intensity
    - 25% Coverage – Sampling Cycle has 4 2-month periods

Sampling – Vessel Selection

- Vessels assigned to port groups
  - Based on port group with the majority of the catch was landed in the previous year (Stratification)
- In each period for each port group, vessels are randomly selected
- Once a vessel has been selected, it is not available for selection in the remaining periods (sampling without replacement)

Sampling

- Period
  - Vessels are selected for a 2-month period
    - All trips selected
    - Periods coincide with the timing of the 2-month cumulative trip limits
      - NOTE: Cumulative limits do not carry over from one period to another
    - Discourages changes in fishing behavior due to the presence of an observer

Data – Limited-Entry Trawl

- Fish Tickets
  - Observed vs. Unobserved Fish Tickets
  - For combined analysis decided to use cycles 2-4
    - Cycle 1 was a learning period for both the fishermen and the observer program
  - Used weight of landed catch for analyses
- Logbooks
  - Logbook data vs. Observer data

Data

- Strata
  - Port Groups
    - Selected Port Group
    - Port group where landings occur (Fish ticket, Logbook, or Return Port)
  - Period Covered

Methods

- Graphical Analysis
- t-test
- Agreement methods - Concordance Correlation
- Other methods to consider
  - Modeling (i.e. regression or other linear models)

Graphical Analysis - Compare Raw Data

- Boxplots
  - Allows comparison of location (median) and scale (quartiles/extreme values)
- Scatterplots of paired data

t-test

- Estimate mean catch by strata (port group and period) for observed and unobserved data for pairs
- Calculate t-test pairing means from observed and unobserved data for each strata

Agreement Methods

- Estimate mean catch by strata (port group and period) for observed and unobserved data for pairs
- Concordance Correlation
  - Measures how well data fit identity line (intercept = 0, slope = 1)
  - Similar to R^2 (measures how well data fits a line)
  - Compares within-sample variance to total variance
  - Compares both means and variances

Agreement Methods

$$\rho_c = \frac{2\sigma_{xy}}{\sigma_x^2 + \sigma_y^2 + \left(\mu_y - \mu_x\right)^2} = 1 - \frac{E(Y-X)^2}{E[(Y-X)^2 \mid \rho = 0]}$$

$$= 1 - \frac{\text{Mean square of the within sample total deviation}}{\text{Mean square of the total deviation}}$$

$$= 1 - \frac{\text{Within - sample variance and bias squared}}{\left(\begin{array}{c}\text{Largest possible variance among non - negative} \\ \text{correlated samples and bias squared}\end{array}\right)}$$

Agreement Methods

- Can also be expressed as a product of Accuracy (χ_a) and Precision (ρ)

$$\rho_c = \chi_a \cdot \rho$$

- Accuracy

$$\chi_a = \frac{2}{\frac{\sigma_x}{\sigma_y} + \frac{\sigma_y}{\sigma_x} + \frac{(\mu_y - \mu_x)^2}{\sigma_x \sigma_y}}$$

- Precision (Pearson's Correlation Coefficient)

$$\rho = \frac{\sigma_{xy}}{\sigma_x \sigma_y}$$

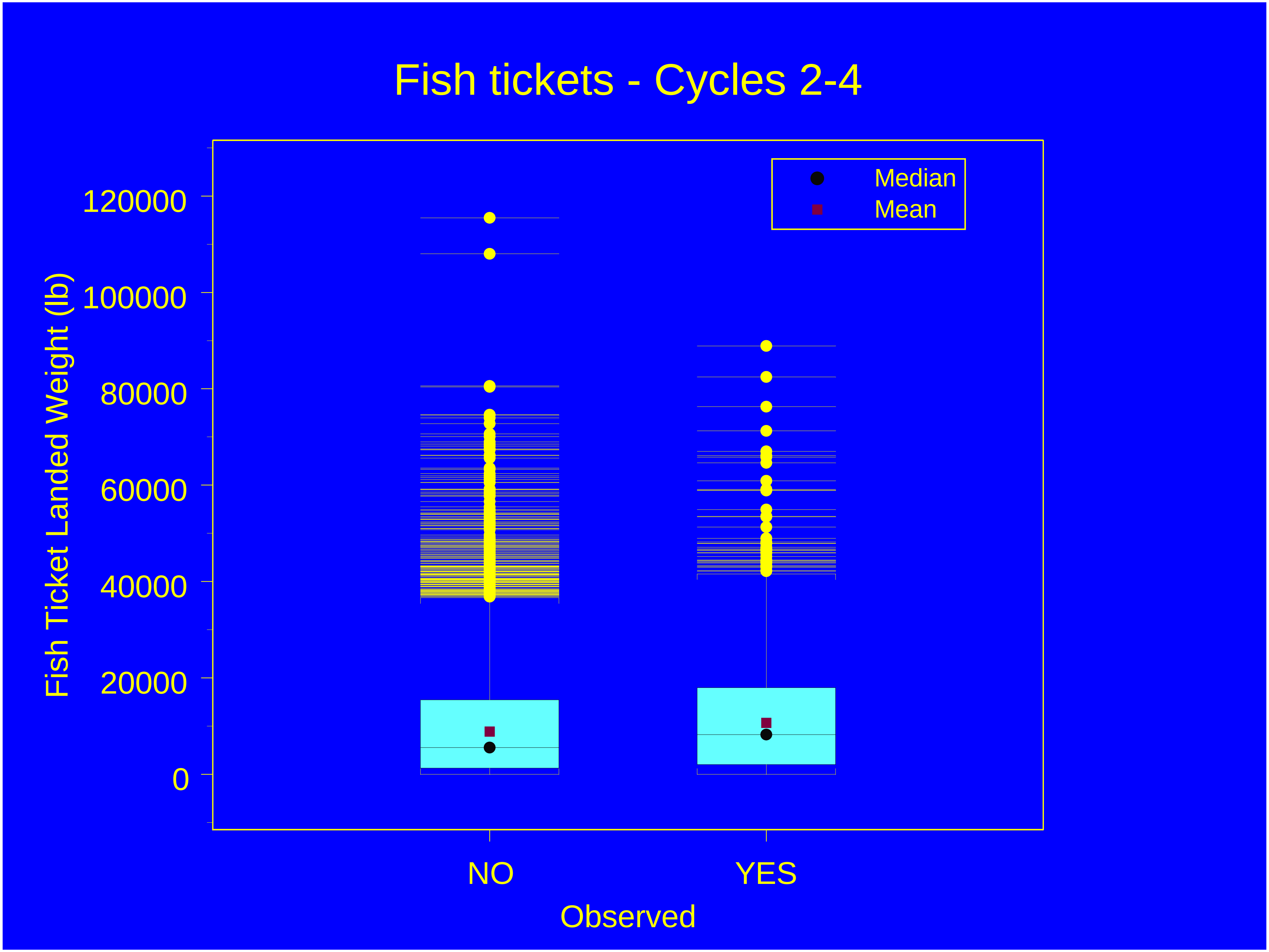
Other methods to consider

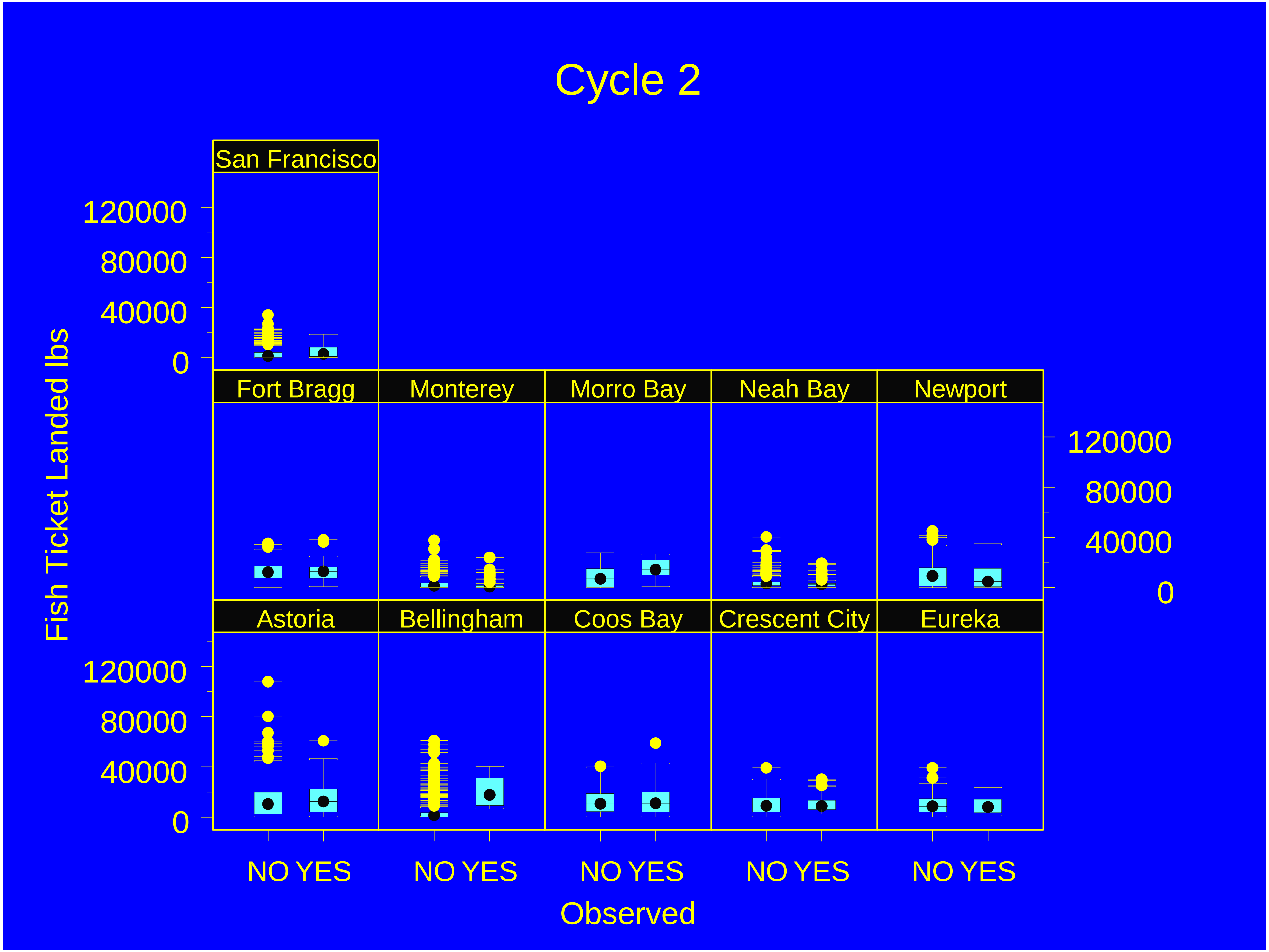
- Linear Regression
- Orthogonal Regression
- Loess Fits on Graphs

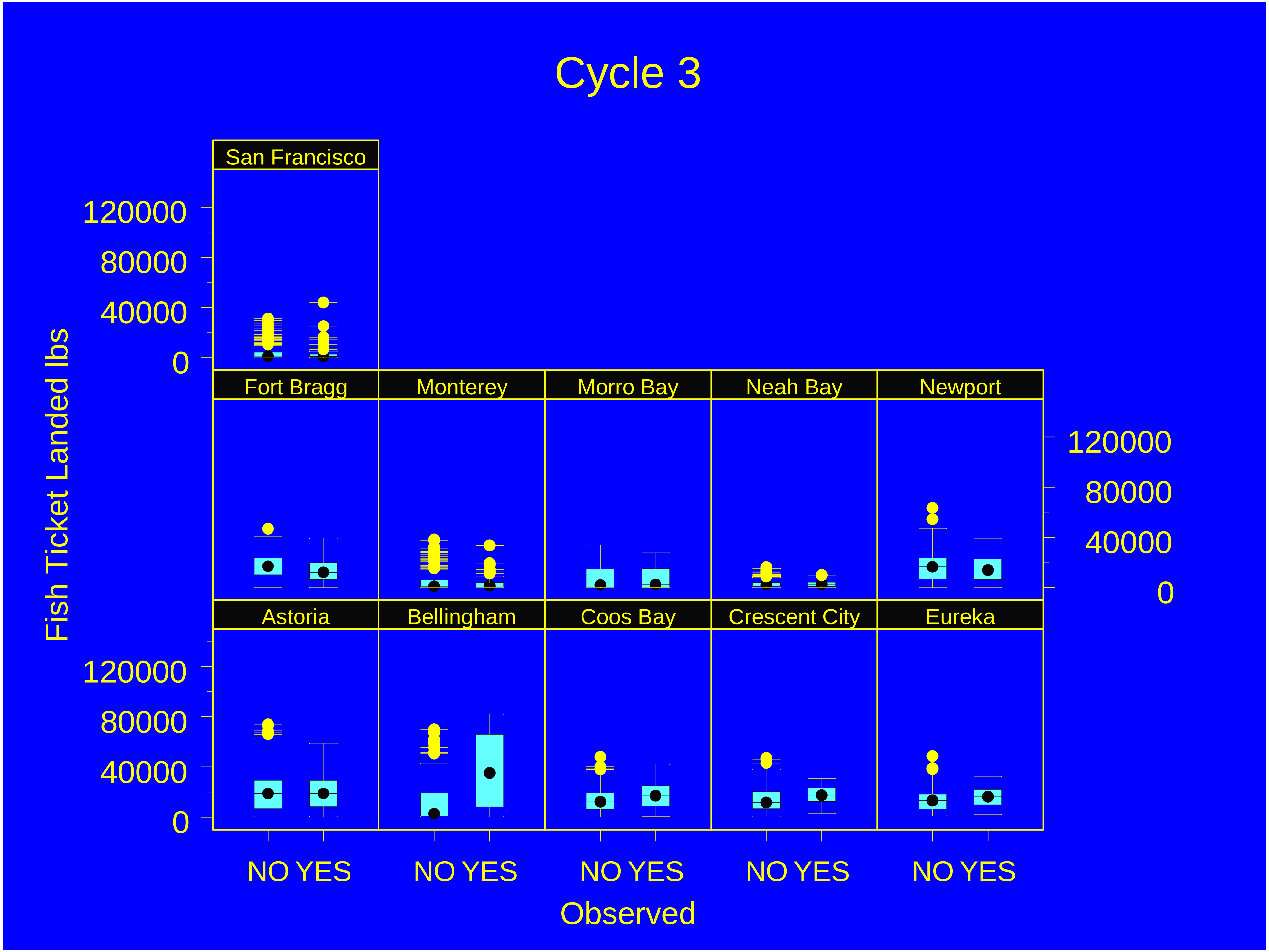
Other methods to consider

- Different methods of fitting linear models
  - Need to consider affects of error assumptions
  - Need to consider proper interpretation of the results
  - Model for common variable such as landed weight
    - Control for other variables (i.e. port group)
      - Need to be aware the affects of multicolinearity
    - Can model variance structure
    - Can include random effects

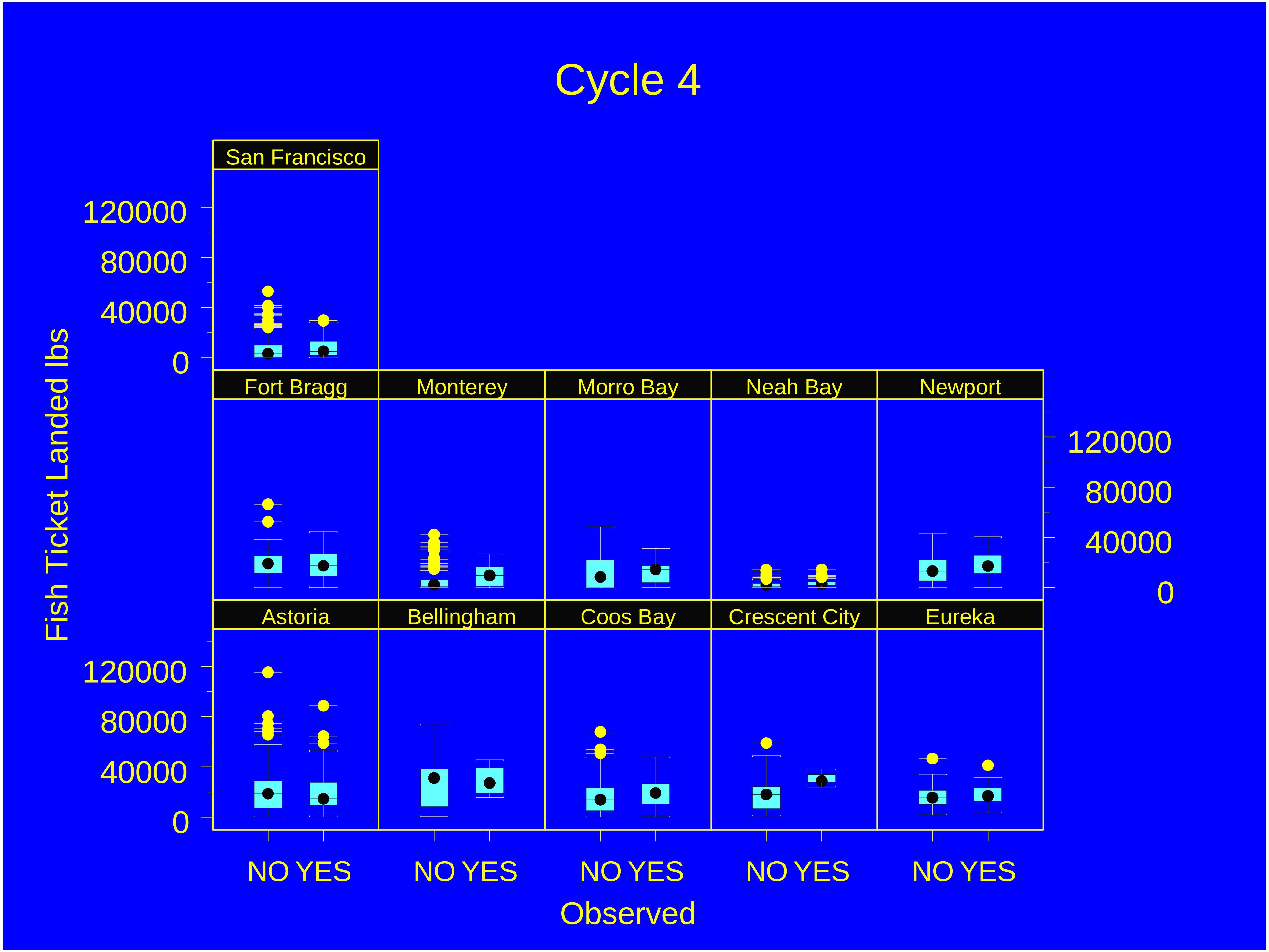
FISH TICKET DATA ANALYSIS


Fish tickets - Cycles 2-4
Median
Mean
120000
100000
80000
60000
40000
20000
0
Fish Ticket Landed Weight (lb)
NO
YES
Observed

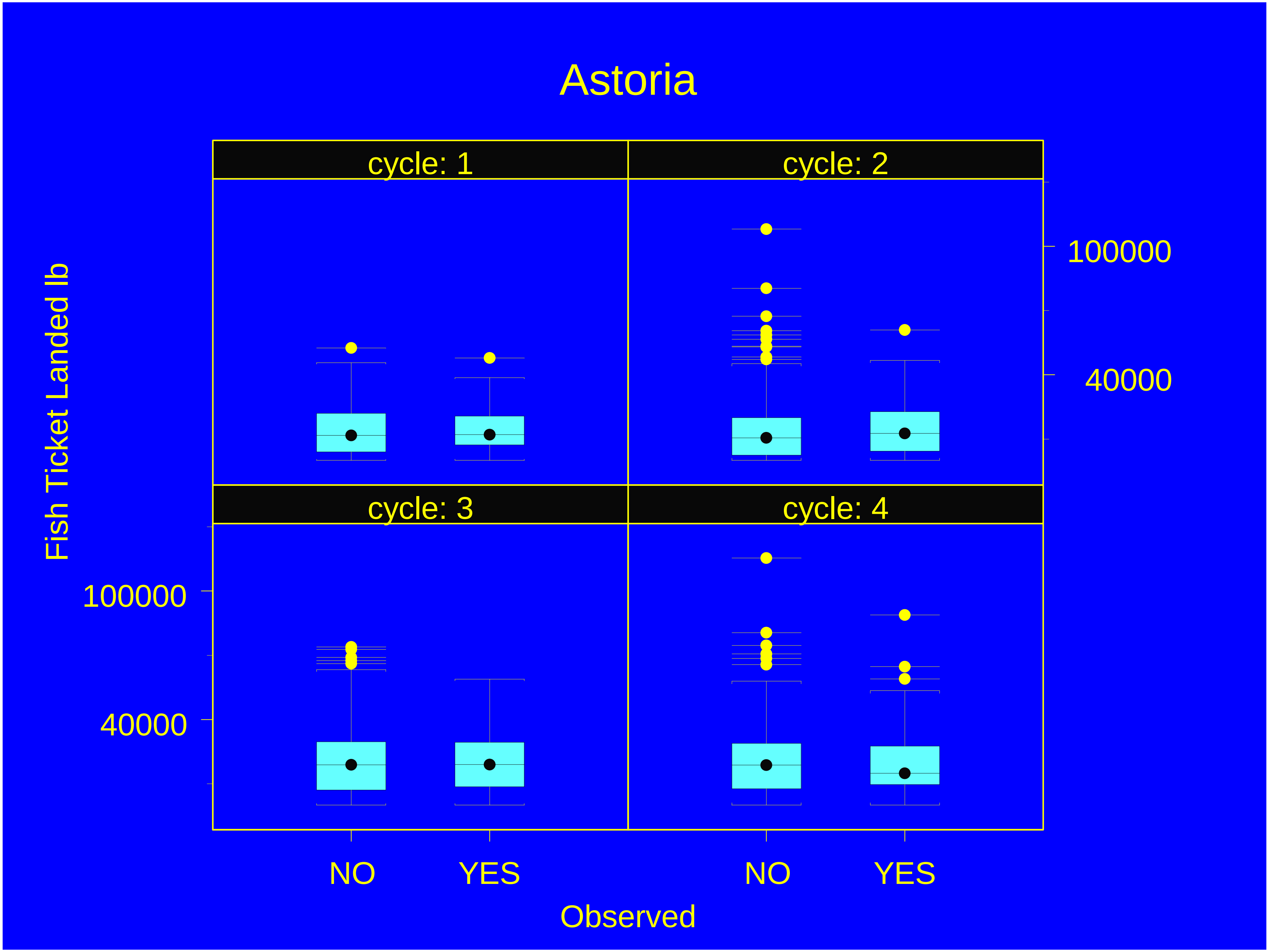

Cycle 2
San Francisco
Fort Bragg
Monterey
Morro Bay
Neah Bay
Newport
Astoria
Bellingham
Coos Bay
Crescent City
Eureka
Fish Ticket Landed lbs
120000
80000
40000
0
NO YES
Observed



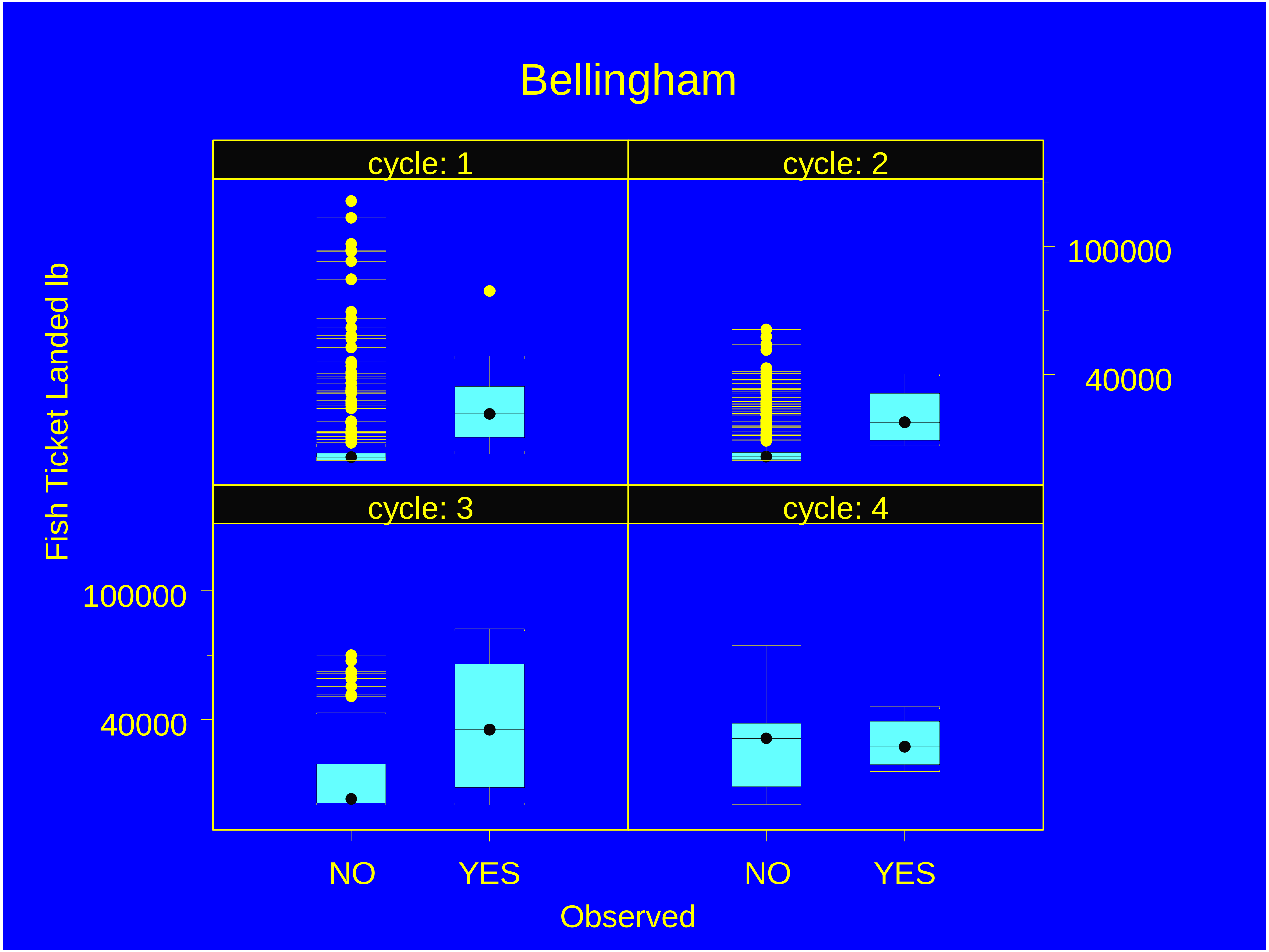
Cycle 3
Fish Ticket Landed lbs
San Francisco
Fort Bragg
Monterey
Morro Bay
Neah Bay
Newport
Astoria
Bellingham
Coos Bay
Crescent City
Eureka
120000
80000
40000
0
NO YES
Observed



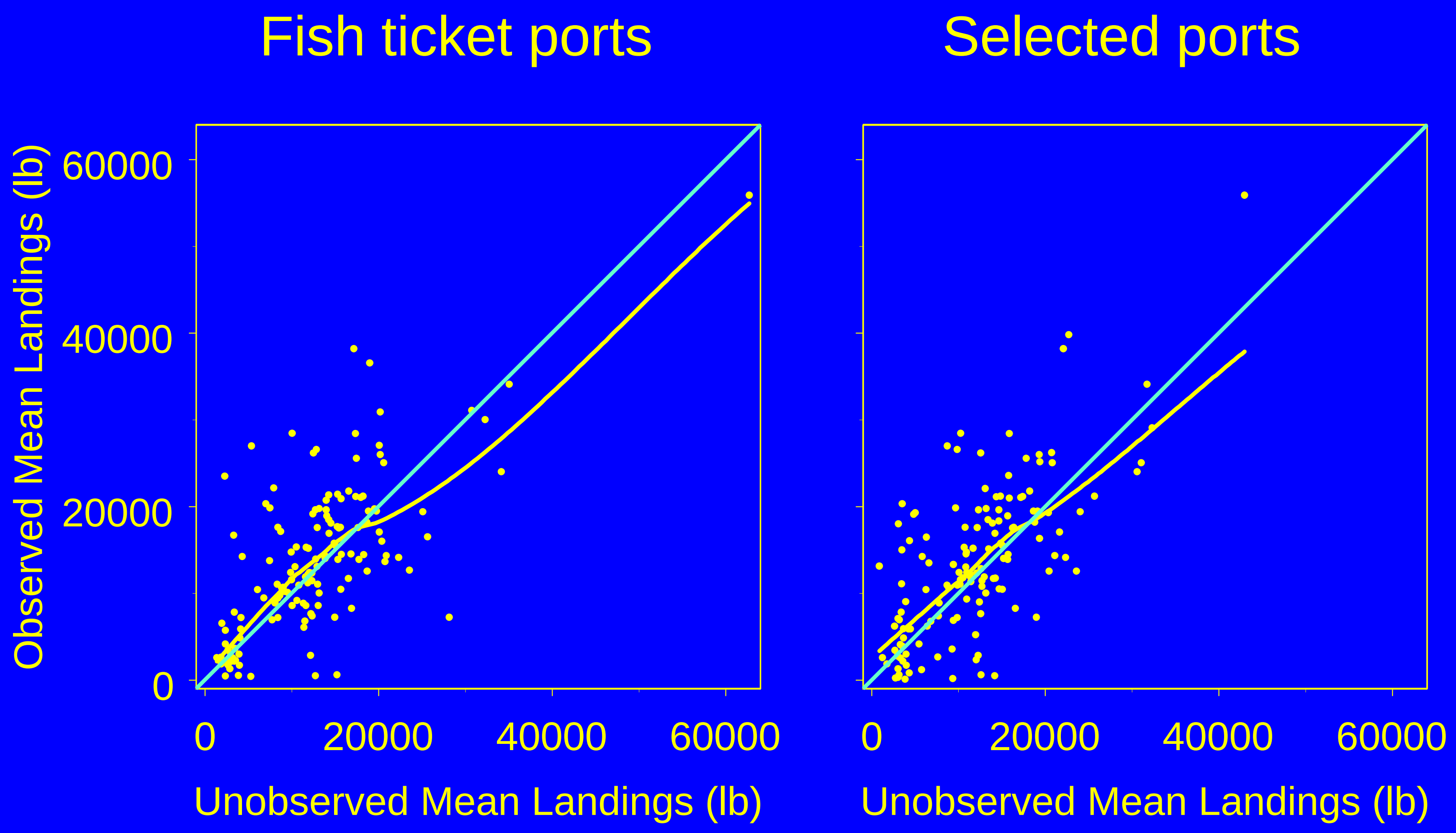
Cycle 4
San Francisco
Fort Bragg
Monterey
Morro Bay
Neah Bay
Newport
Astoria
Bellingham
Coos Bay
Crescent City
Eureka
Fish Ticket Landed lbs
120000
80000
40000
0
NO YES
Observed

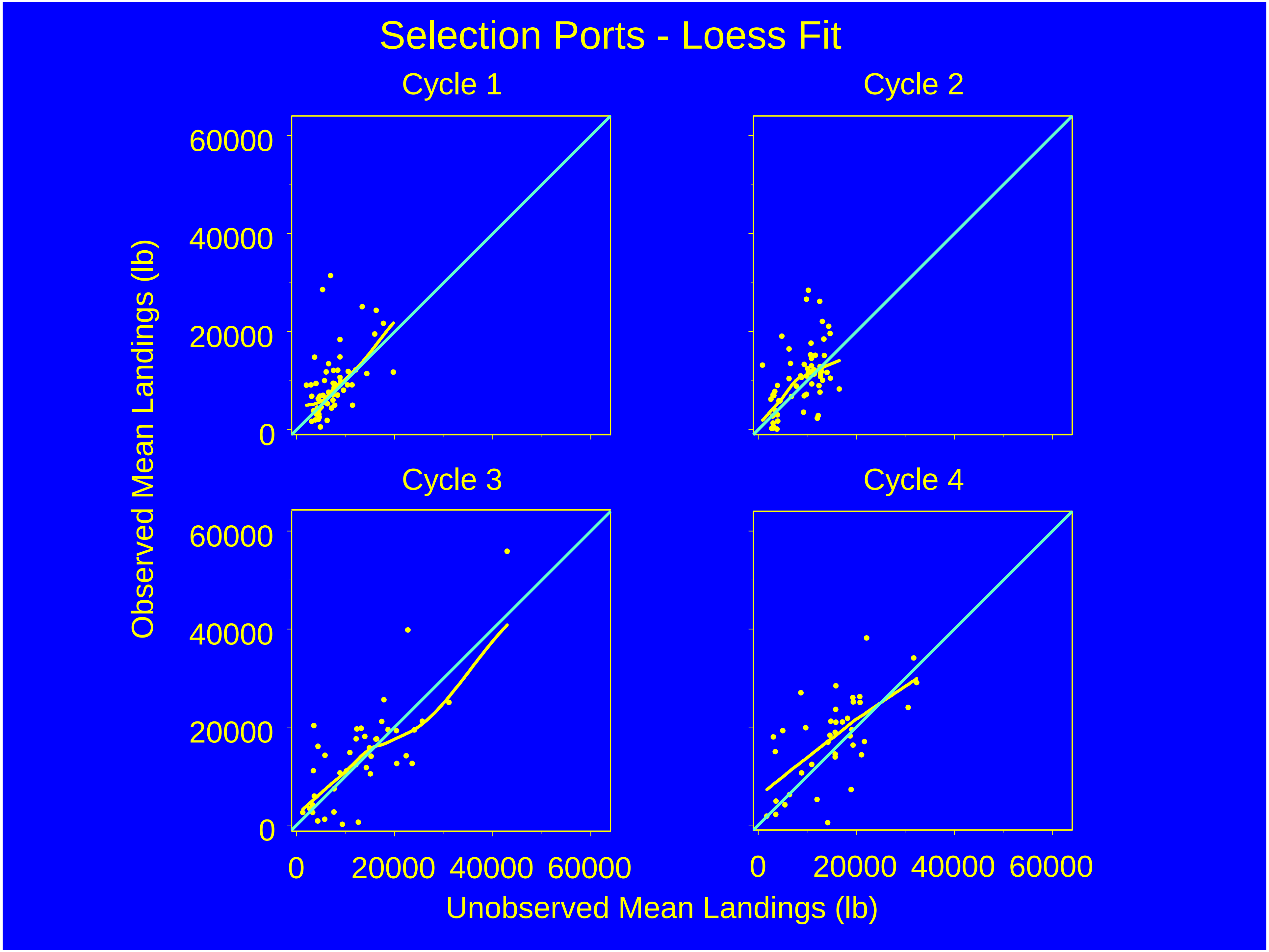


Astoria
cycle: 1
cycle: 2
cycle: 3
cycle: 4
Fish Ticket Landed lb
100000
40000
100000
40000
NO
YES
NO
YES
Observed

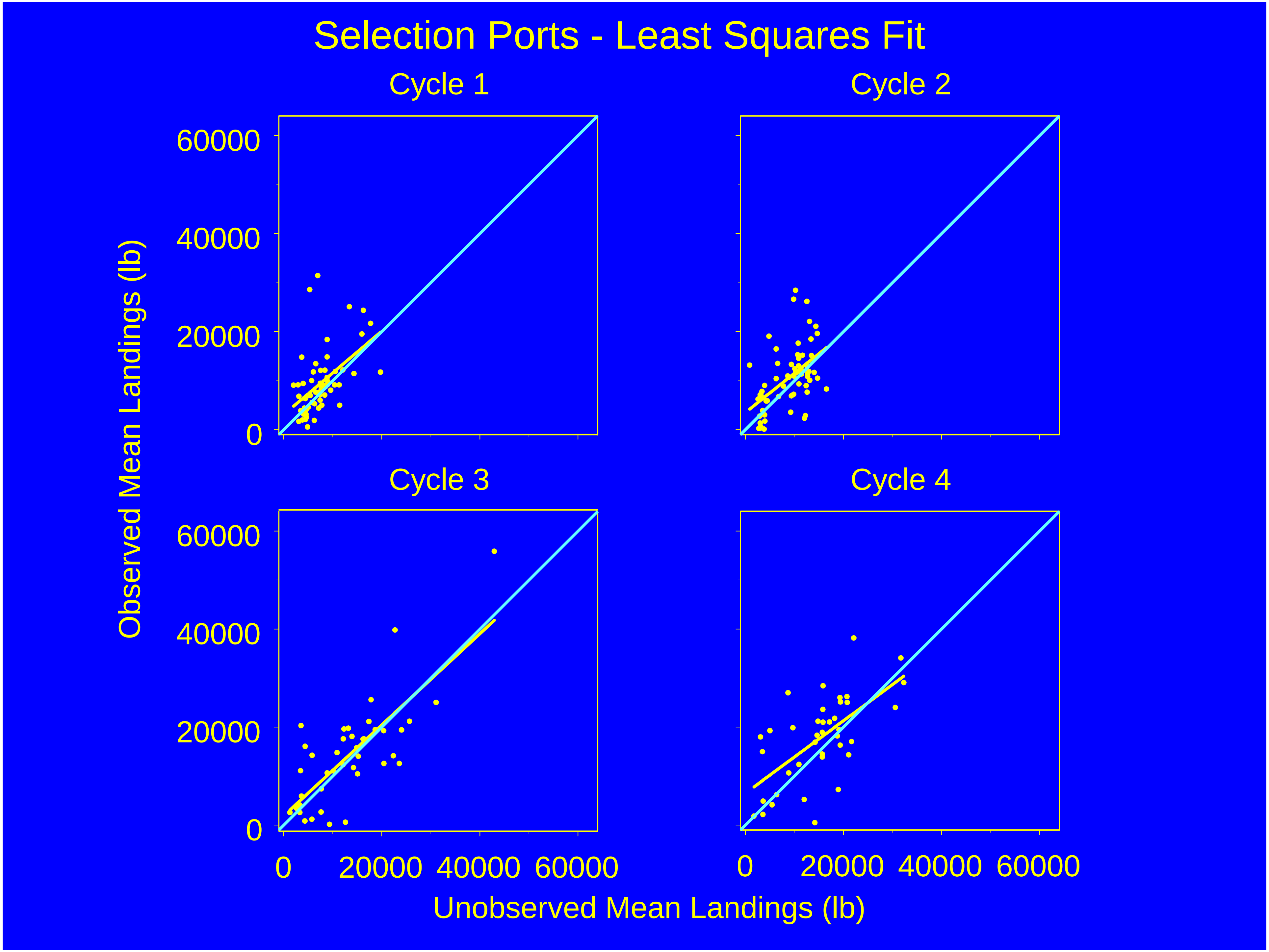


Bellingham
cycle: 1
cycle: 2
cycle: 3
cycle: 4
100000
40000
100000
40000
Fish Ticket Landed lb
NO
YES
NO
YES
Observed


Fish ticket ports
Selected ports
Observed Mean Landings (lb)
0
20000
40000
60000
0
20000
40000
60000
Unobserved Mean Landings (lb)
0
20000
40000
60000
Unobserved Mean Landings (lb)



Selection Ports - Loess Fit
Cycle 1
Cycle 2
Cycle 3
Cycle 4
60000
40000
20000
0
Observed Mean Landings (lb)
0
20000
40000
60000
Unobserved Mean Landings (lb)

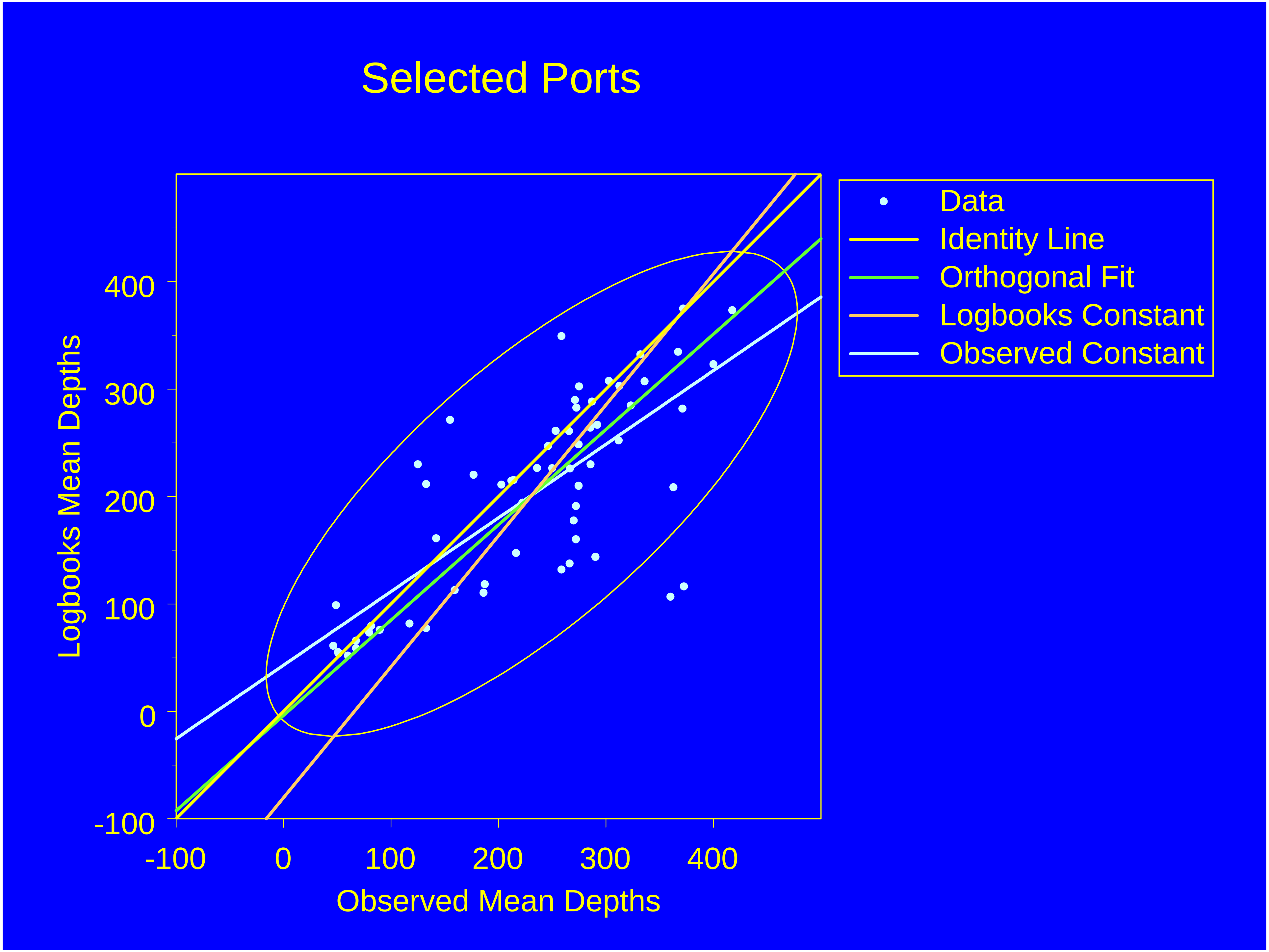


Selection Ports - Least Squares Fit
Cycle 1
Cycle 2
Cycle 3
Cycle 4
Observed Mean Landings (lb)
60000
40000
20000
0
0
20000
40000
60000
Unobserved Mean Landings (lb)

Comparison Results

Paired t-tests	Cycles 2-4	Cycle 2	Cycle 3	Cycle 4
difference	1,083	1,735	930	2,617
t-value	2.08	2.37	0.87	2.20
df	134	60	40	37
p-value	0.039	0.021	0.388	0.034

	Cycles 2-4	Cycle 2	Cycle 3	Cycle 4
Concordance Correlation	0.708	0.420	0.735	0.601
Accuracy measure	0.999	0.913	0.986	0.985
Pearson Correlation	0.758	0.504	0.766	0.627



Selected Ports
Data
Identity Line
Orthogonal Fit
Logbooks Constant
Observed Constant
Logbooks Mean Depths
Observed Mean Depths
400
300
200
100
0
-100
-100
0
100
200
300
400

Conclusions

- There are differences between observed and unobserved data sets
  - These differences are not alarmingly huge
    - Relationship between observed and unobserved data is close to the identity line (intercept = 0 and slope = 1)
    - The two data sets are not exactly the same, but they are similar.

Conclusions

- Substantial variability in data
  - Variability may be due to
    - Port group differences
    - Seasonal differences
    - Vessels differences
    - Measurement error

Conclusions – What this really means

- Large changes should be noticeable in both observed and unobserved data sets
- Small changes and differences in observed/ unobserved trips may not be noticed due to variability
  - Small changes may be due to either observer effect or other changes in the fishery

Conclusions – What this really means

- Variability of the data is more of an issue than observer effect
- Even with perfect data (No measurement error) there may still be substantial variability due to differences in
  - Port groups
  - Period
  - Individual vessel behavior

Opinion of Data Sources

- Fish Ticket Data
  - Difficulty filtering for specific fishery
- Logbook data vs. Observer data
  - Difficulty filtering for specific fishery
  - For logbooks, does a significant difference indicate a difference in fishing behavior or a difference in how logbooks are filled out?

Comparison of methods

- Graphical methods
  - Invaluable, but can't determine statistical significance
- Estimation of means by strata
  - Allows for calculation of a single statistic
  - Allows for paired comparison between different data sets
  - Ignores any differences in the distribution of observed and unobserved trips/tows
  - Maybe some variance issues when strata have different sample sizes (i.e. the variance of the mean is proportional to 1/n)

Comparison of methods

- t-test
  - Allows for simple comparison of data
  - Ignores any differences in the distribution of observed and unobserved trips/tows
  - Ignores magnitude of actual observations
  - Very likely to reject in the case of larges sample sizes
    - What does it mean when this happens?
    - Statistical significance vs. biological significance

Comparison of Methods

- Agreement methods
  - Compares both the mean and variance of the data
  - Examine how well the data fits the identity line
  - Incorporates both accuracy and precision
  - Difficult to interpret
  - Calculations not in many standard software packages

Other Methods to consider

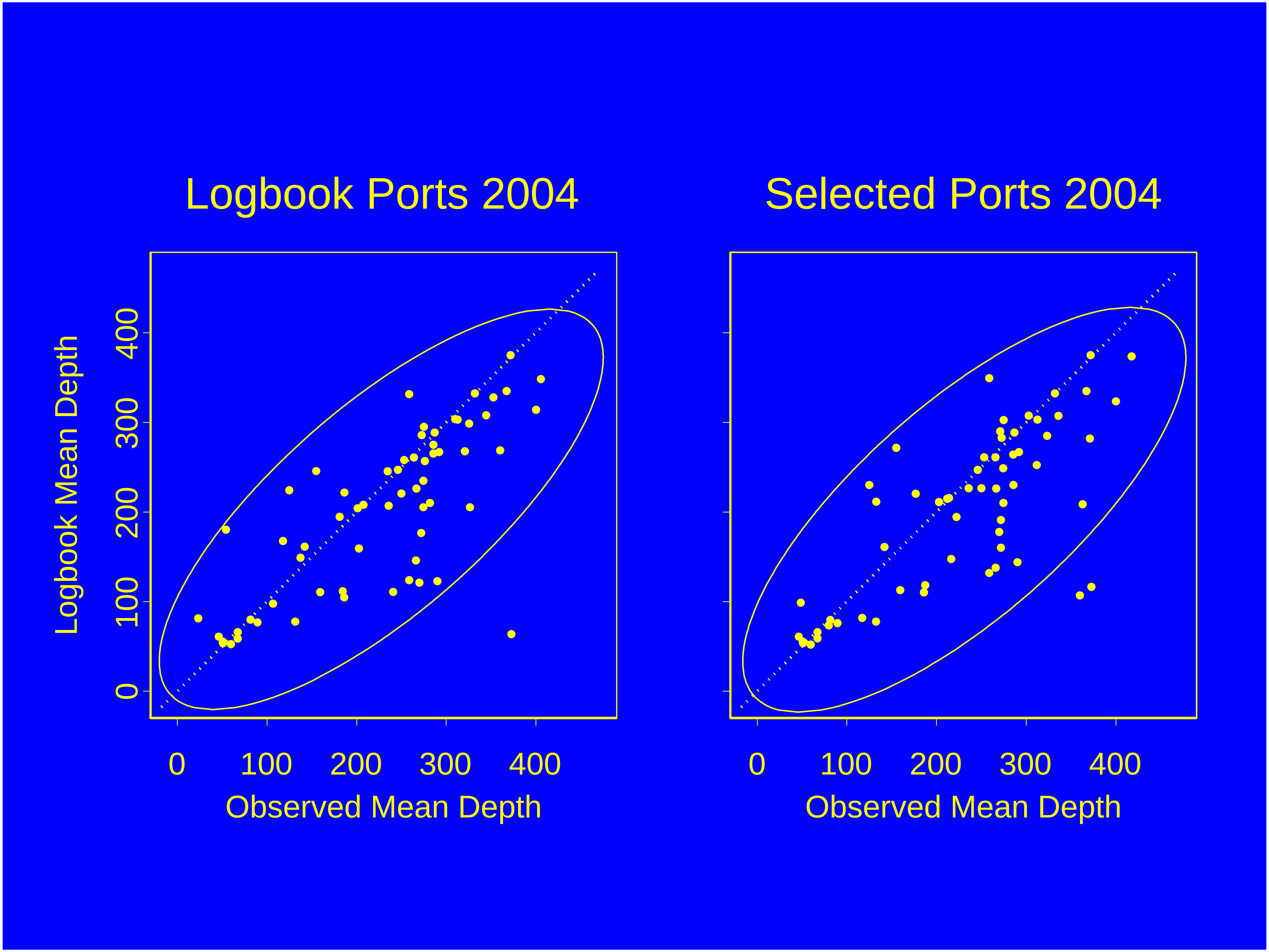
- Modeling
  - Test significance of observed vs. unobserved in model

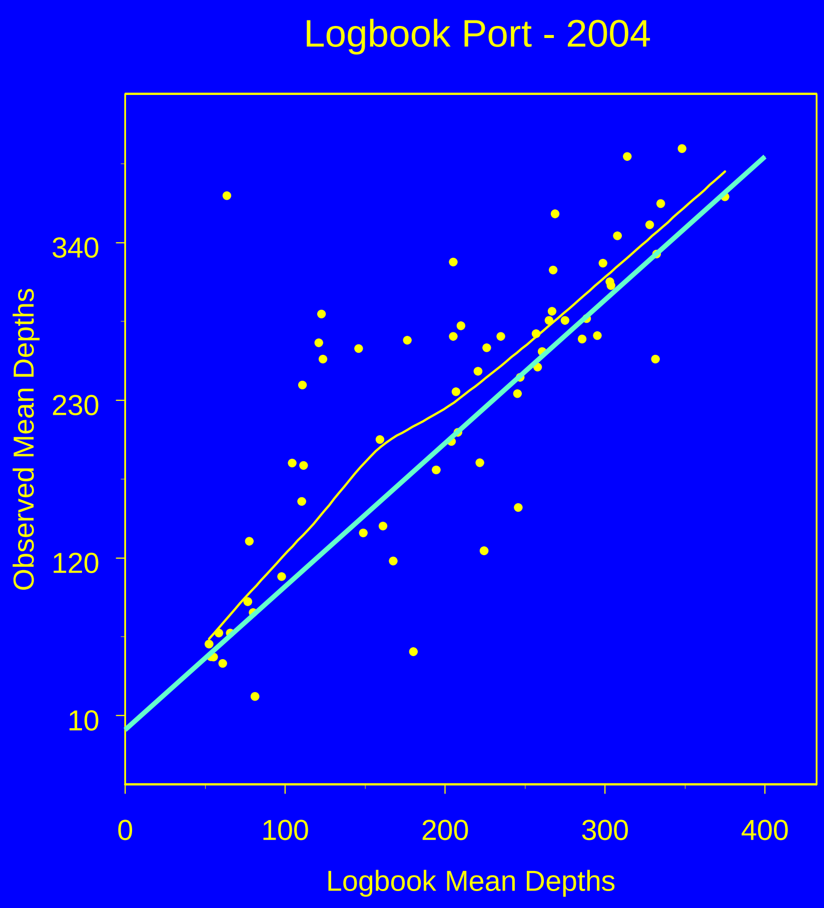
Other Issues

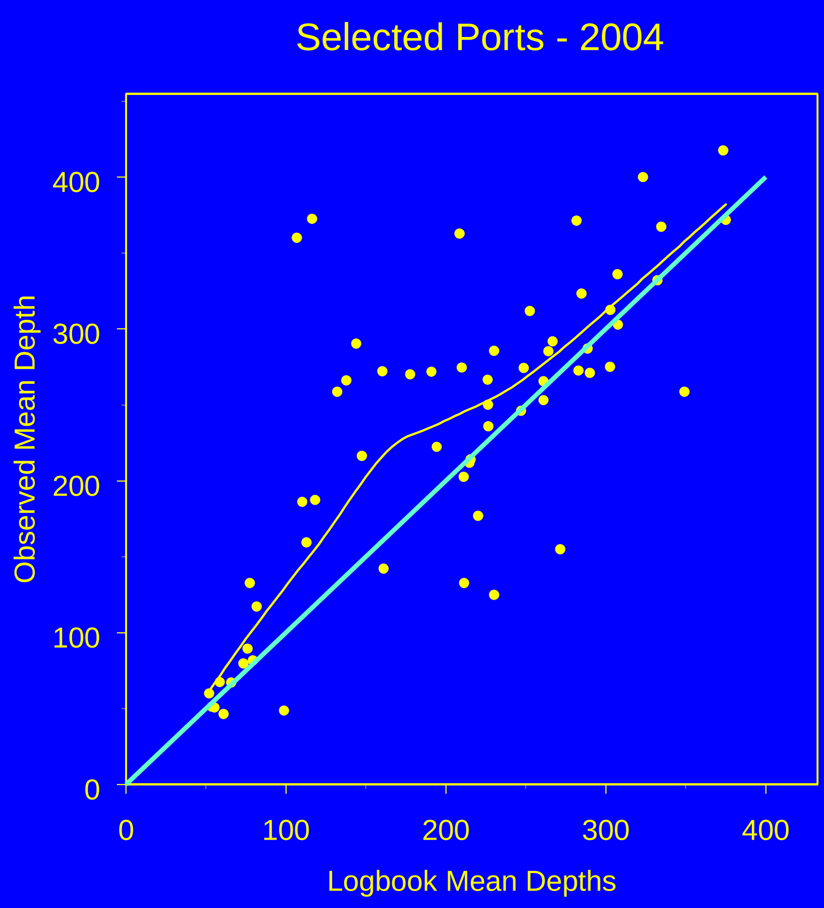
- Unpermitted fisheries
  - Open Access
- Dynamic sampling frames
  - Permit switching
  - “Stacking” permits in sablefish-endorsed fishery
- Small fisheries
  - Tend to have sporadic, but clustered activity often driven by weather

[redacted]

LOGBOOK/OBSERVER DATA ANALYSIS


Logbook Ports 2004
Selected Ports 2004
Logbook Mean Depth
0
100
200
300
400
Observed Mean Depth
Observed Mean Depth


Logbook Port - 2004
Observed Mean Depths
340
230
120
10
0
100
200
300
400
Logbook Mean Depths


Selected Ports - 2004
Observed Mean Depth
400
300
200
100
0
0
100
200
300
400
Logbook Mean Depths

Comparison Results

Fish ticket Port groups

Paired t-tests	all data	cycle 1	cycle 2	cycle 3	cycle 4
difference	1,355	1,500	1,603	145	1,929
t-value	2.94	1.85	2.33	0.14	1.47
df	198	57	60	38	40
p-value	0.004	0.069	0.024	0.887	0.150

	all data	cycle 1	cycle 2	cycle 3	cycle 4
Concordance Correlation	0.610	0.373	0.444	0.838	0.422
Accuracy measure	0.999	0.917	0.935	1.000	0.989
Pearson Correlation	0.678	0.427	0.538	0.821	0.555

Comparison Results

Logbook/Observer Port groups

Paired t-tests	2004	Cycle 4 (May-Dec 2004)
difference	26.9	31.7
t-value	3.16	2.64
df	62	42
p-value	0.002	0.012

	2004	Cycle 4 (May-Dec 2004)
Concordance Correlation	0.722	0.657
Accuracy measure	0.996	0.996
Pearson Correlation	0.758	0.701

Selection Port groups

Paired t-tests	2004	Cycle 4 (May-Dec 2004)
difference	30	31
t-value	3.36	2.68
df	60	39
p-value	0.001	0.011

	2004	Cycle 4 (May-Dec 2004)
Concordance Correlation	0.728	0.719
Accuracy measure	0.994	0.992
Pearson Correlation	0.758	0.739

Sampling Frame - Limited-Entry Trawl

- Some differences in weight distribution
  - Vessels not in the sampling frame
    - have a lower median landed catch
    - don't have the extreme values in landings
      - these values are primarily due to a few vessels in one port
- Minimal differences in lengths from vessels not in sampling frame

Sampling Frame – Limited-Entry Trawl

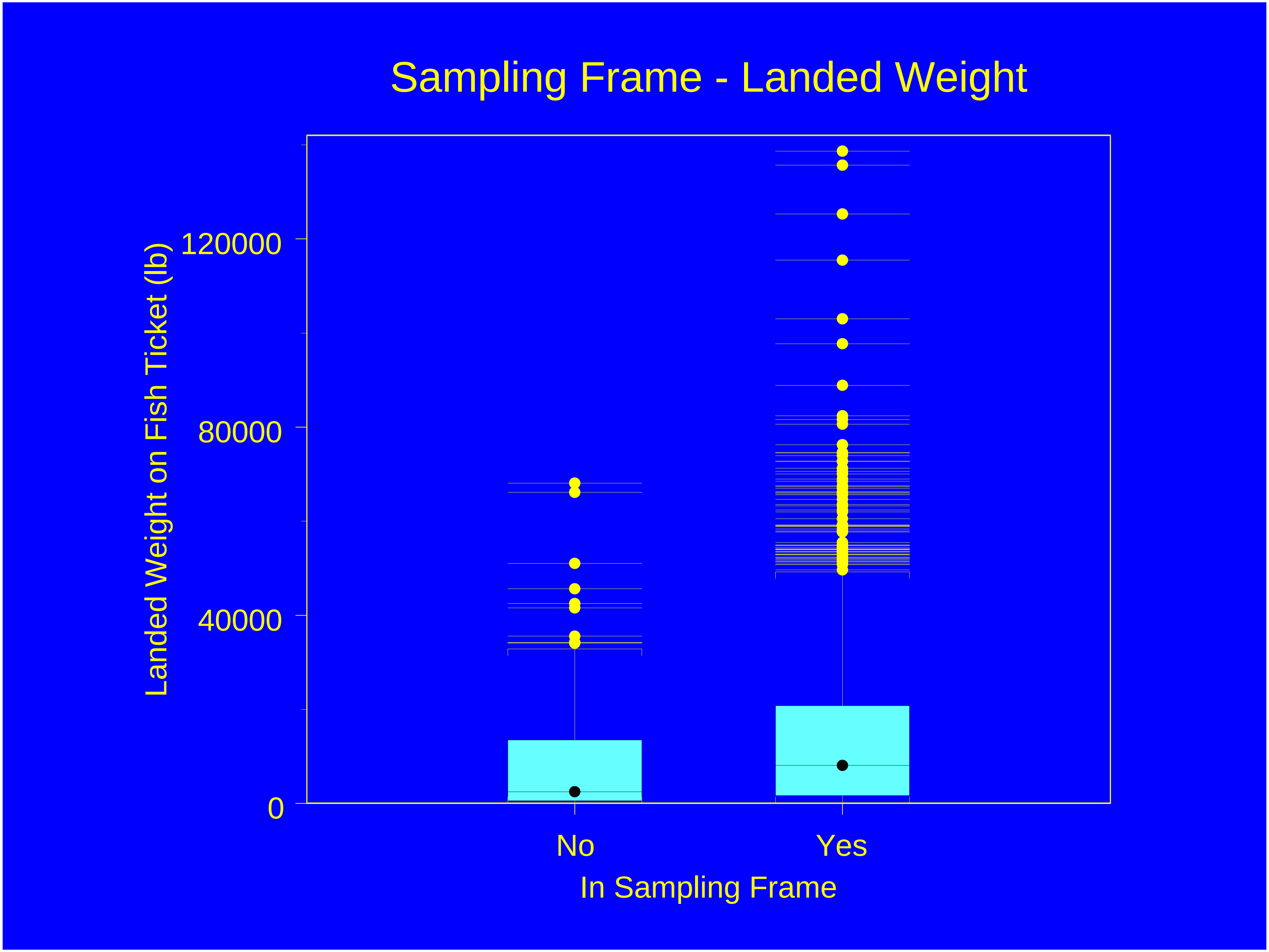
- 180 Limited-Entry Trawl Permits in 2004
  - Active - 127 permits
    - Fished in previous year
    - Selected for the current coverage cycle.
  - In active - 53 permits
    - Permit was not actively fished in the last year or the permit is currently not assigned to a vessel.

Sampling Frame – Limited-Entry Trawl – 127 Active Vessels in 2004

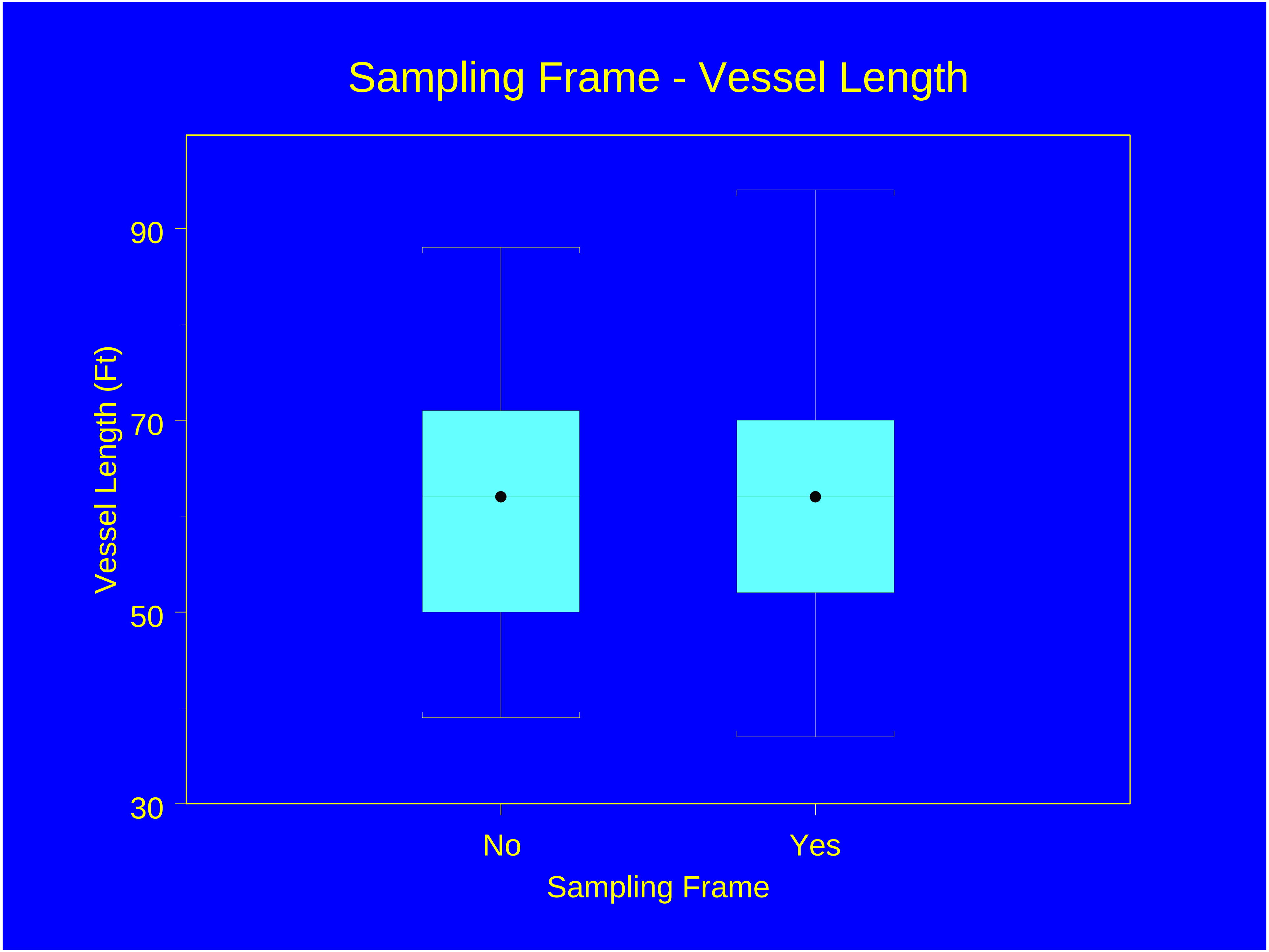
- 102 Permits Observed
- 25 not observed
  - 4 - Safety
  - 1 - Space
  - 5 - Permit switching
  - 4 - Observer availability/No trips when selected
  - 6 - Pacific whiting only
  - 2 - Other fisheries
  - 3 - Other
    - 2 boats had only one trip in 2004
    - 1 boat had three trips in 2004

Sampling Frame - Limited-Entry Trawl

- 5.7% of the landings (lb) came from vessels that fell outside the sampling frame
- Confidentiality Issues when reporting mean catch from vessels not covered by port group – Most of the ports have only 2 or fewer vessels that weren't observed



Sampling Frame - Landed Weight
Landed Weight on Fish Ticket (lb)
120000
80000
40000
0
No
Yes
In Sampling Frame


Sampling Frame - Vessel Length
Vessel Length (Ft)
90
70
50
30
No
Yes
Sampling Frame

Sampling Frame – Limited-Entry Trawl

- Some differences in landings from the vessels not in the sampling frame
- These differences should not have a substantial impact on analysis & management decisions made with the data
  - Only 5 boats fell outside of the sampling frame for reasons of safety/room.
  - The other boats will be included in the sampling frame in the following year
  - Vessels would need to have dramatically different discard rates to have a noticeable impact

An evaluation of observer data for salmon bycatch characteristics: are there vessel selection effects?

James Ianelli
AFSC/NMFS/NOAA

Overview relative to salmon bycatch in pollock fishery

1. **The completeness of the sampling fr**

   Does the list include all vessels in t … which inferences about catch and by-catch … to be made

   Complete?

2. **Bias caused by the procedure for sel… ls**

   Ad-hoc selection may not guarantee … selections result in samples that, on average, r… the fleet

   Potential bias

3. **Bias in the sample of vessels on which obser…ers are actually deployed.**

   Difficult to eliminate, often caused … constraints. May be similar to ad-hoc selection p… s

   Probably ok

4. **Bias caused by changes in fishing behavior wh… observers are deployed.**

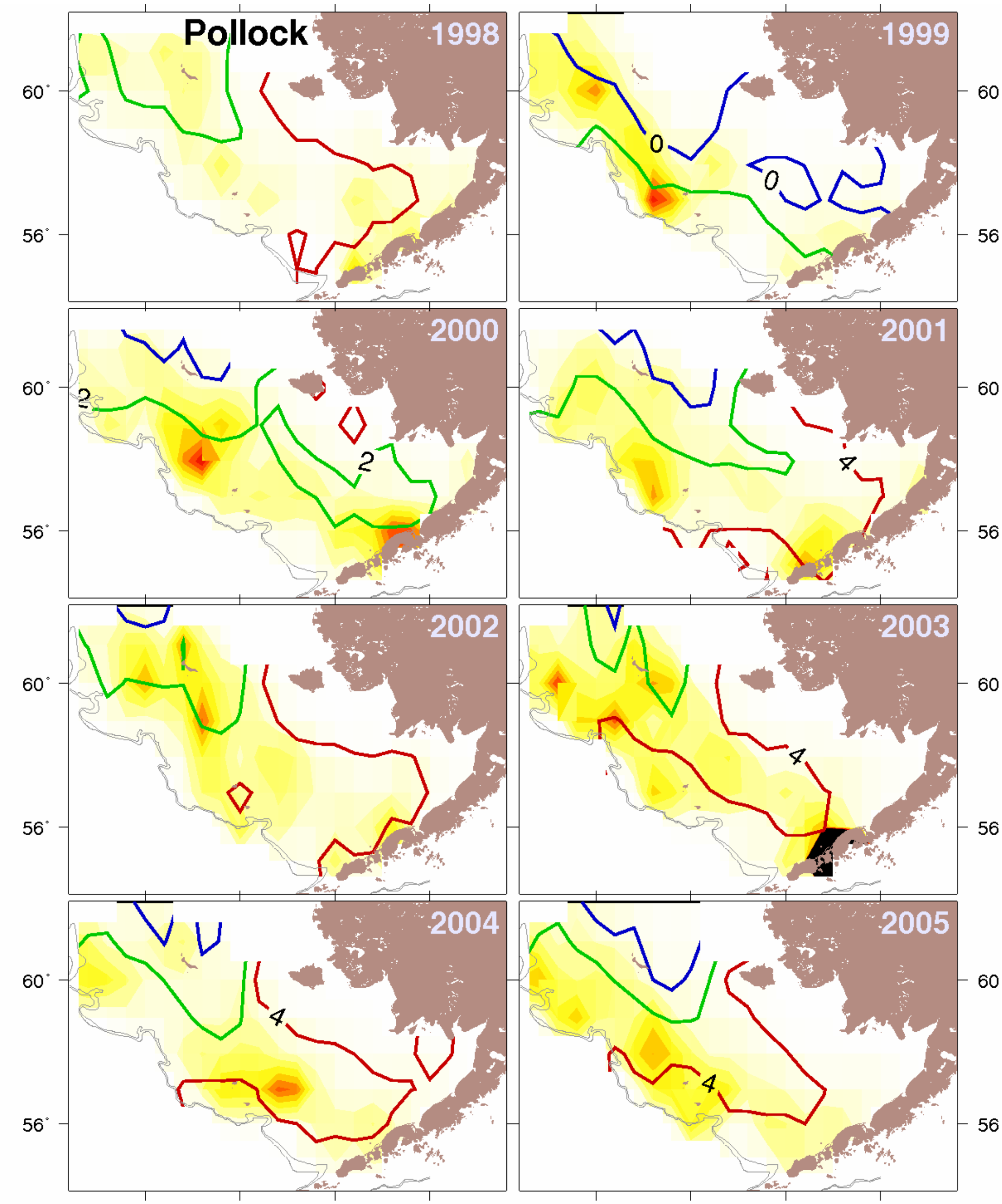
   May yield estimates with systemati … ssel operators alter fishing strategy.

   Potential bias

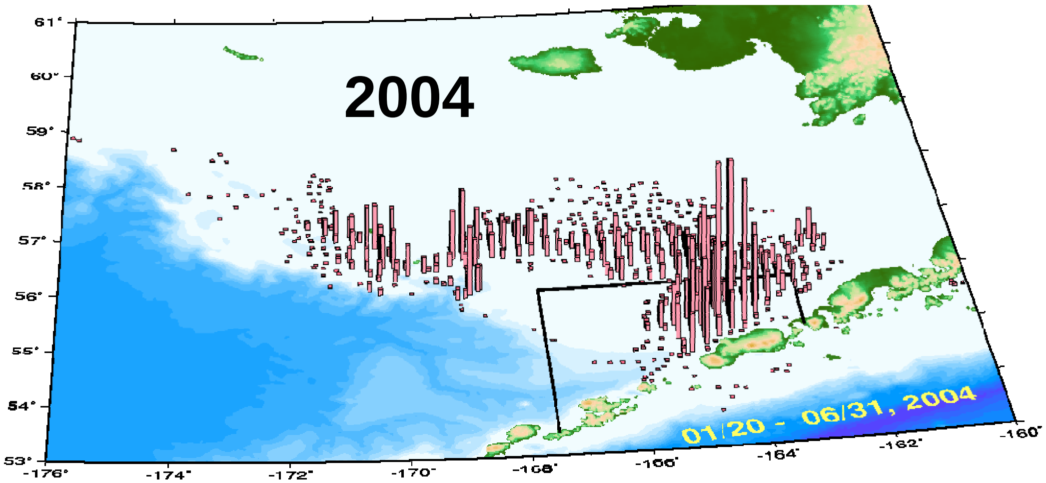
General features of pollock distribution

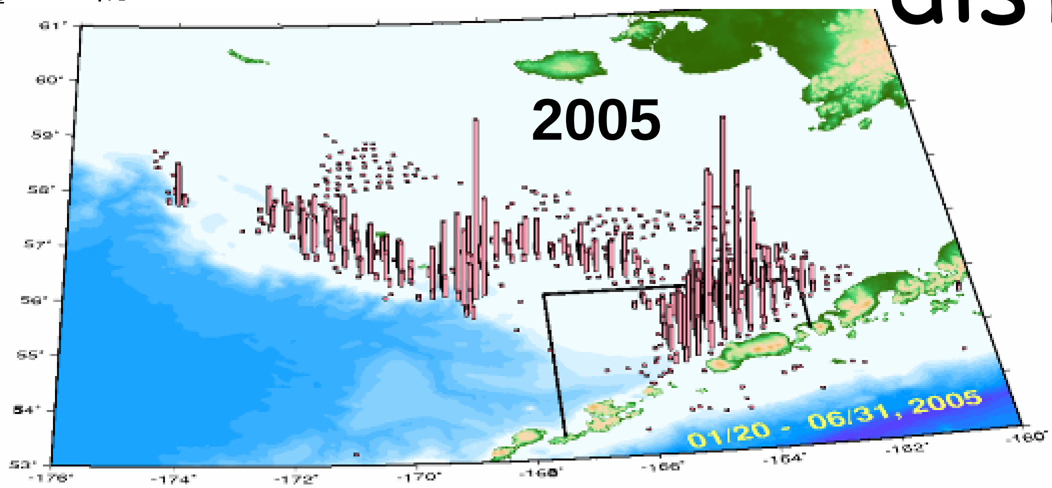
- Spatial patterns from survey data
- Fishery characteristics

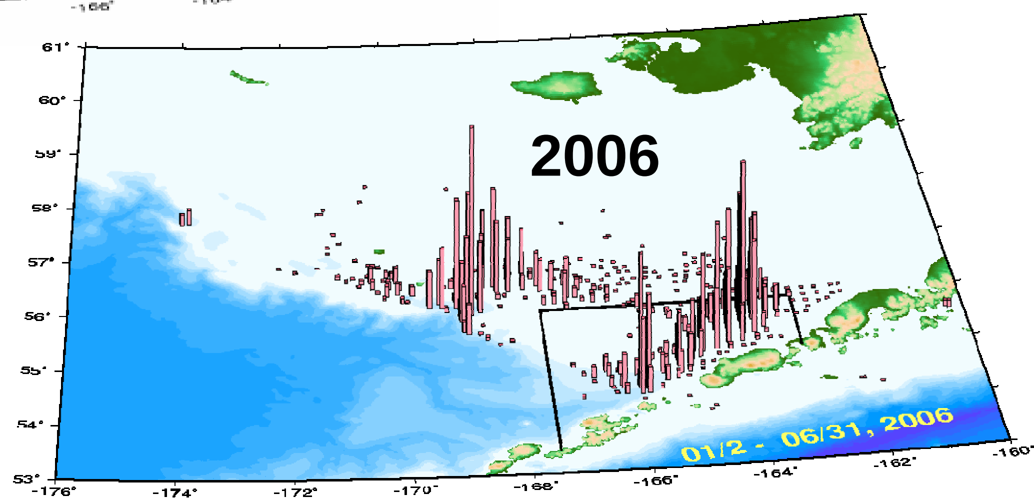
Pollock bottom-trawl survey CPUE relative to bottom temperature



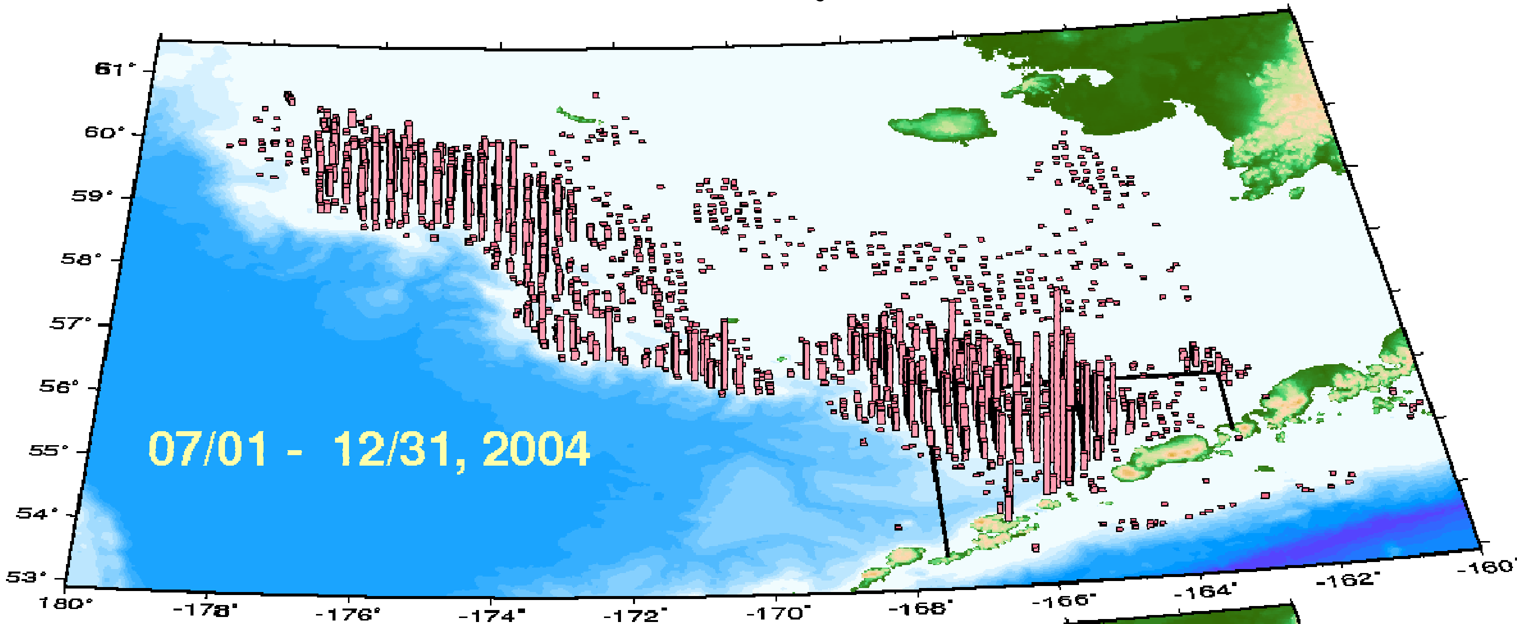
Winter pollock fishery distributions

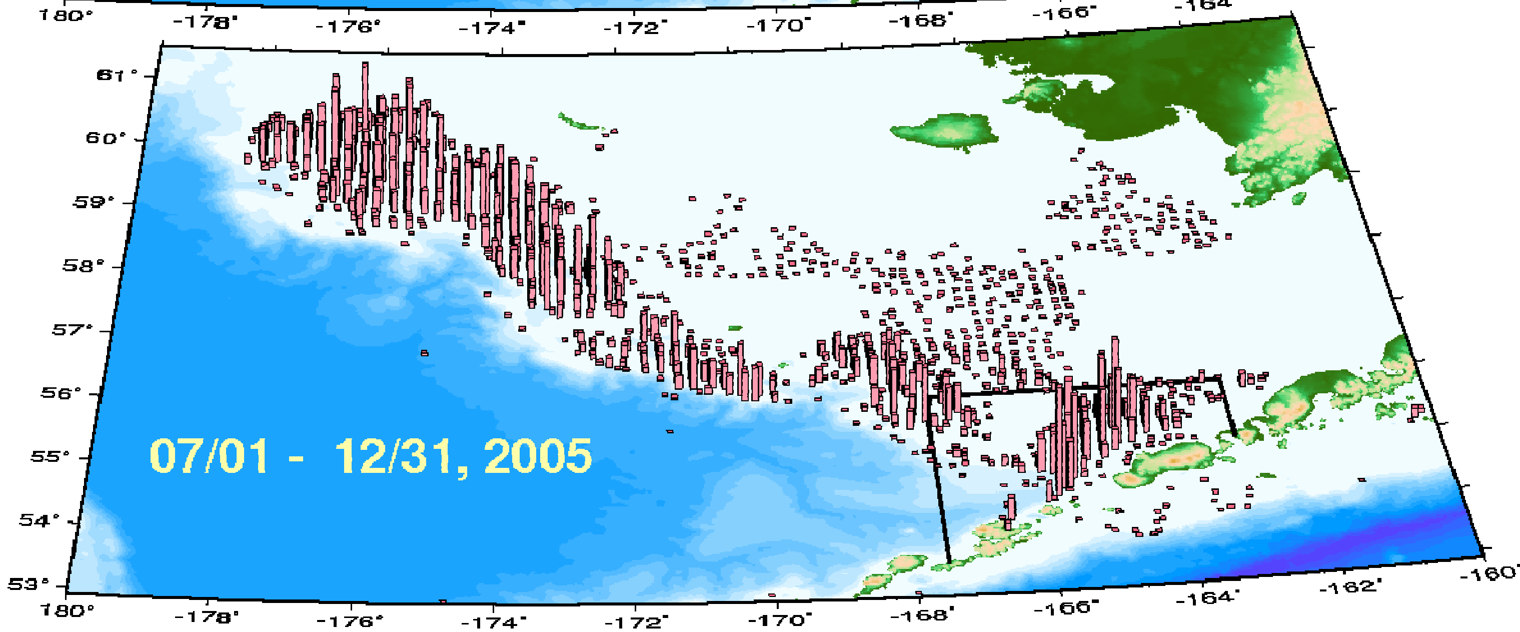




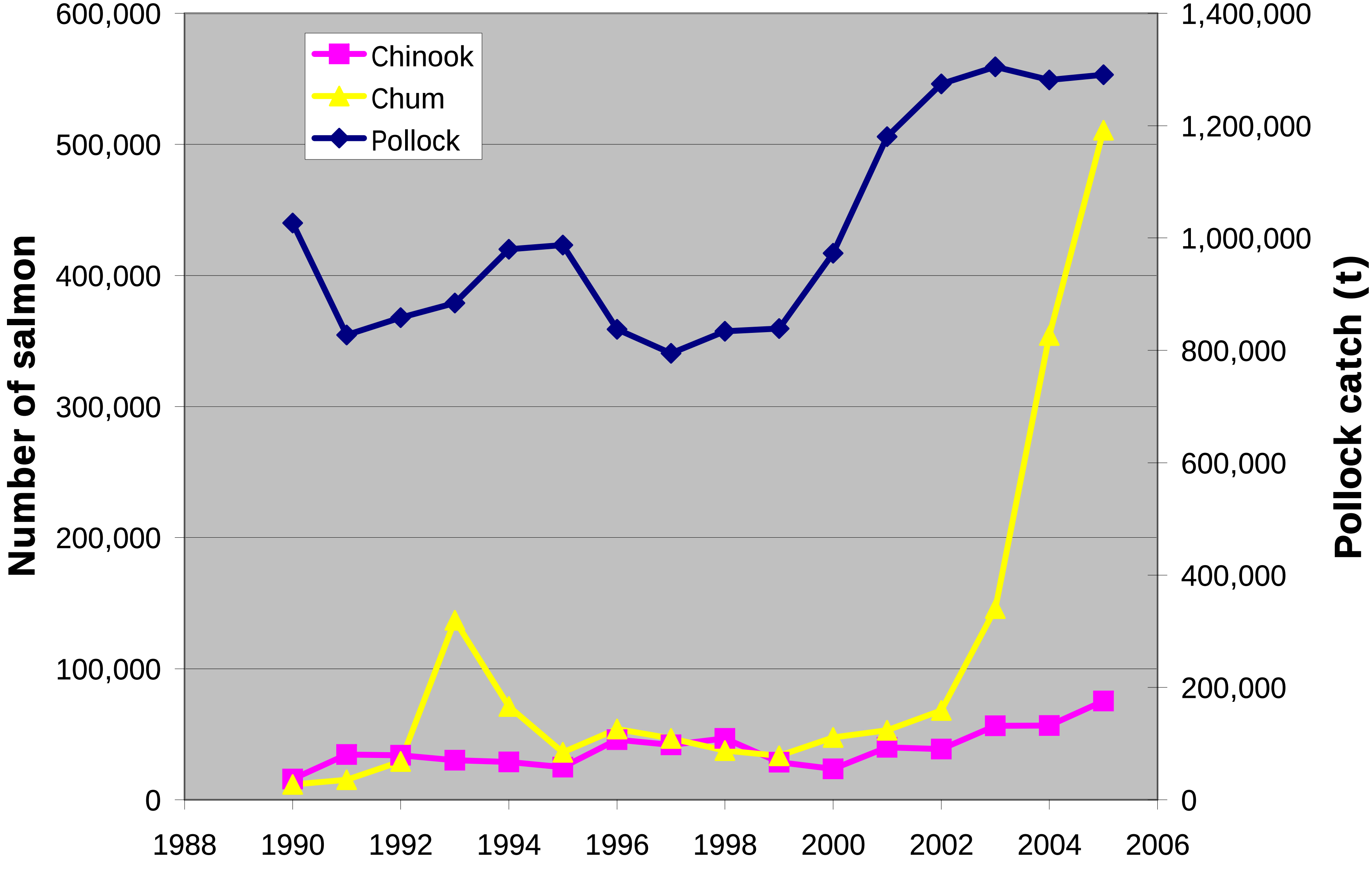


Summer fishery distribution



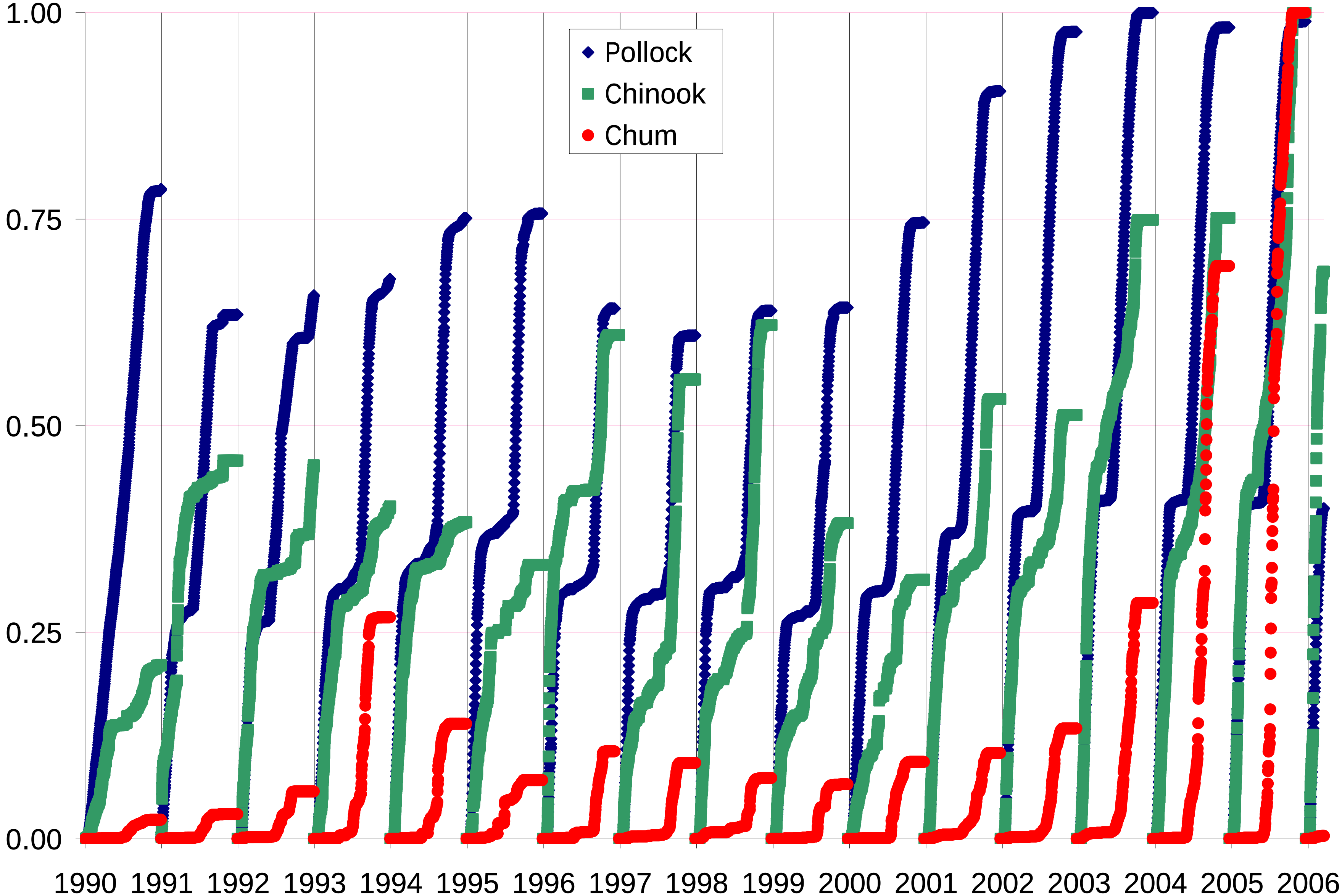


Problem: bycatch trends

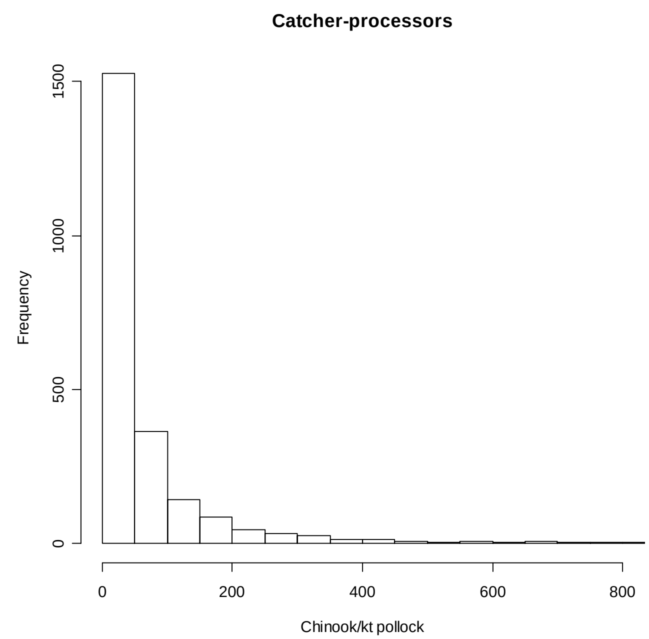


Observed within-year trends

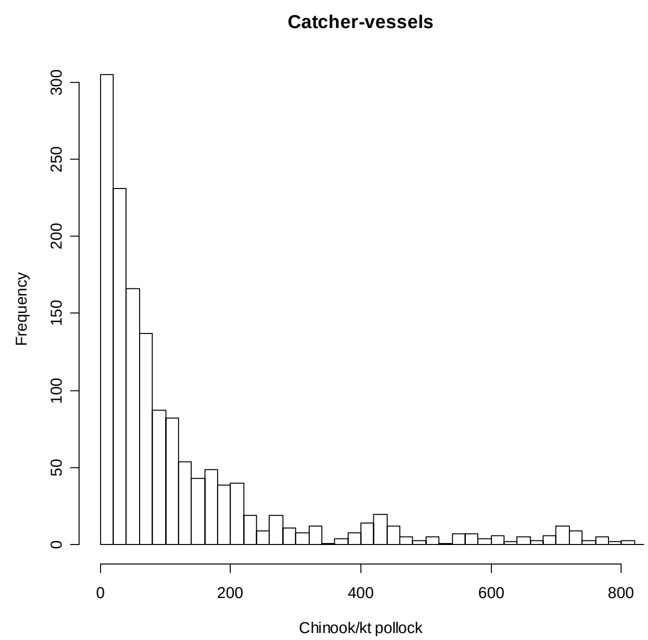
relative to annual maxima



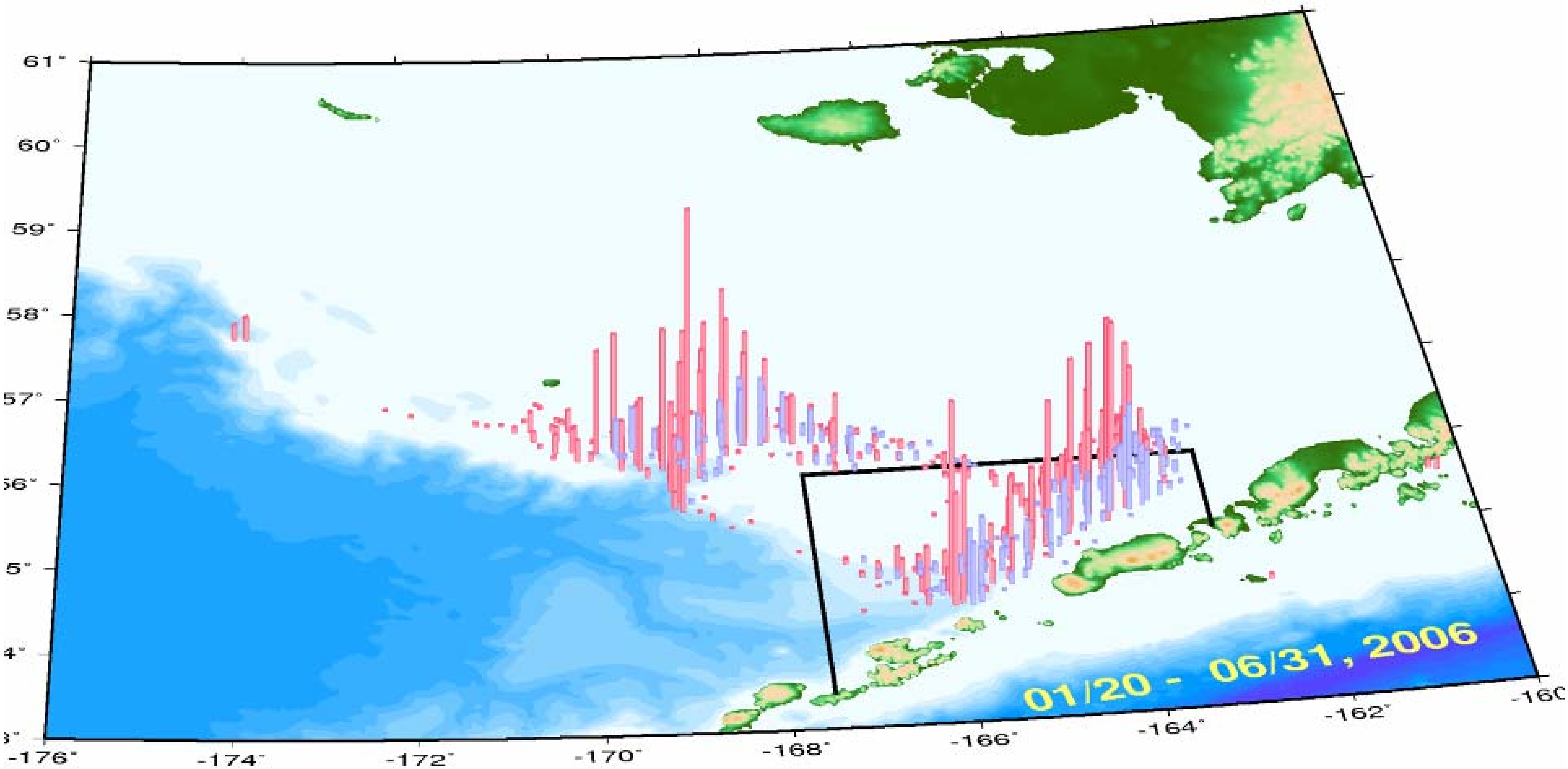
Catcher-processors



Catcher vessels

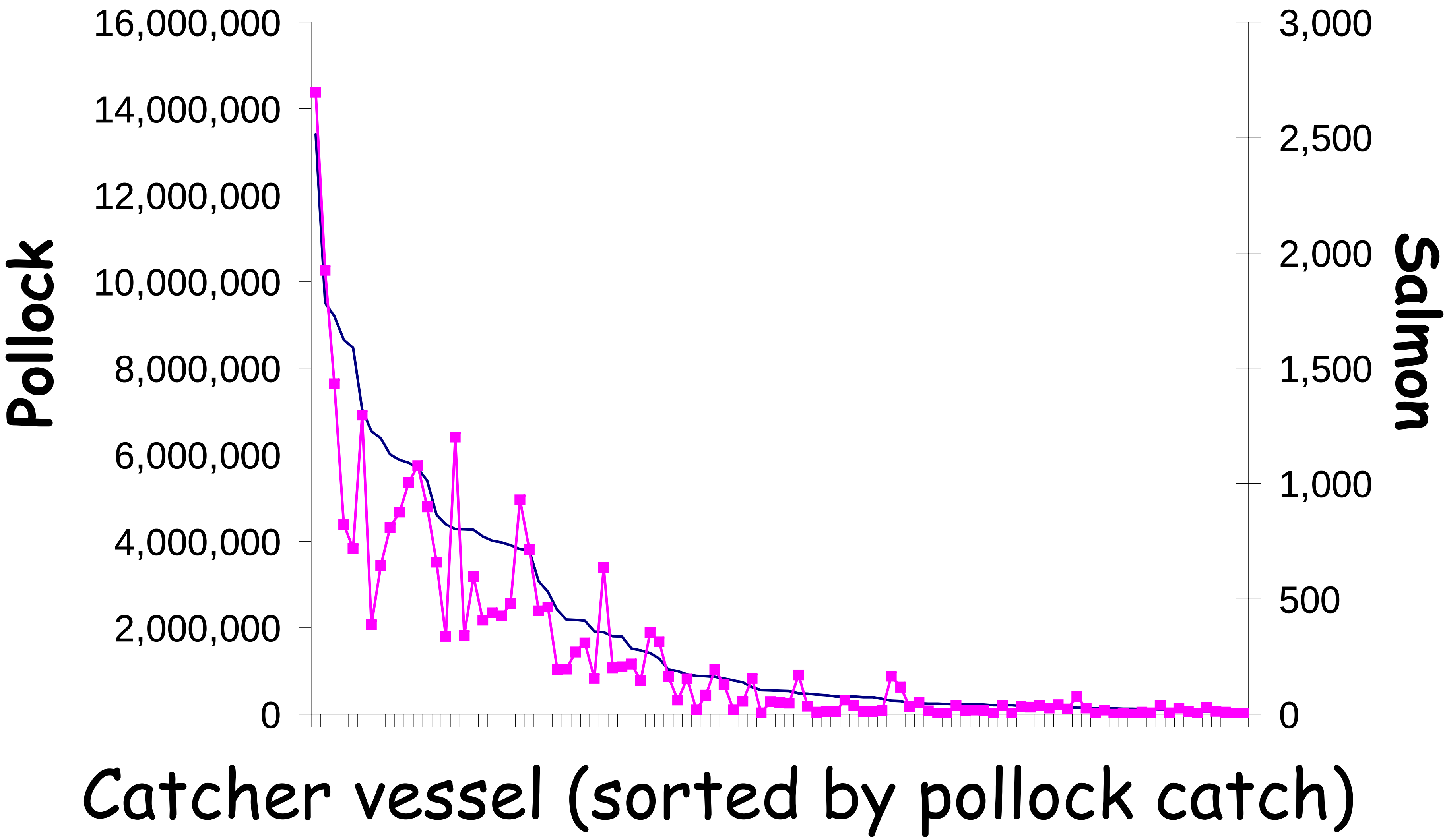


Fleet makeup



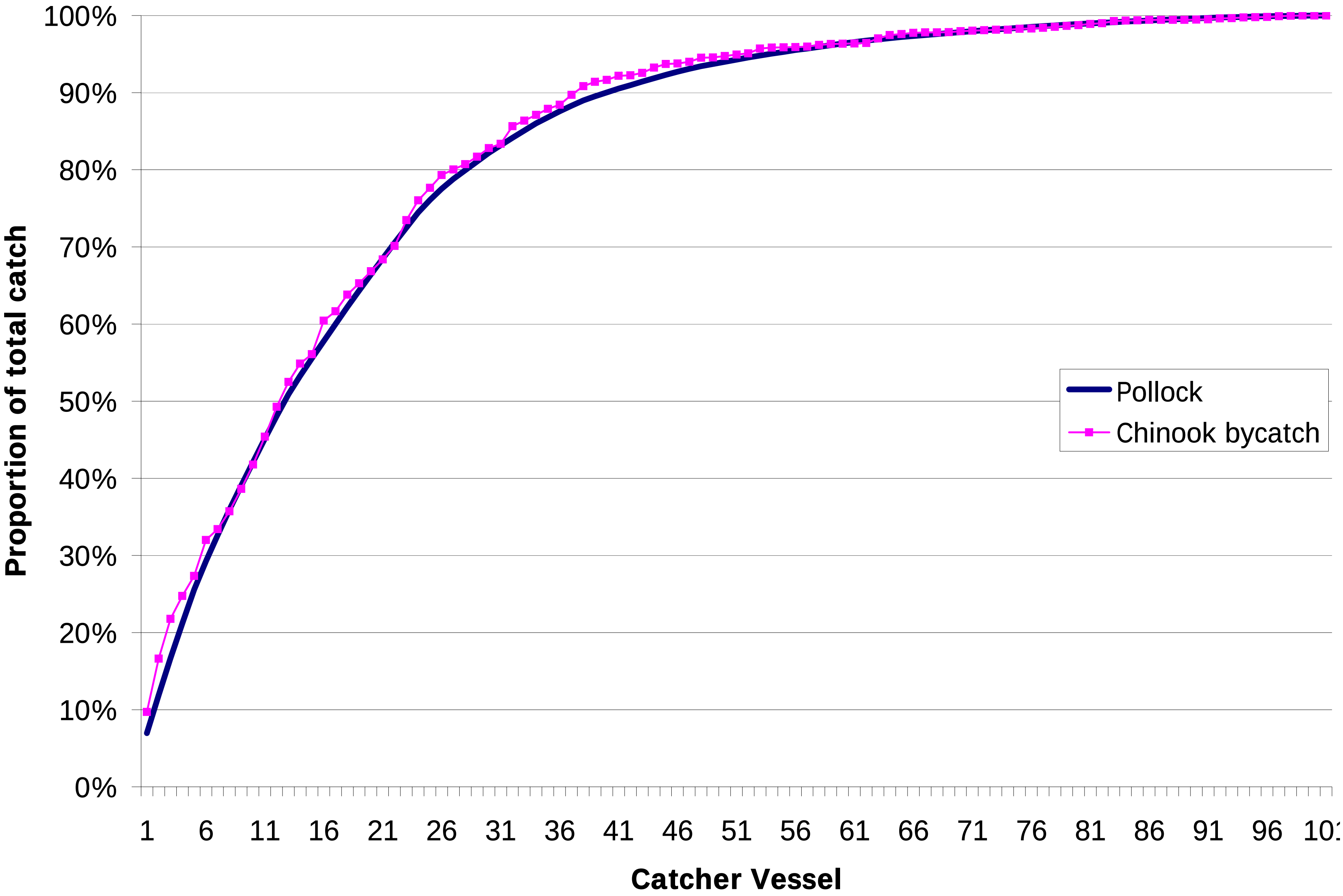
Blue = catcher-vessels (CV)
Pink = catcher-processors (CP)

Catcher-vessel characteristics



Cumulative catch

2006 Catcher vessel evaluations



Key question

- Has the fishery changed in a way that affects salmon bycatch?
- Approaches from observer data:
  - Details on fishery bycatch
    - By fleet
    - By time of year
    - Time of day
    - Depth
  - Spatial bycatch trends
  - Spatial extent

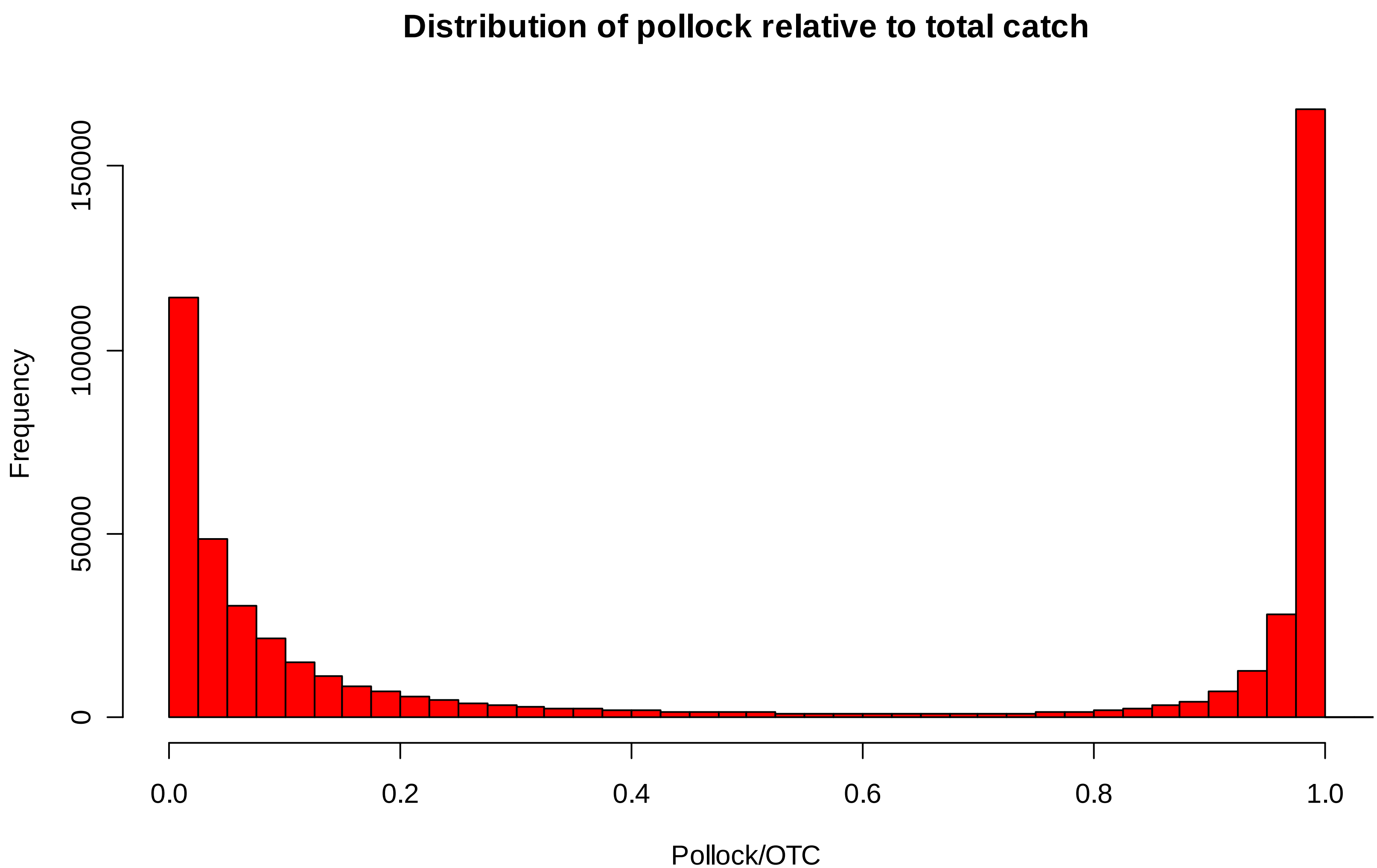
Evaluation of observer data

- Observed salmon incidence w/in tows
- Number per ton of pollock
- CPUE weighted centers of distribution

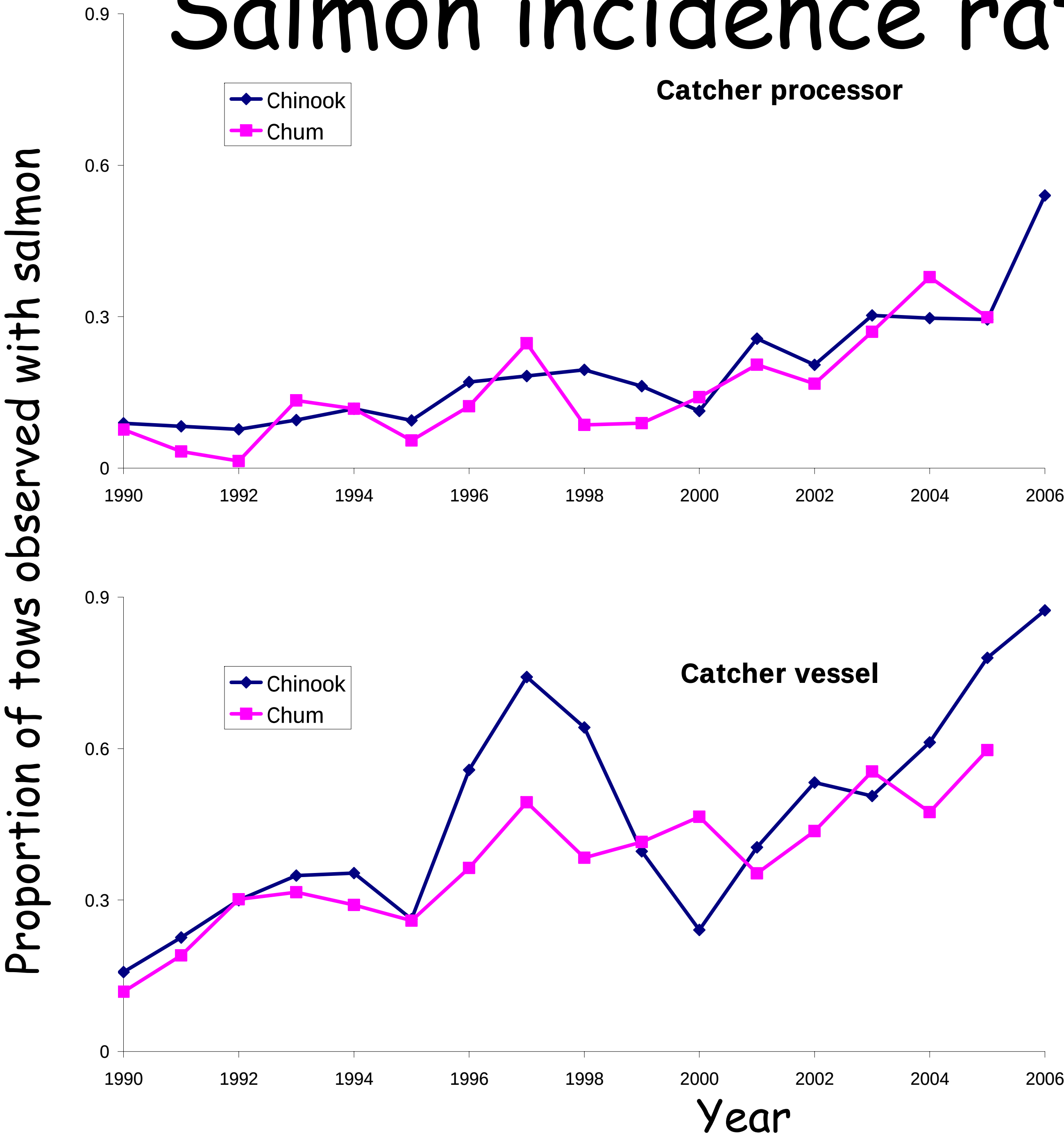
Methods: data screening

As a fraction of total catch

80% used as cut-off for “pollock” tows

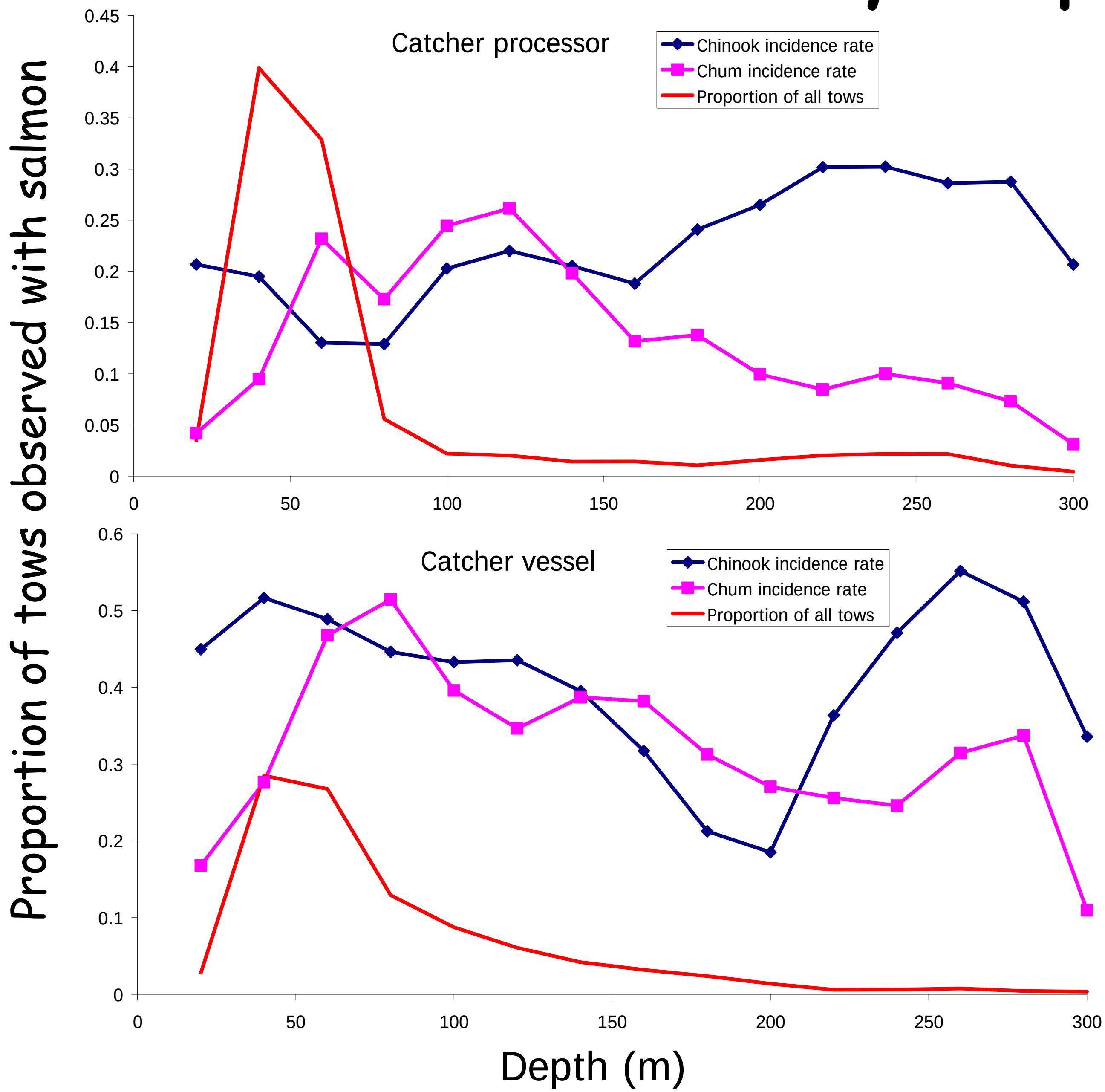


Salmon incidence rate (by year)



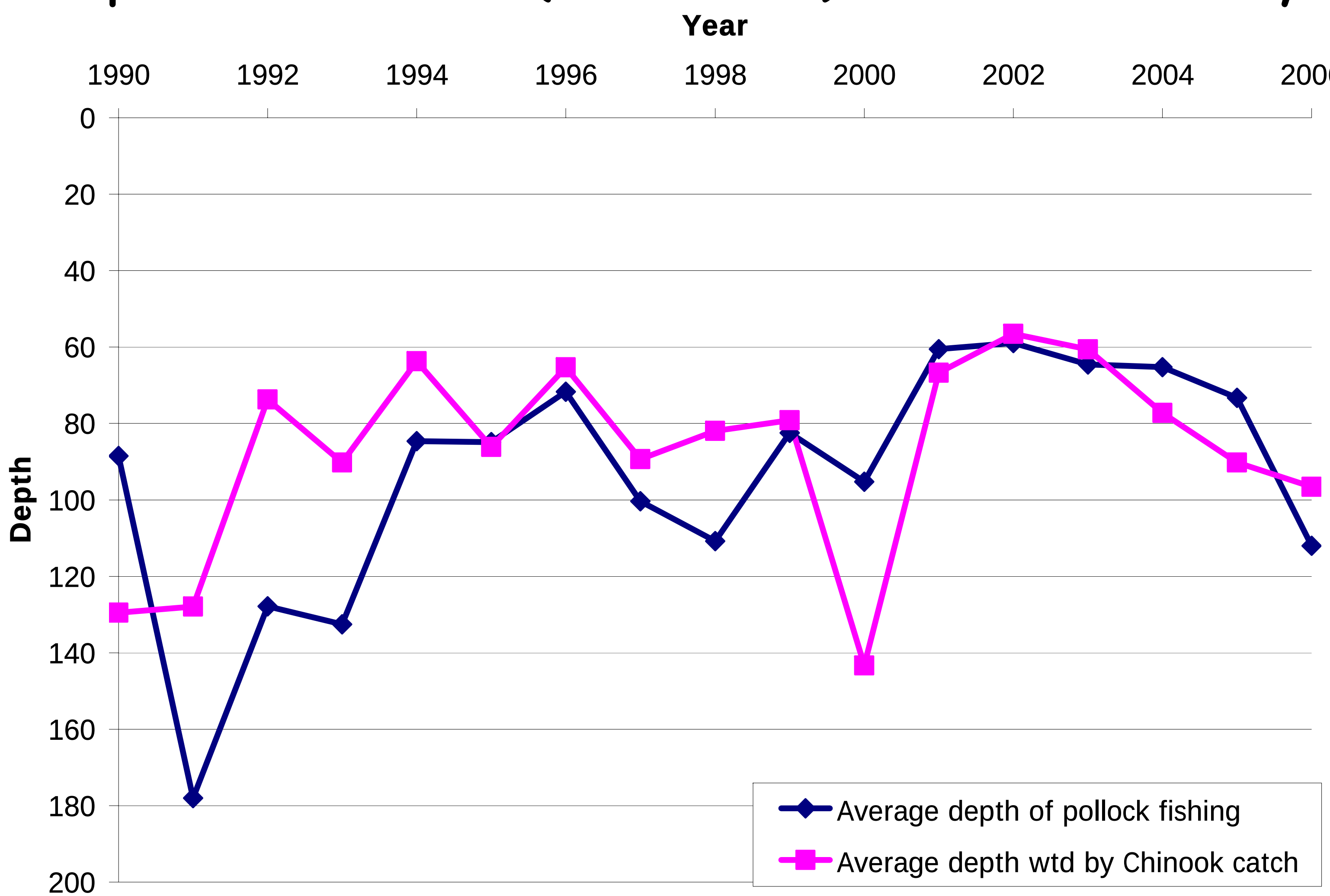
Note: Catch-vessel data based on port-sampler assignments to tows

Salmon incidence by depth



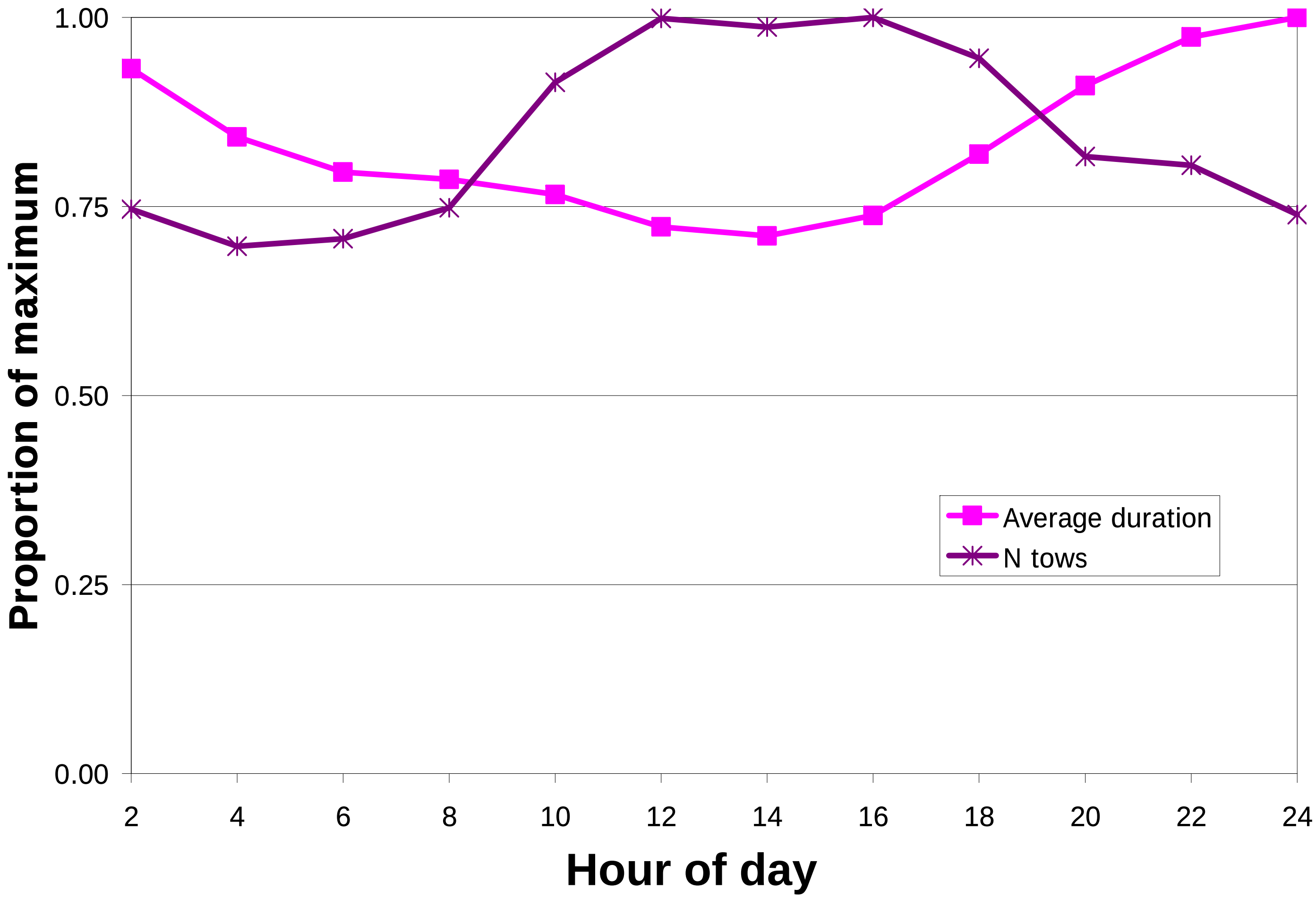
Pollock fishery characteristics

- Depth of effort (A season) and Chinook bycatch



Pollock fishery and time of day

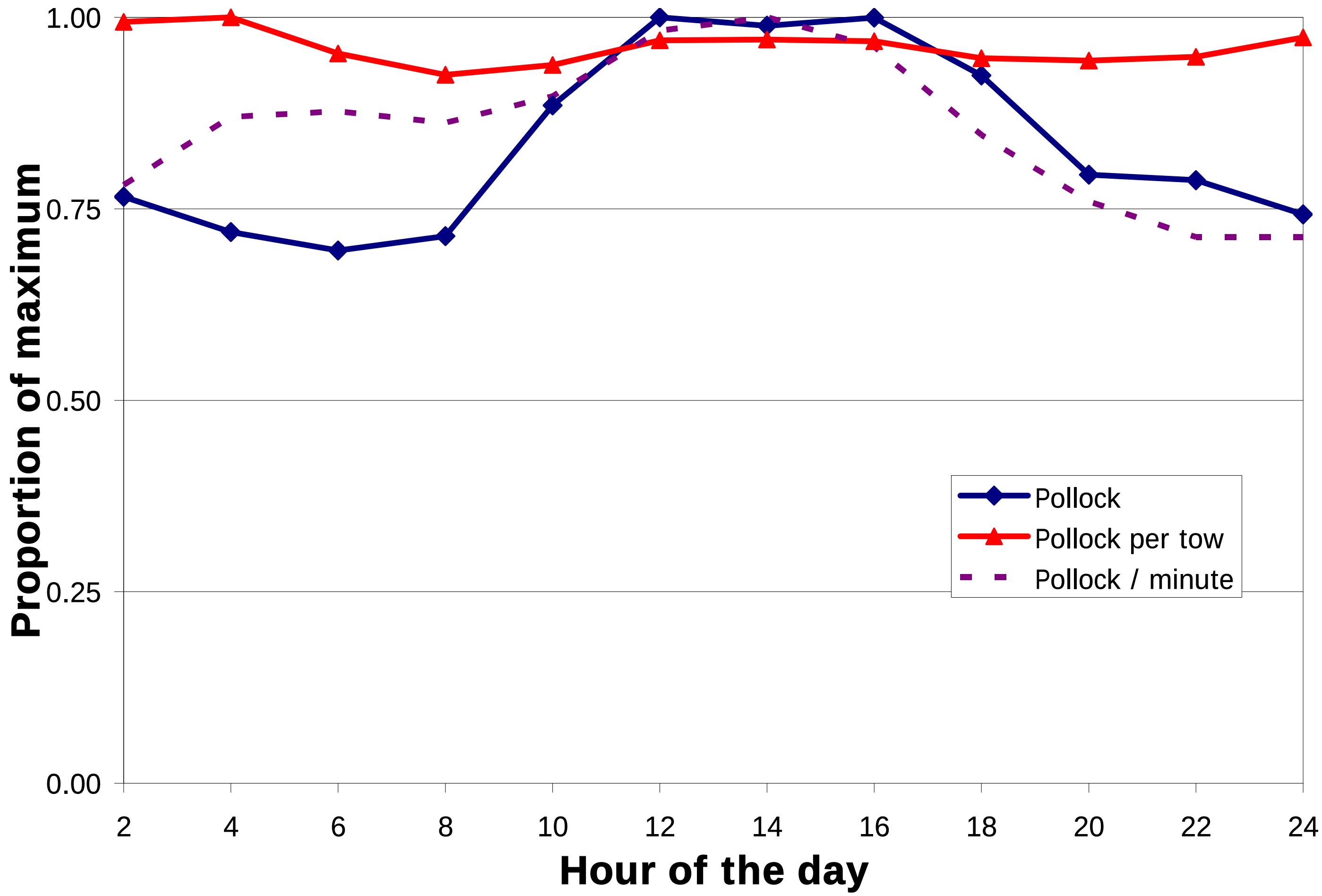
- Tow duration and frequency (1990-2006)



- ***Longer tows at night, most tows in mid afternoon***

Pollock fishery characteristics

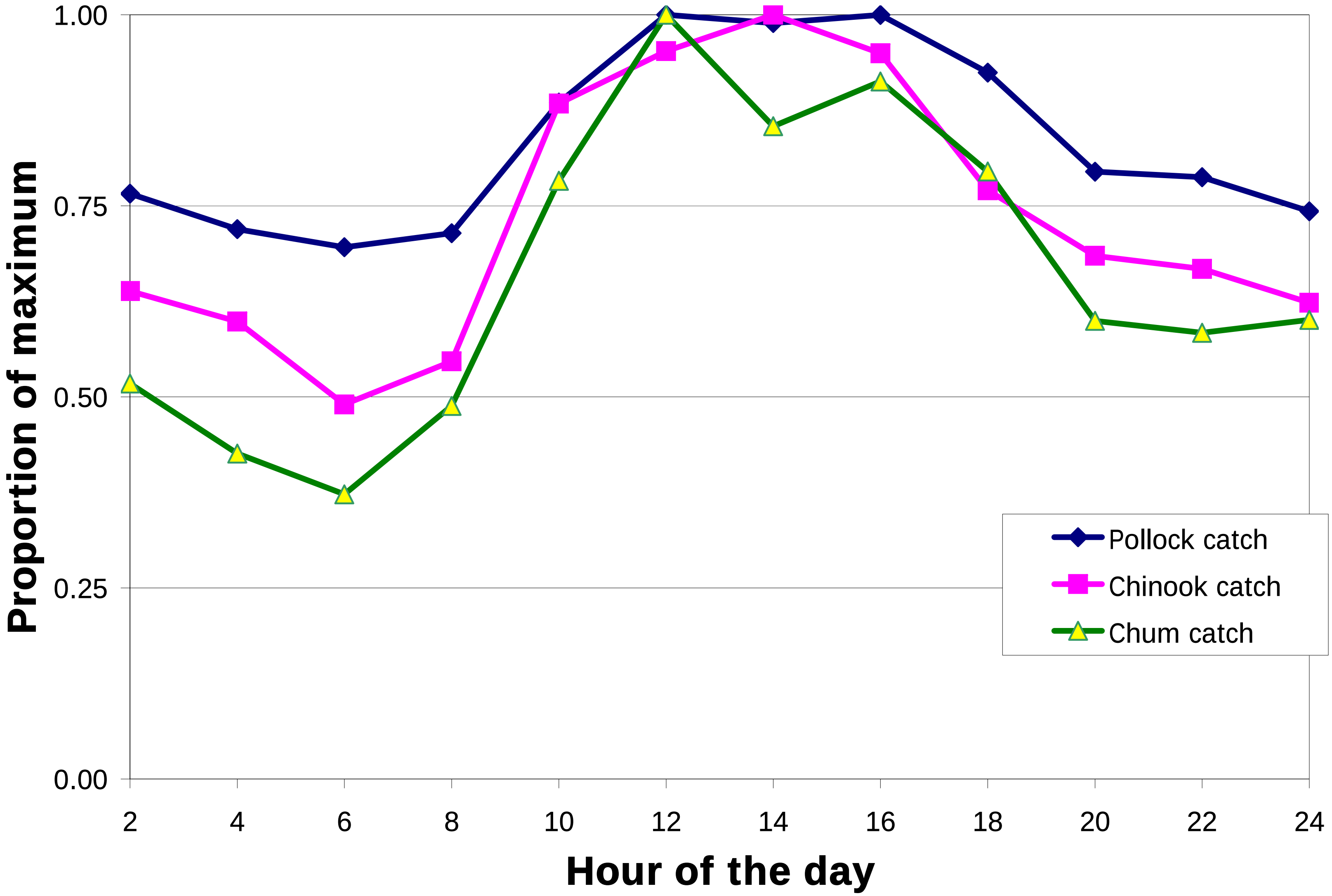
- Pollock catch



- ***Best CPUE and most pollock caught in mid afternoon***

Pollock fishery characteristics

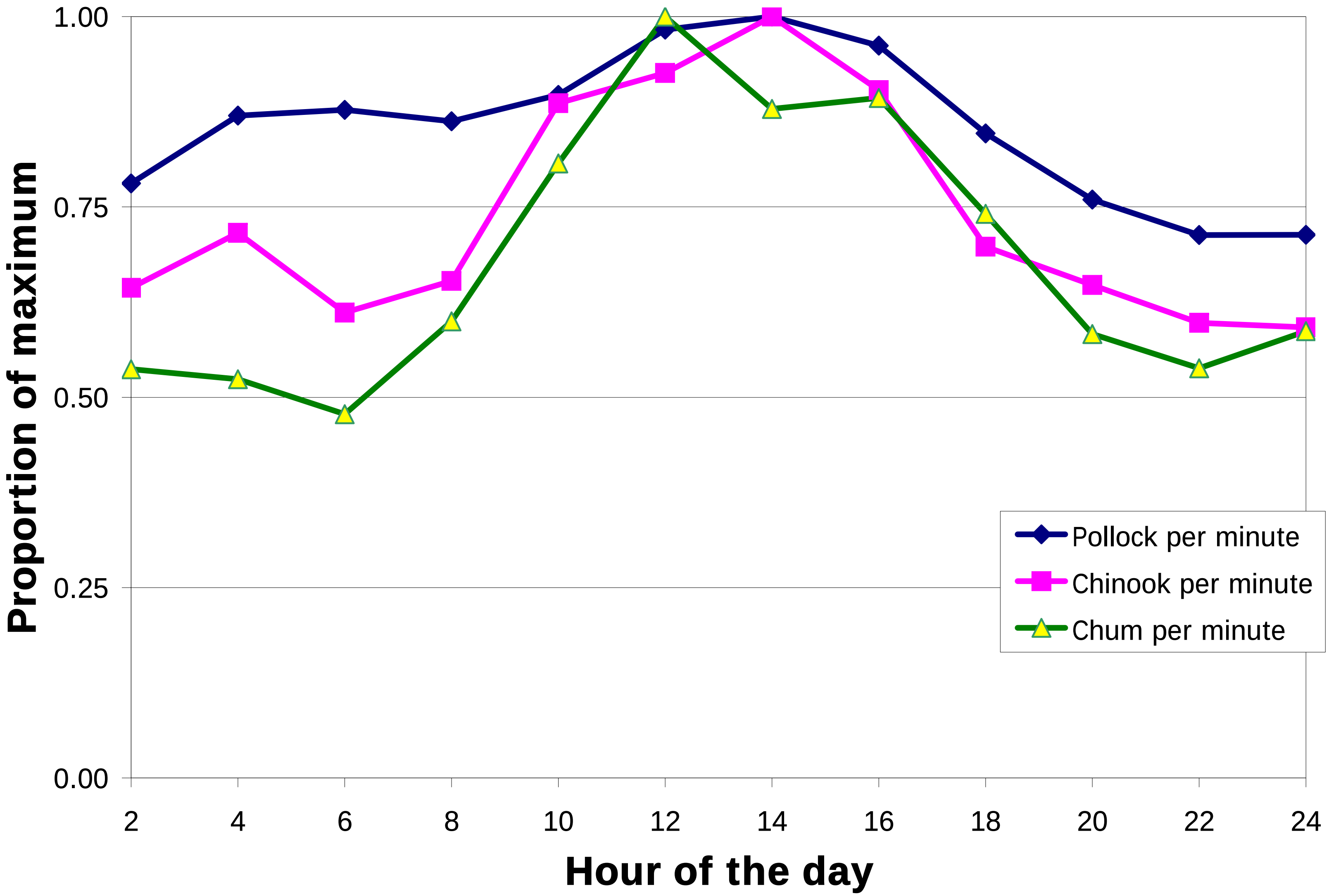
- Salmon bycatch and pollock catch



- *Most salmon caught in mid afternoon*

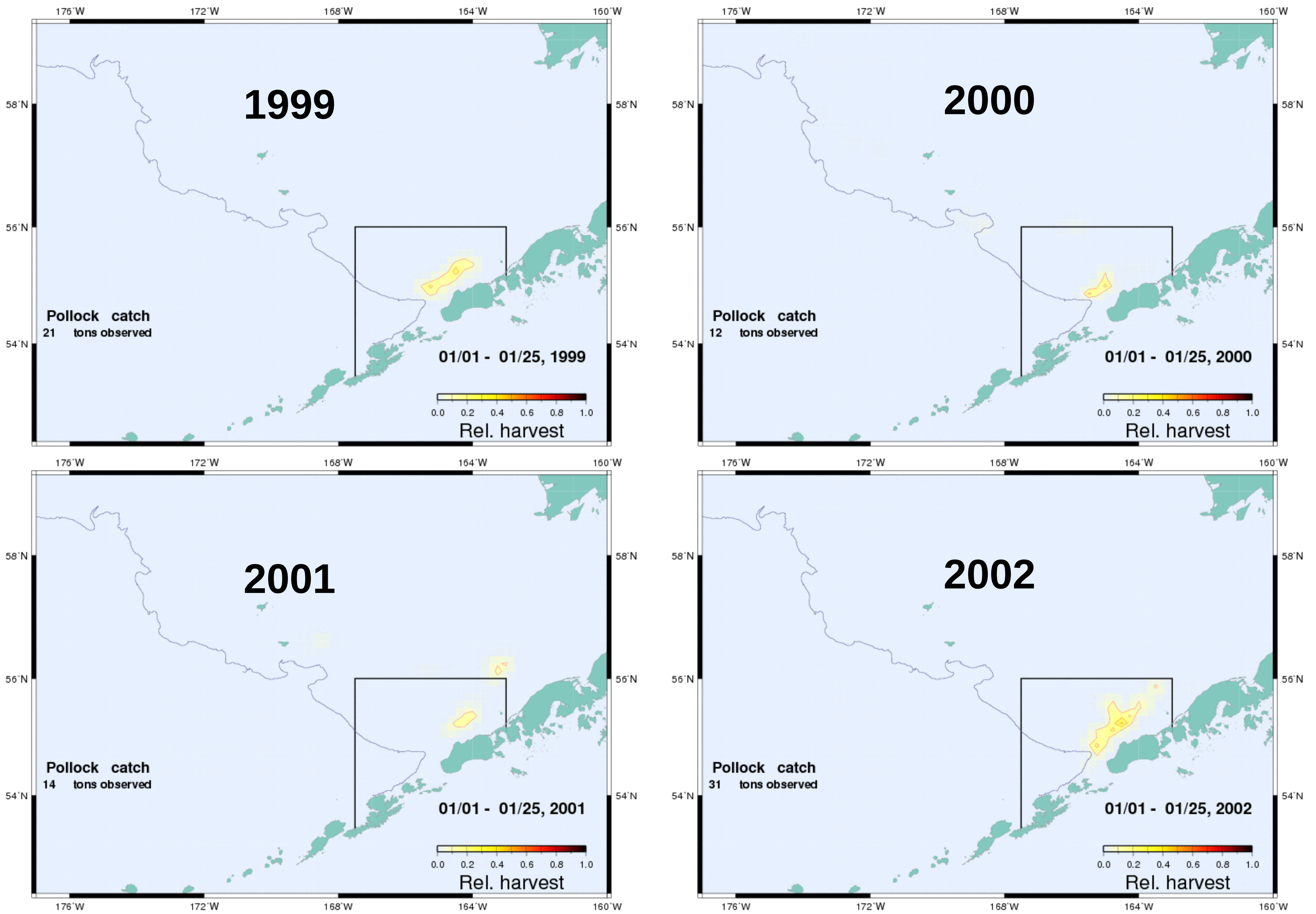
Pollock fishery characteristics

- Salmon and pollock catch rates

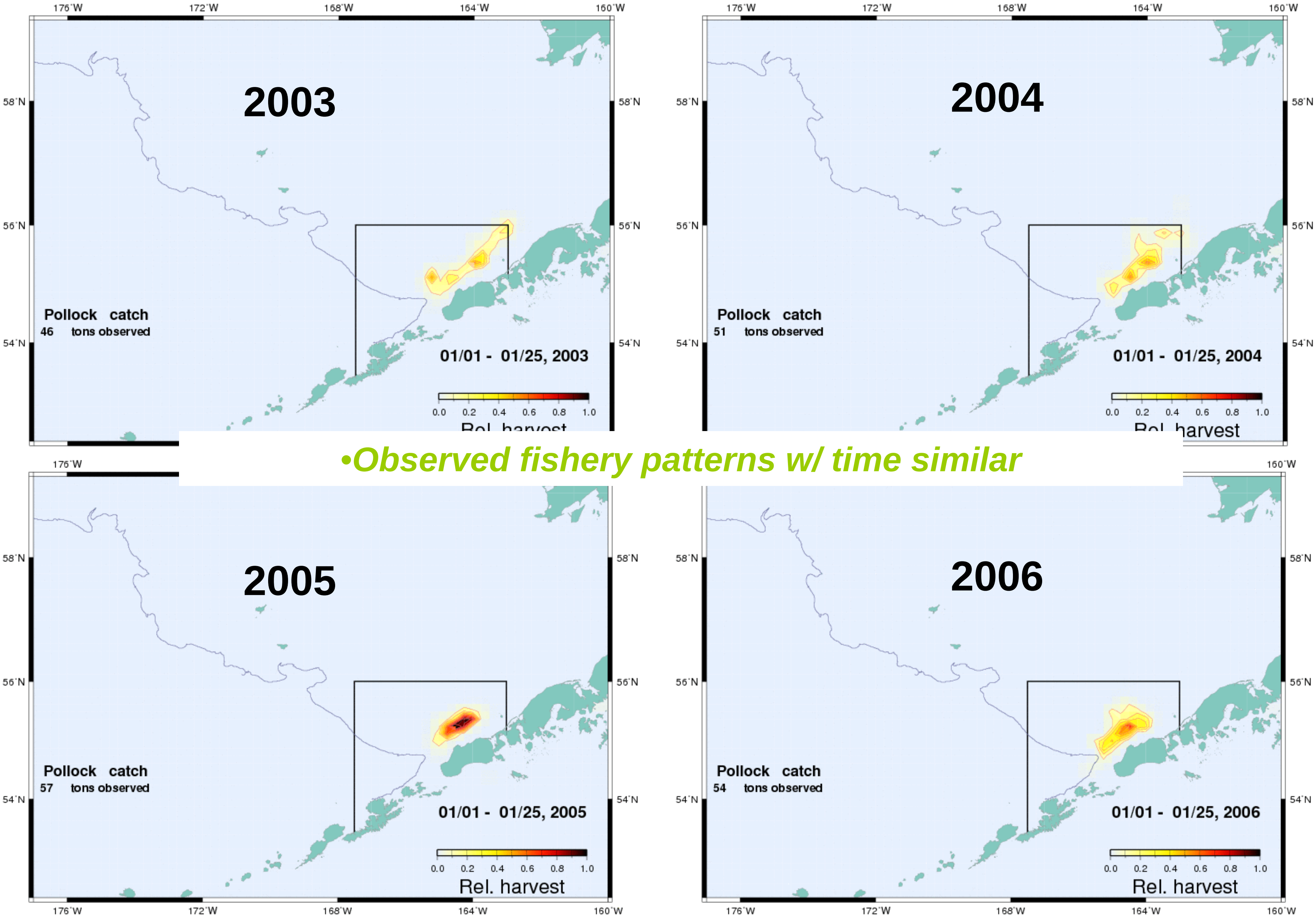


- *Salmon CPUE drops more during night*

Pollock A season, 1999-2002

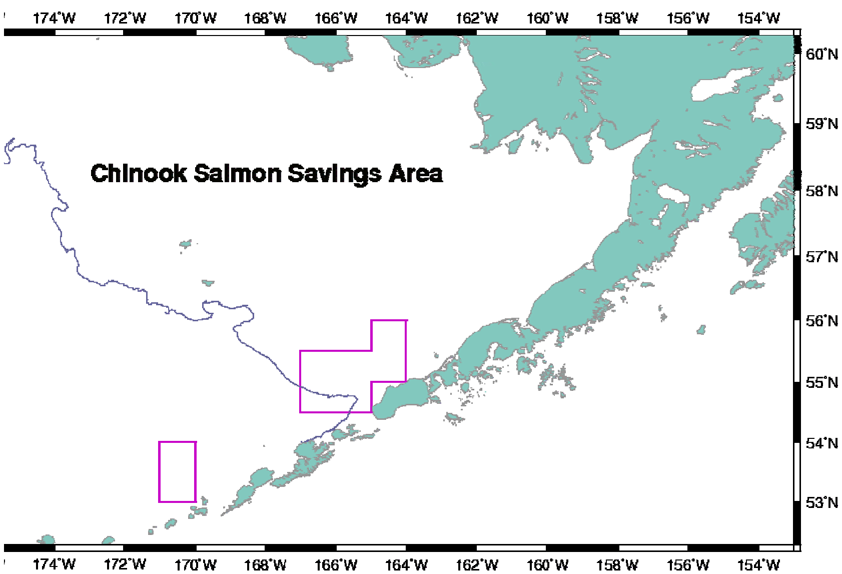


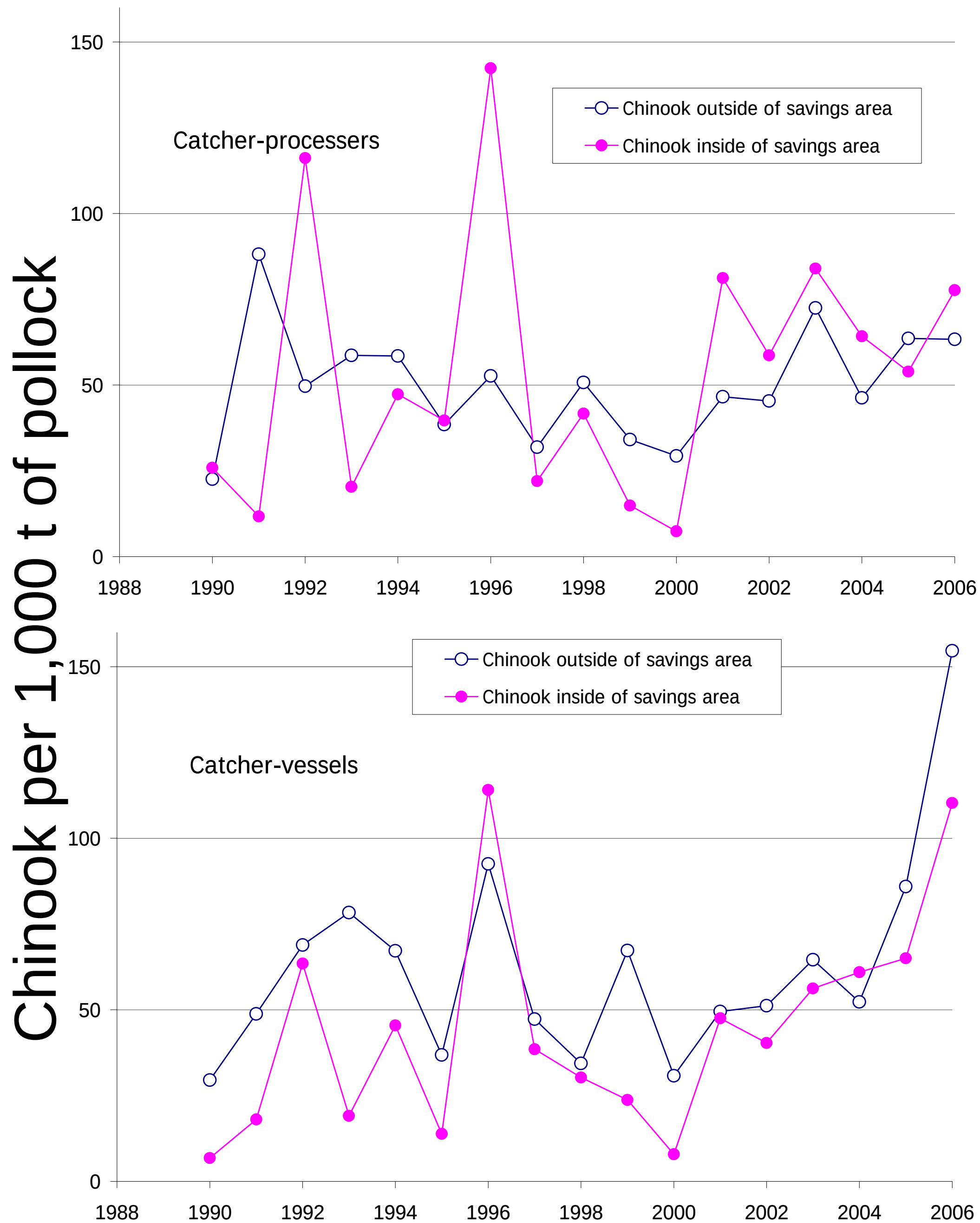
Pollock A season, 2003-2006



- *Observed fishery patterns w/ time similar*

Chinook



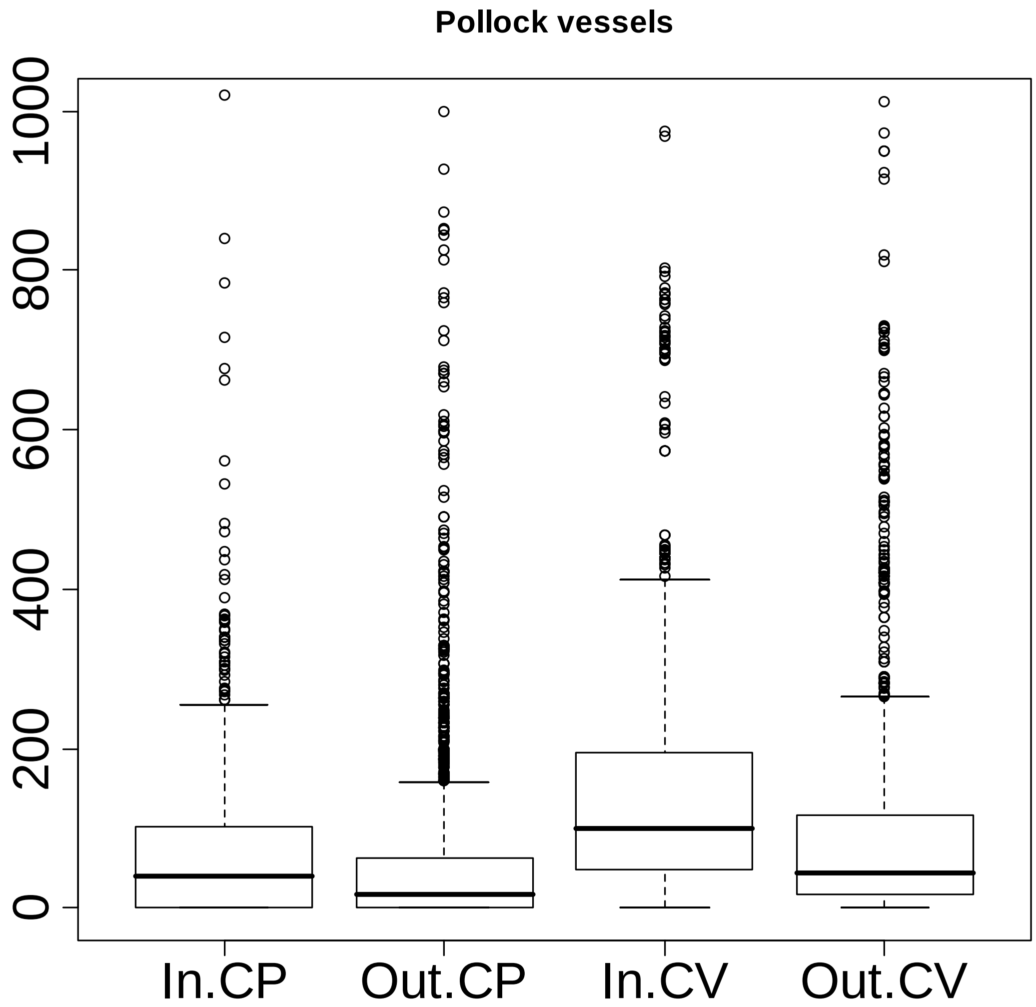


- *Chinook / kt of pollock variable can be higher inside CSSA*

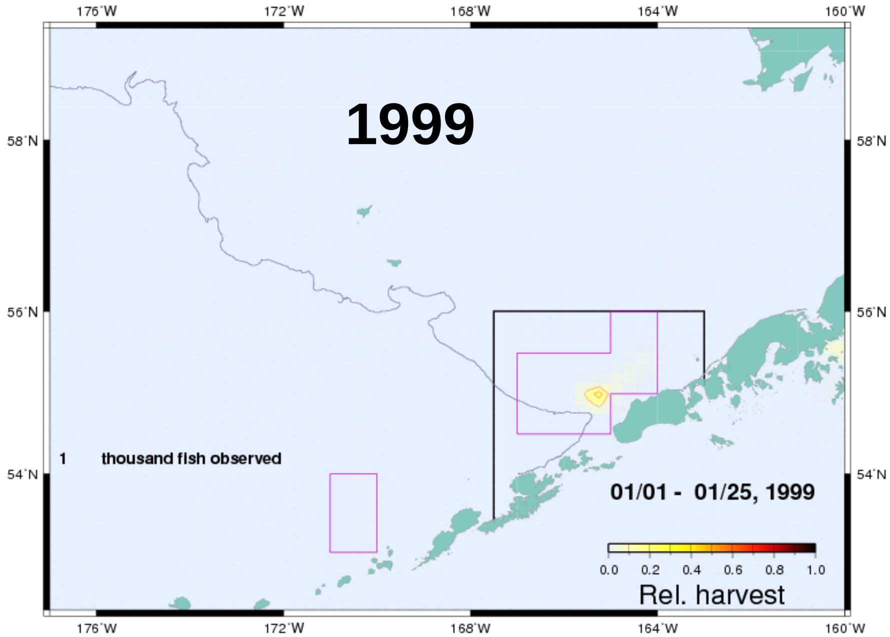
Comparison in and out of savings area

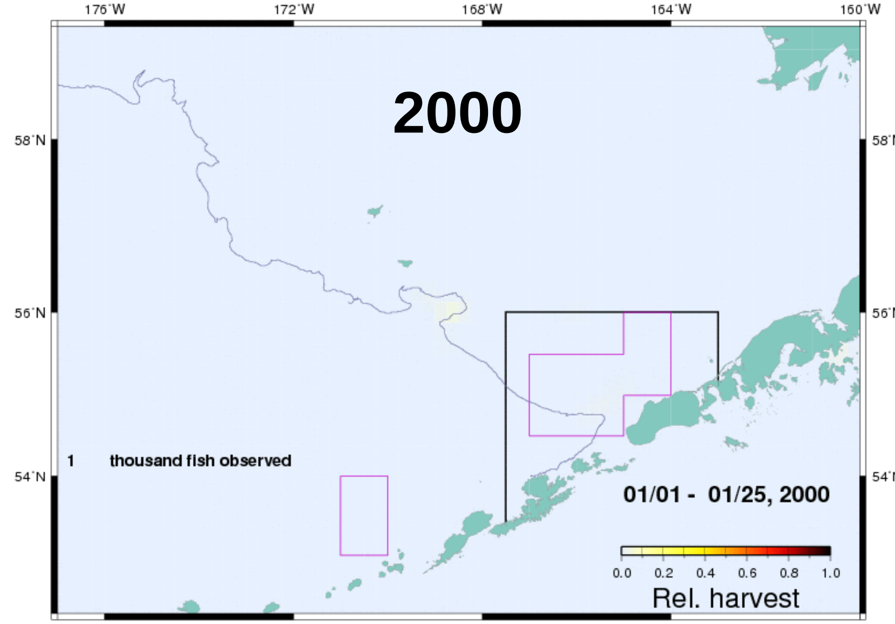
2006 data

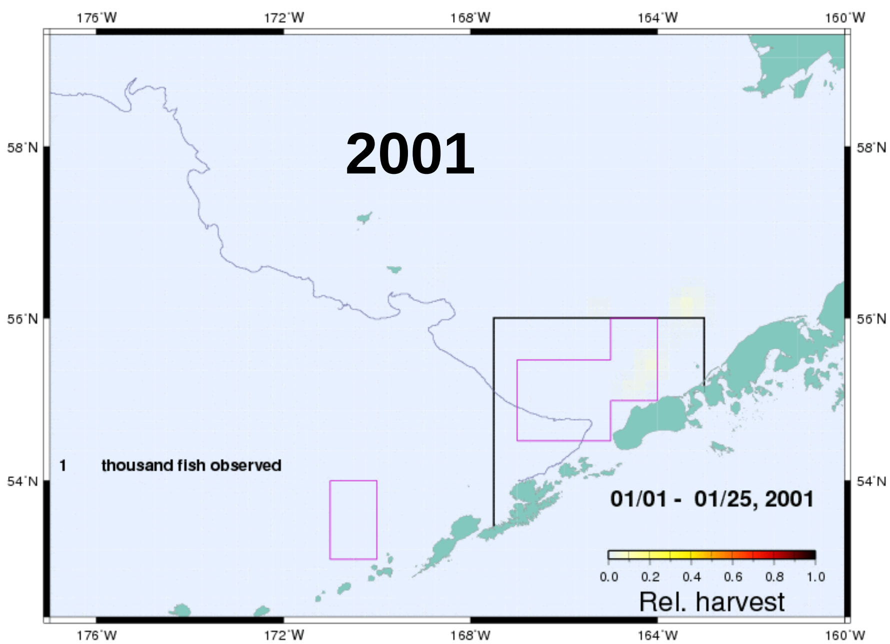
Salmon/
kt of pollock

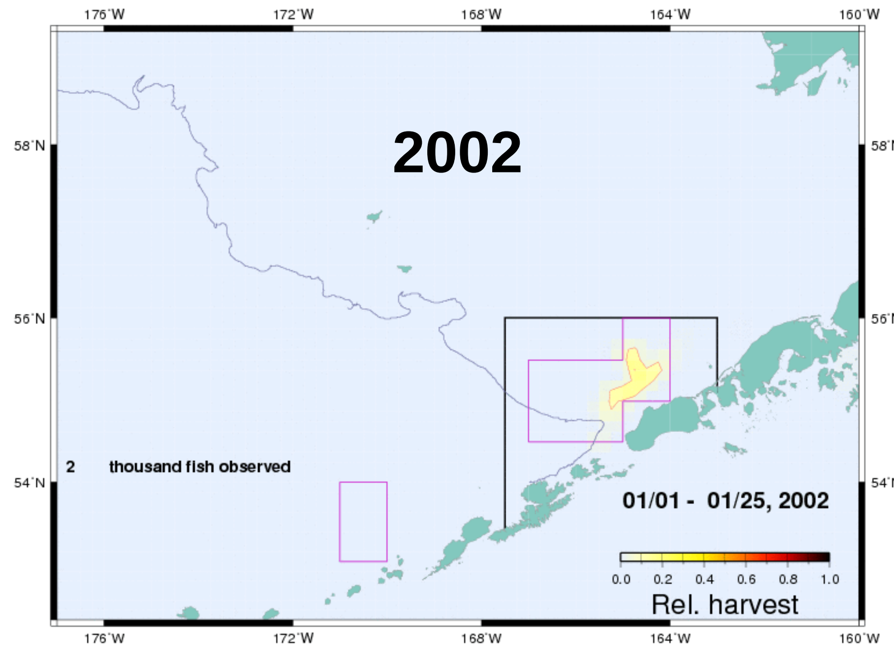


Chinook A season

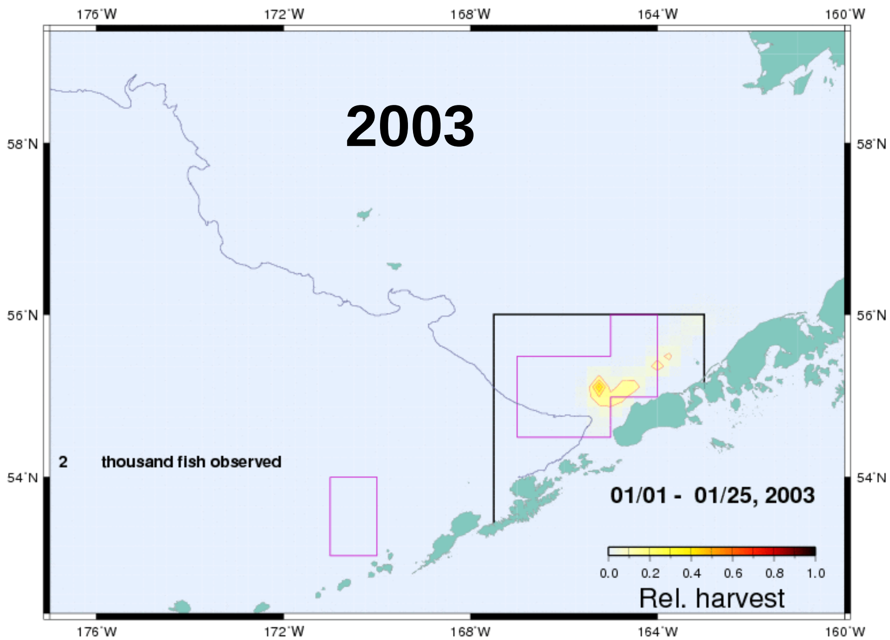


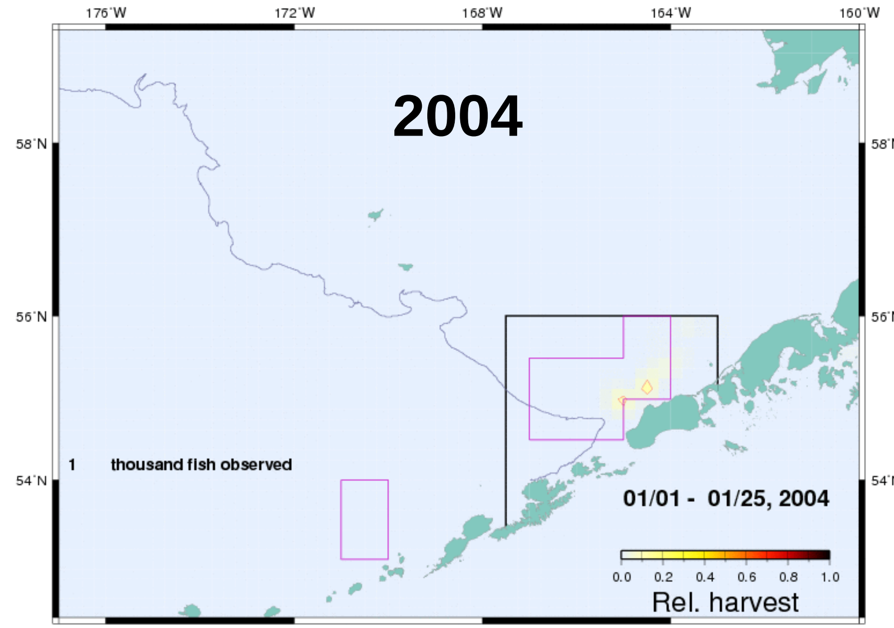


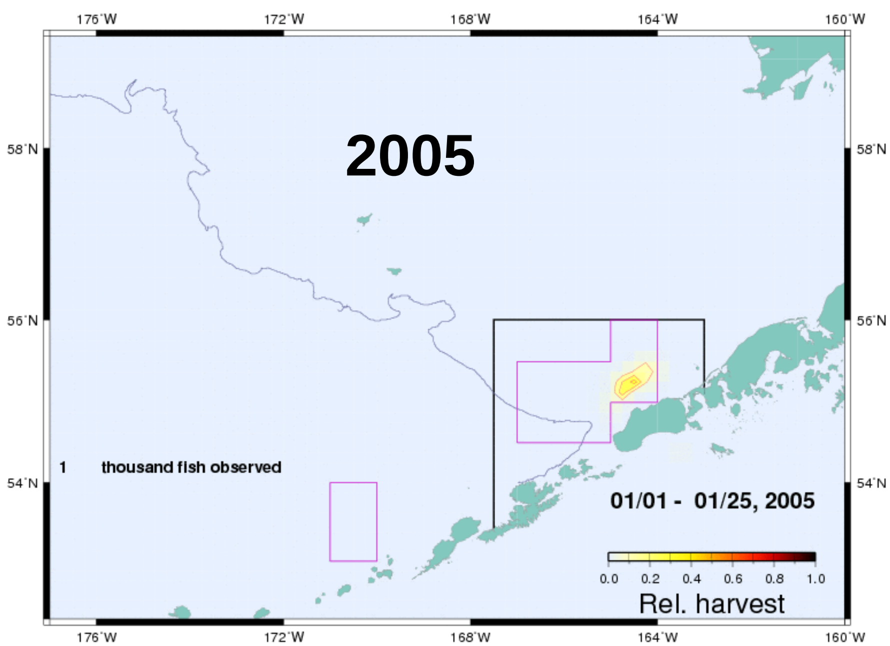


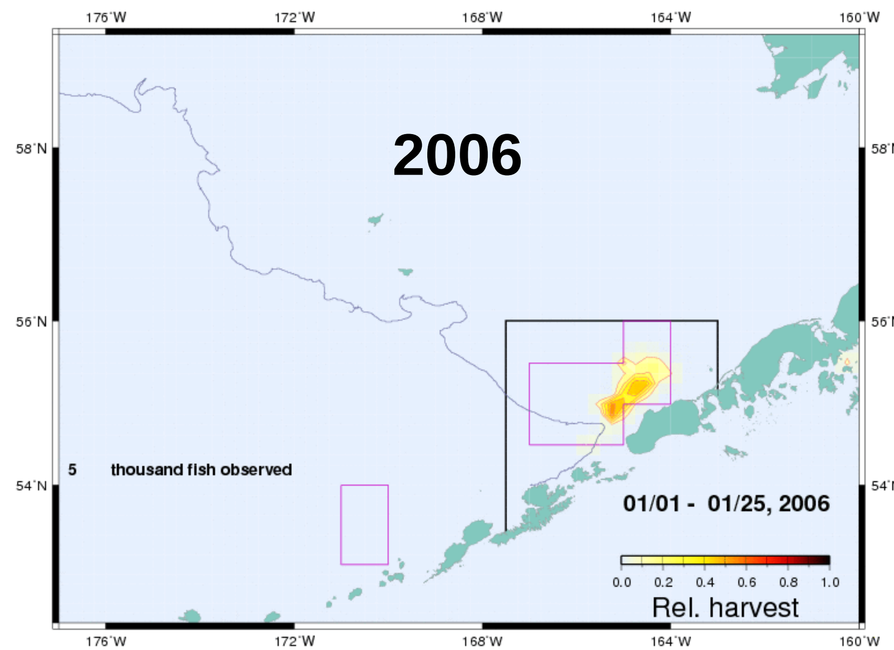


Chinook A season

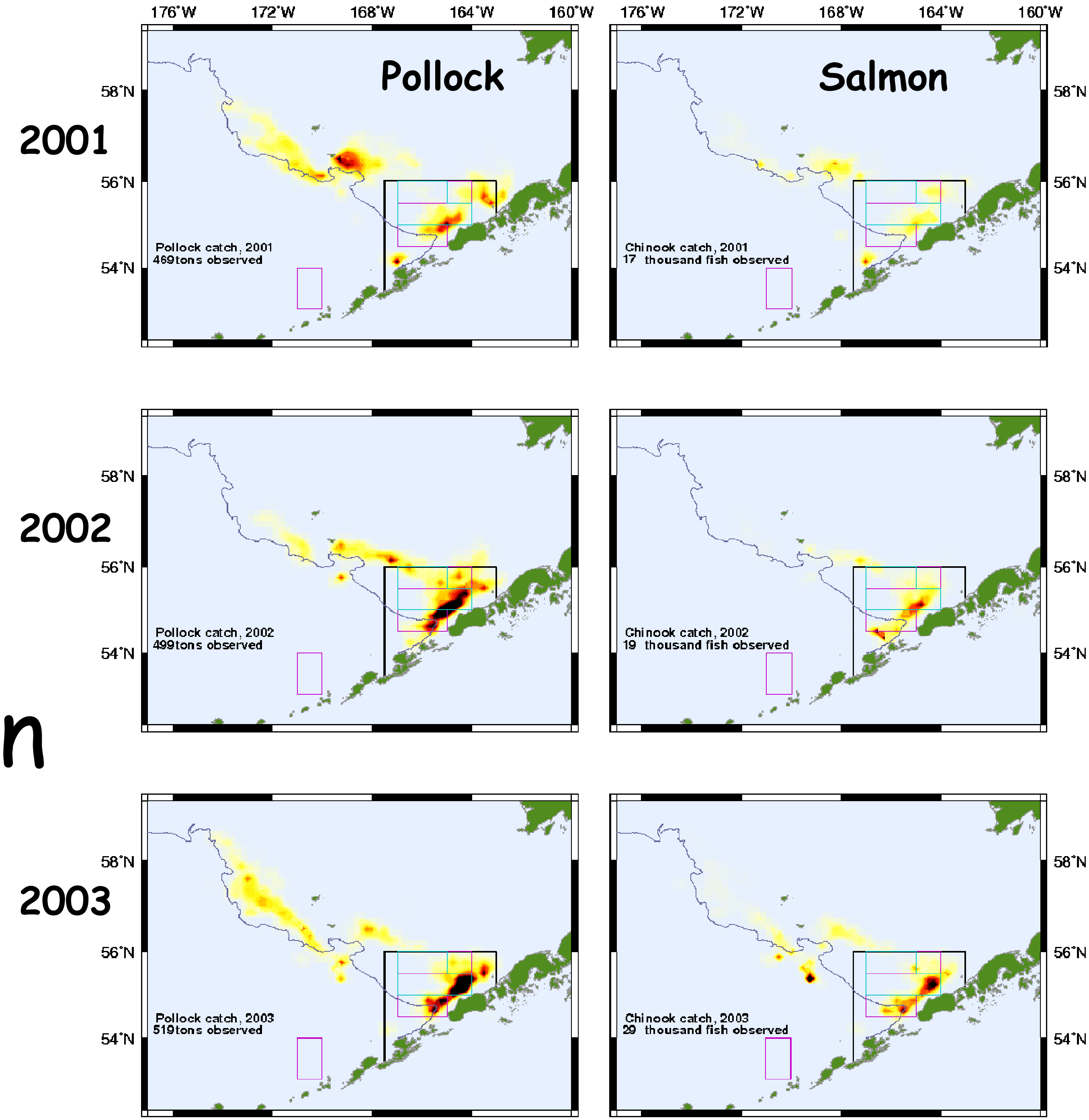




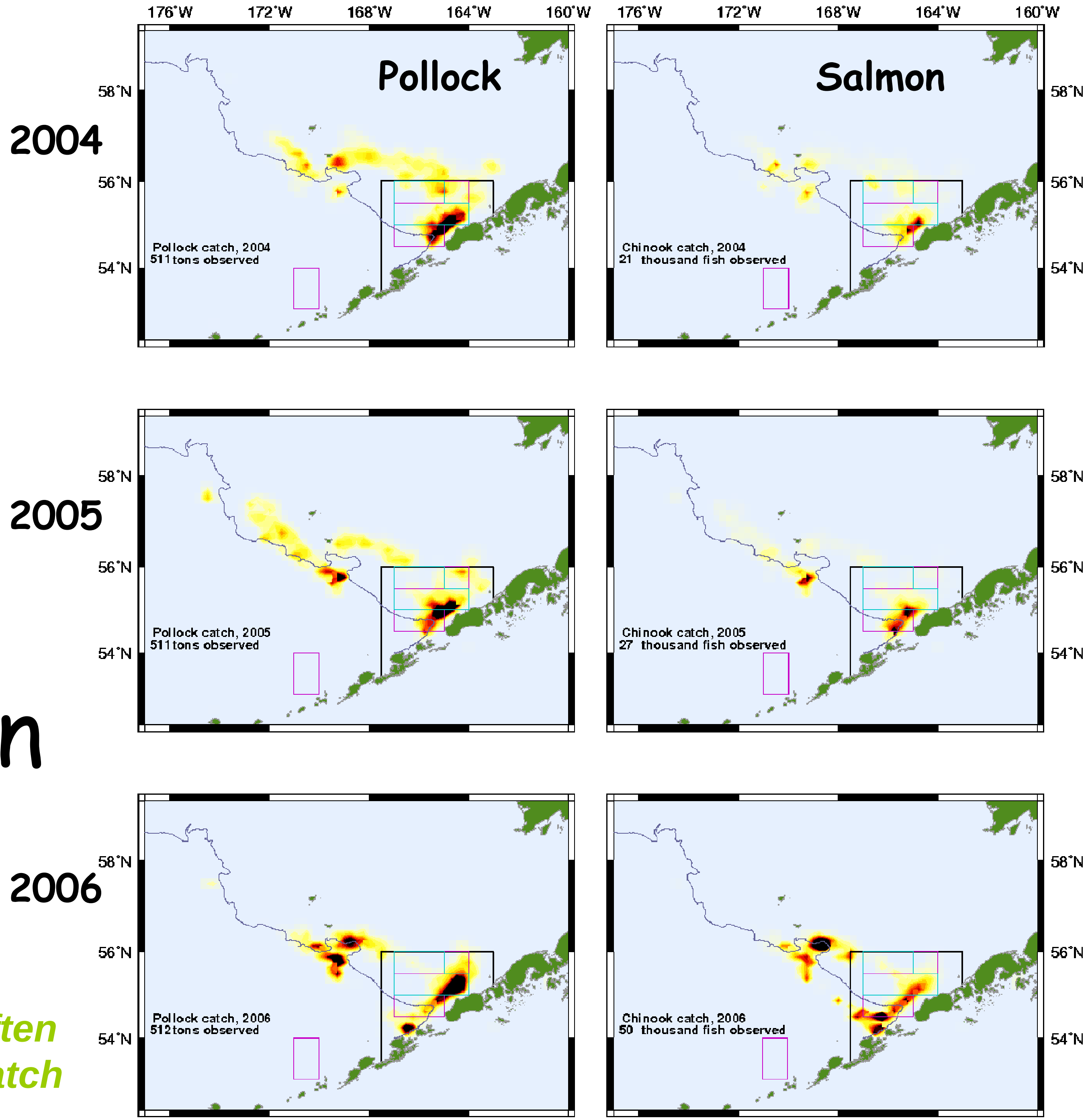




Pollock and chinook A-season



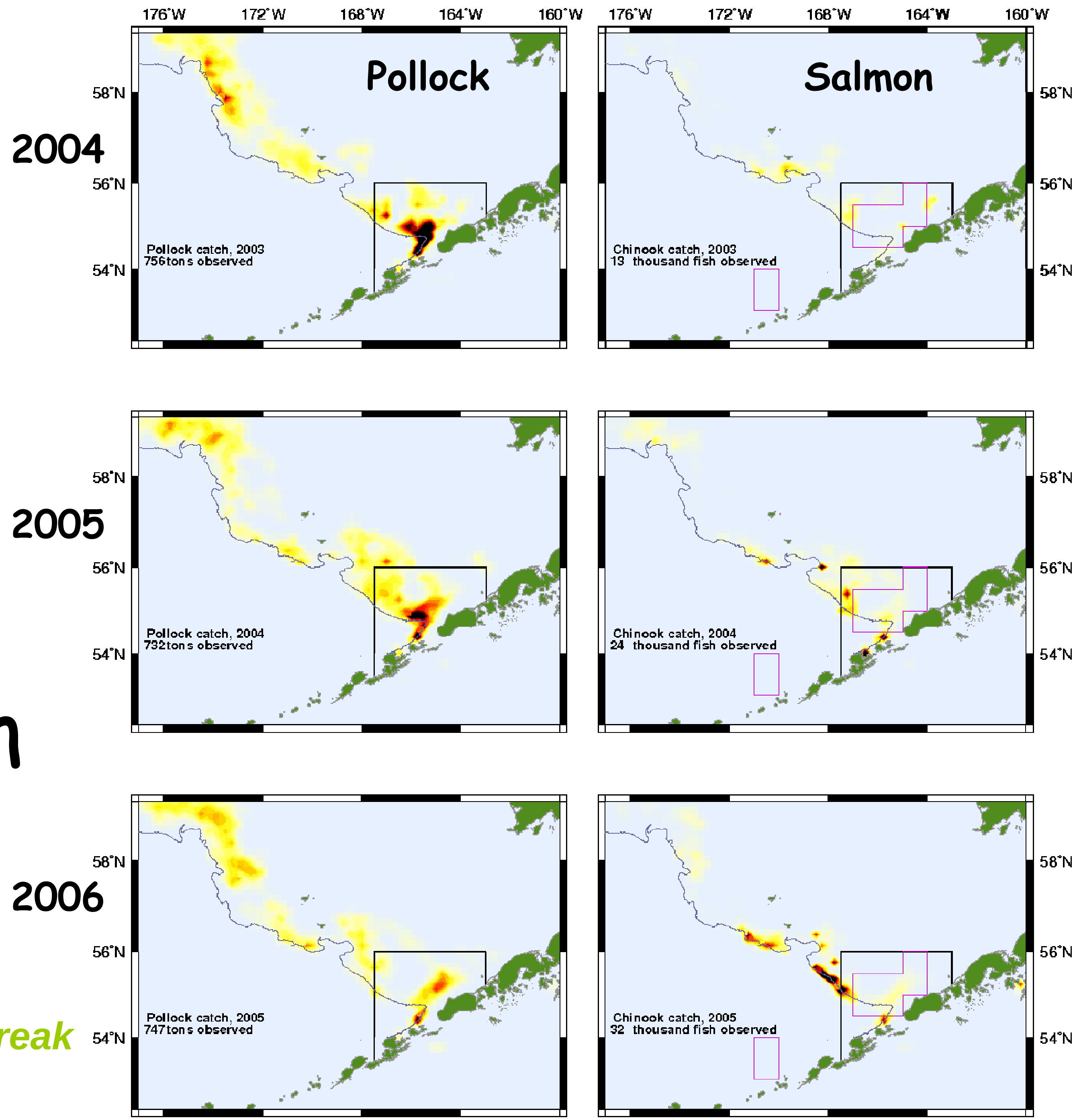
Pollock and chinook A-season



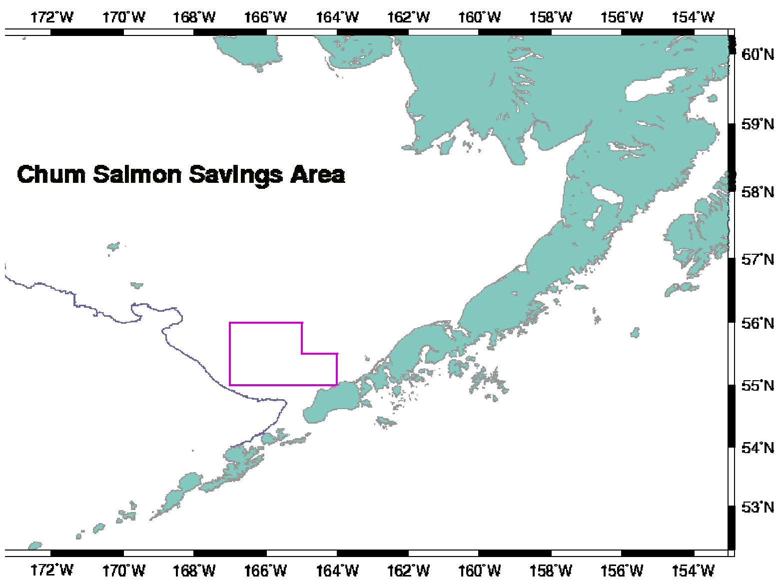
- *Chinook bycatch often at fringe of pollock catch*

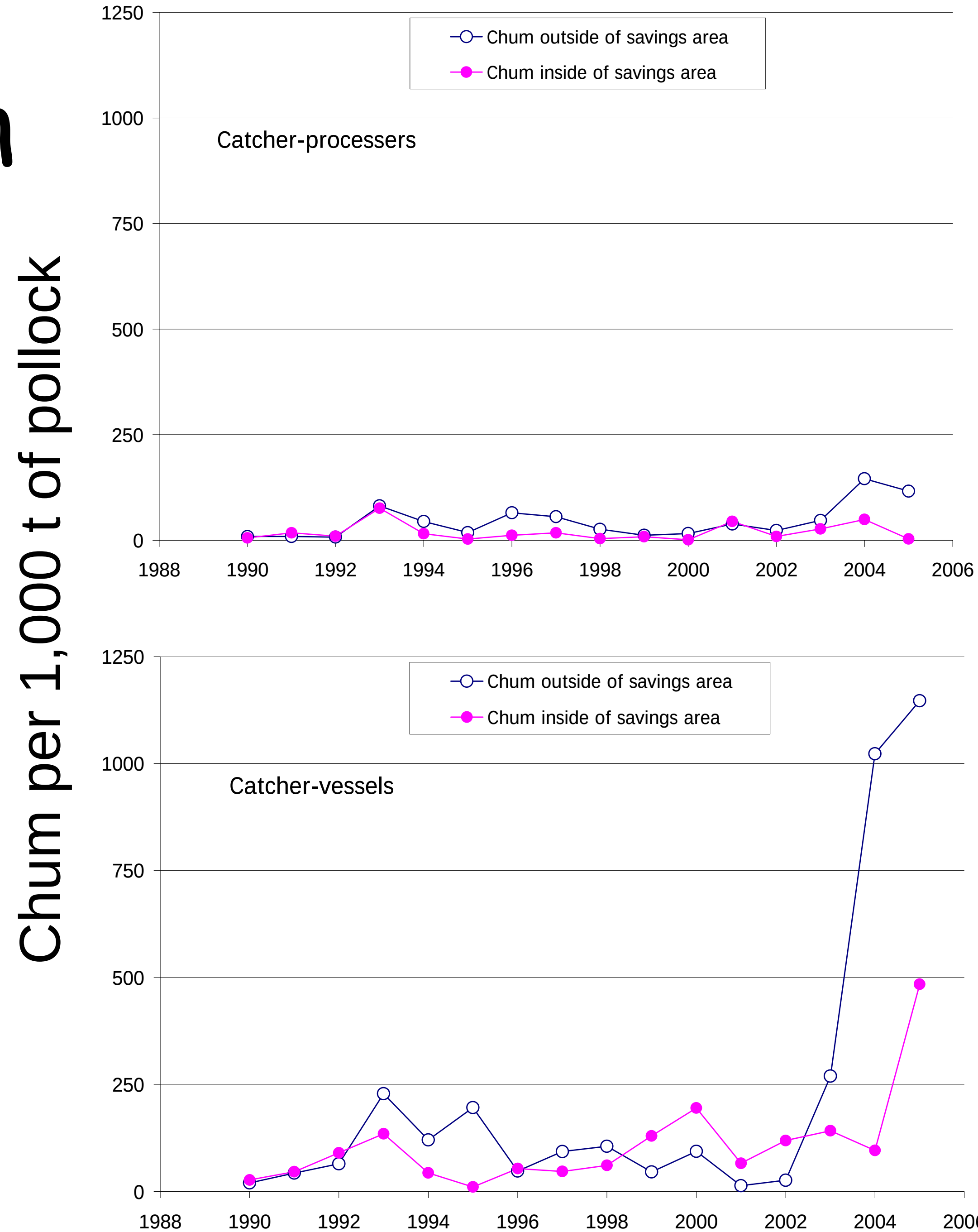
Pollock and chinook B-season

- *Chinook bycatch in summer along shelf break*



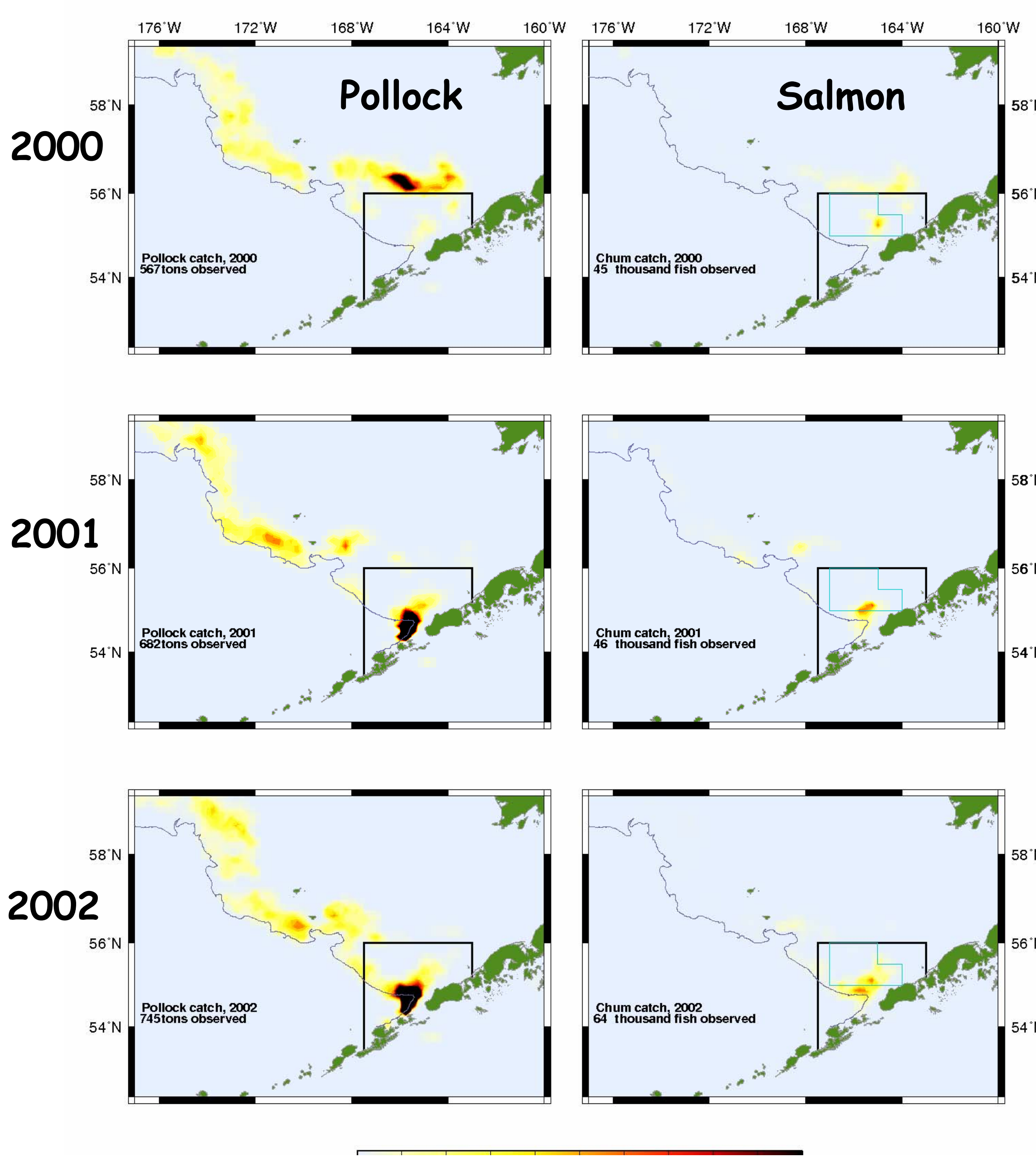
Chum salmon



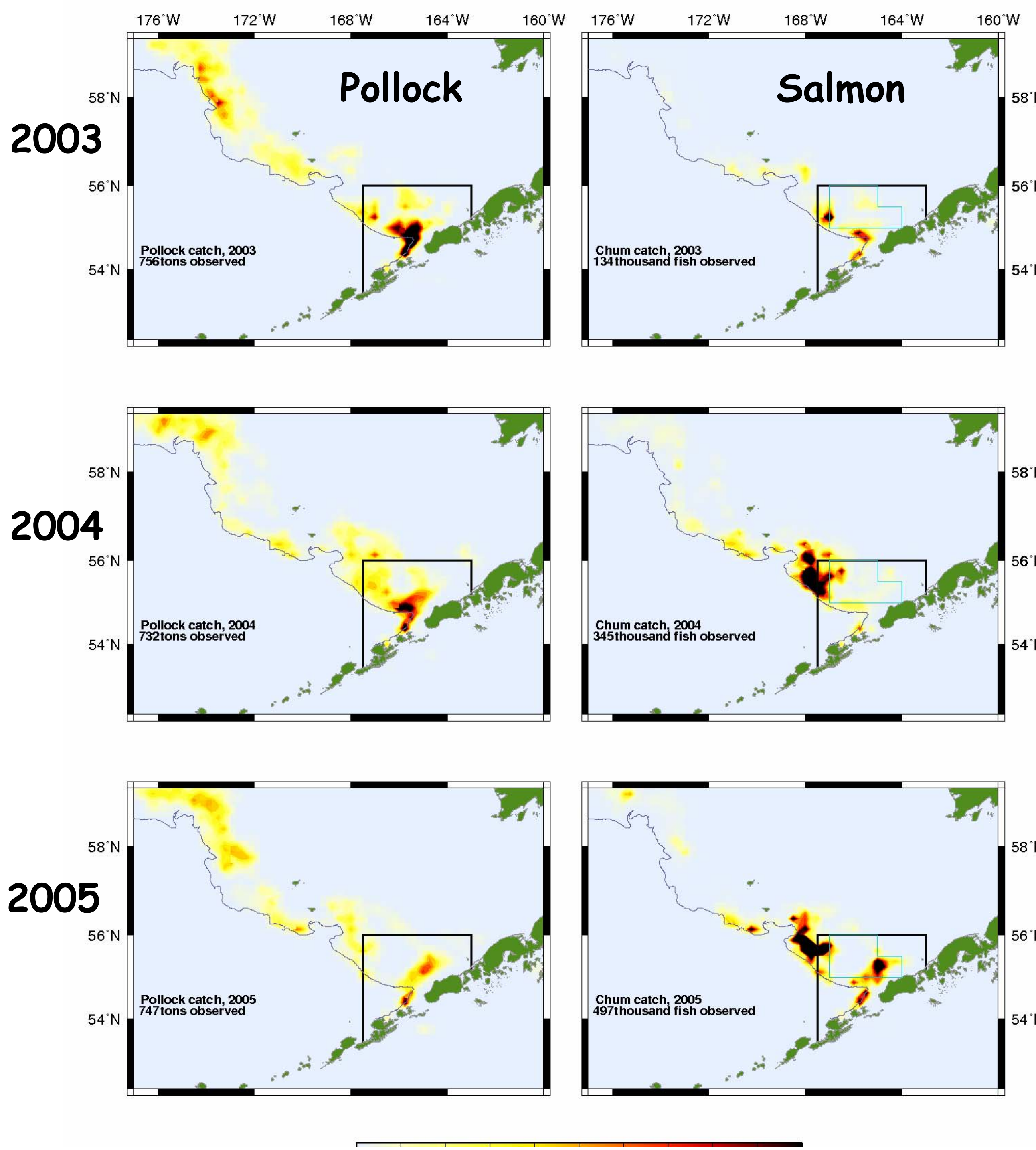


- ***Chum / kt of pollock variable can be higher inside CSSA***

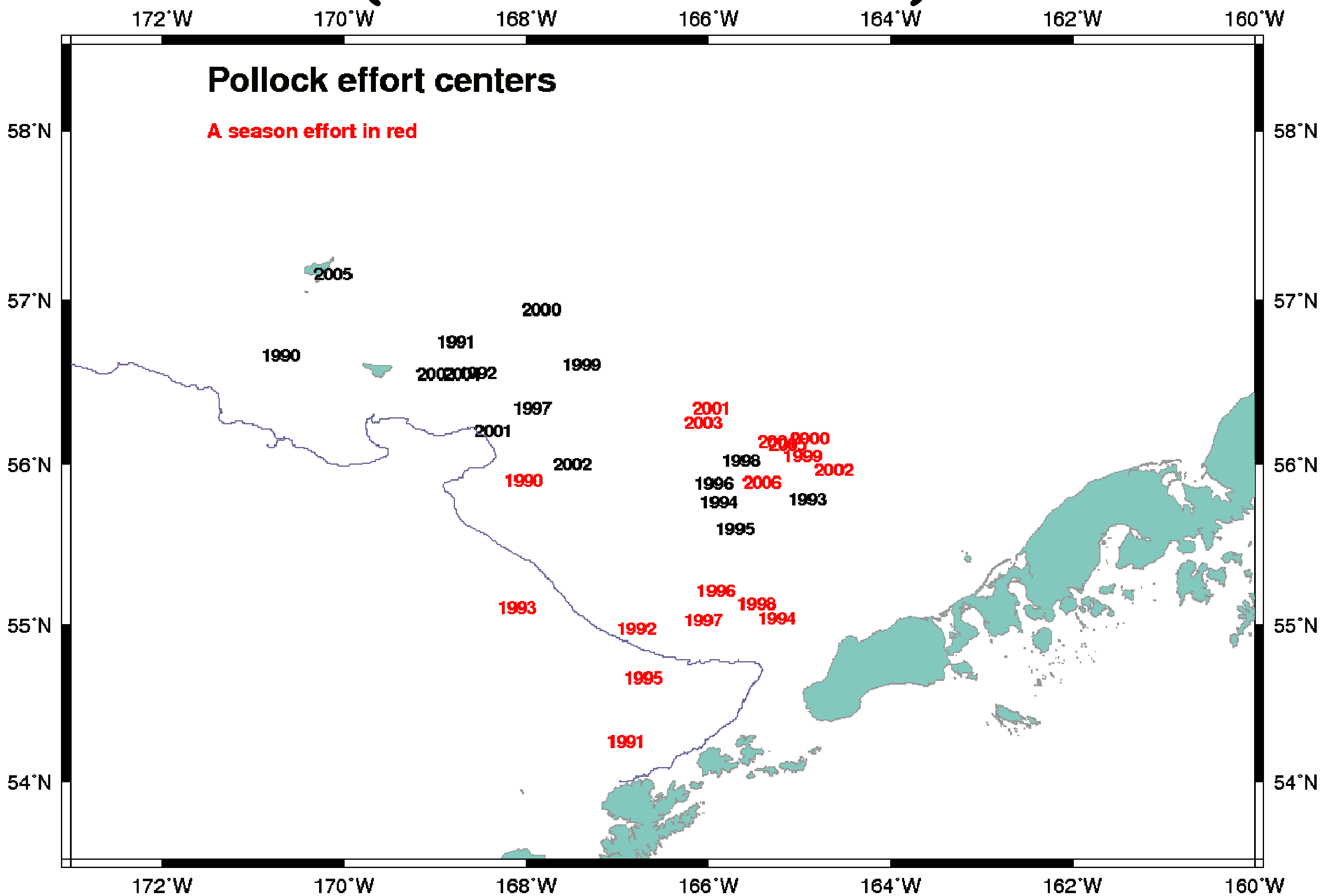
Pollock and chum B-season



Pollock and chum B-season



Centers of effort
(A and B seasons)

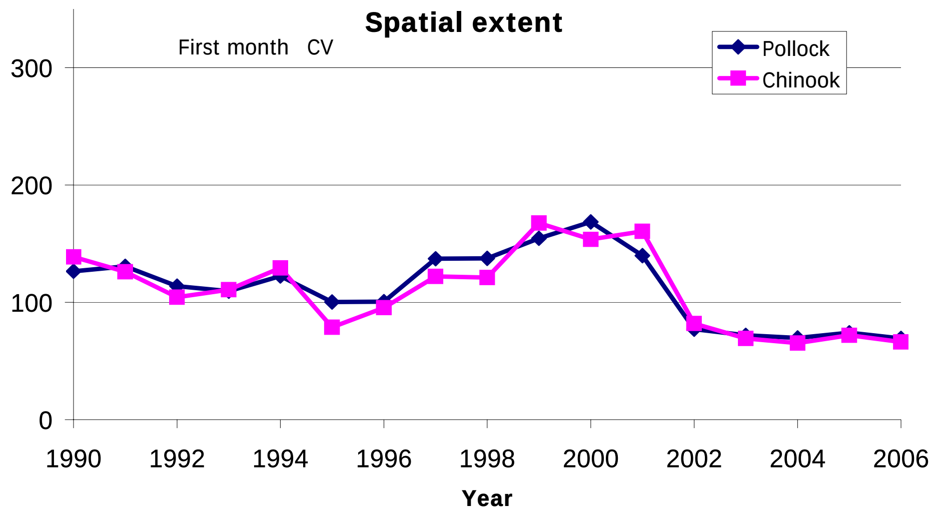


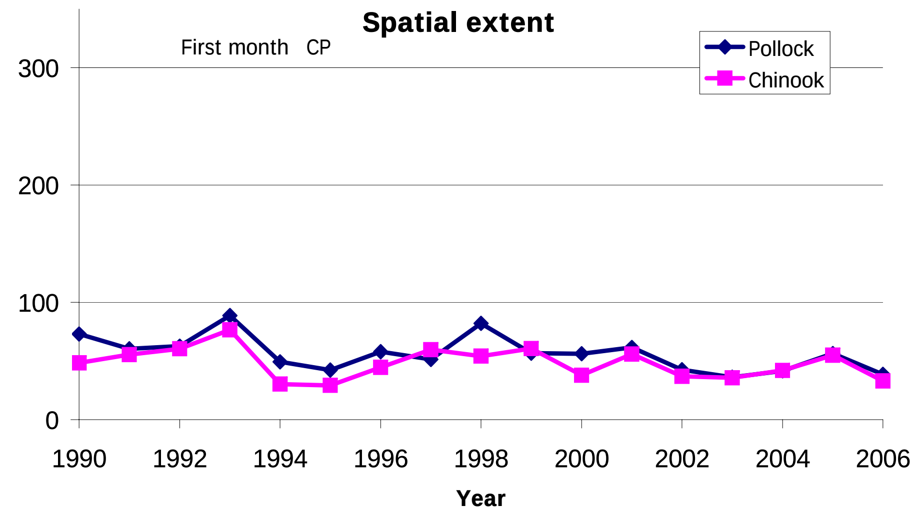
Fleet dispersion

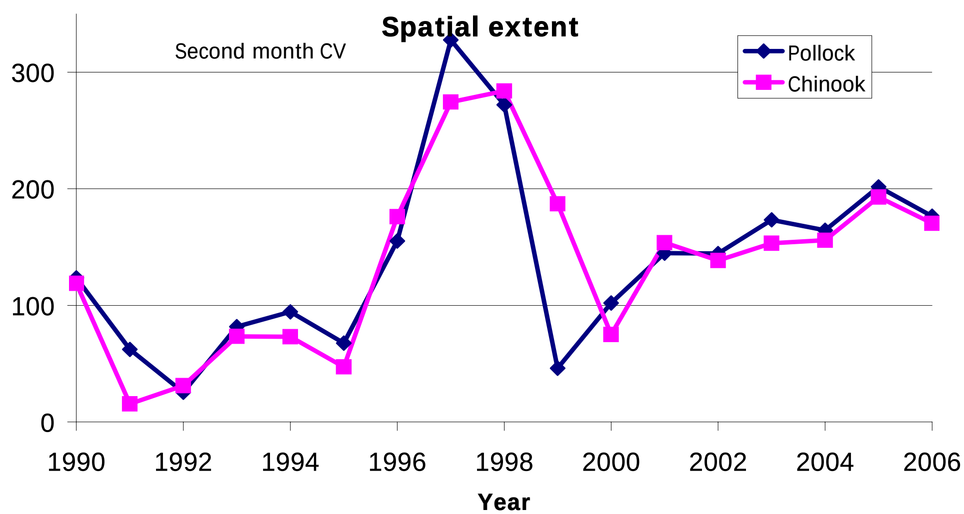
$$S = \frac{\sum_{i=1}^{n} D_i}{n}$$

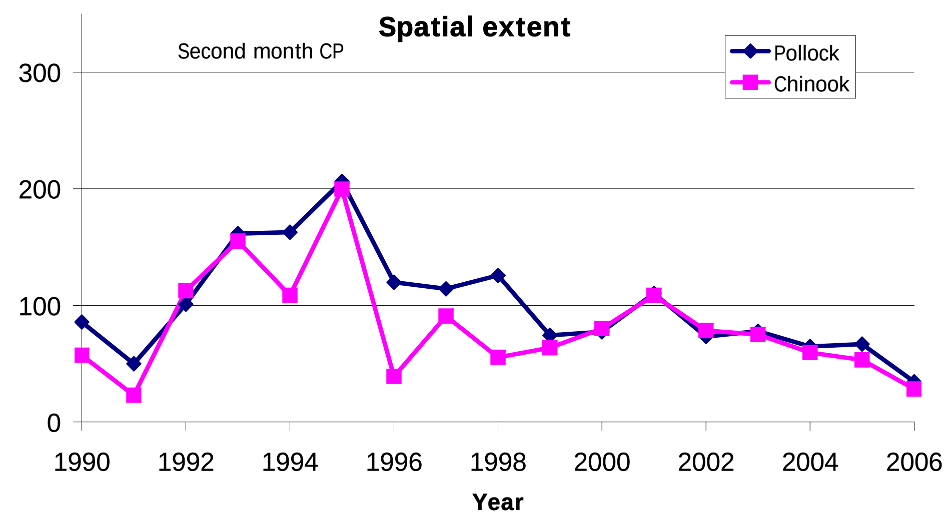
Catcher vessels

Catcher processors

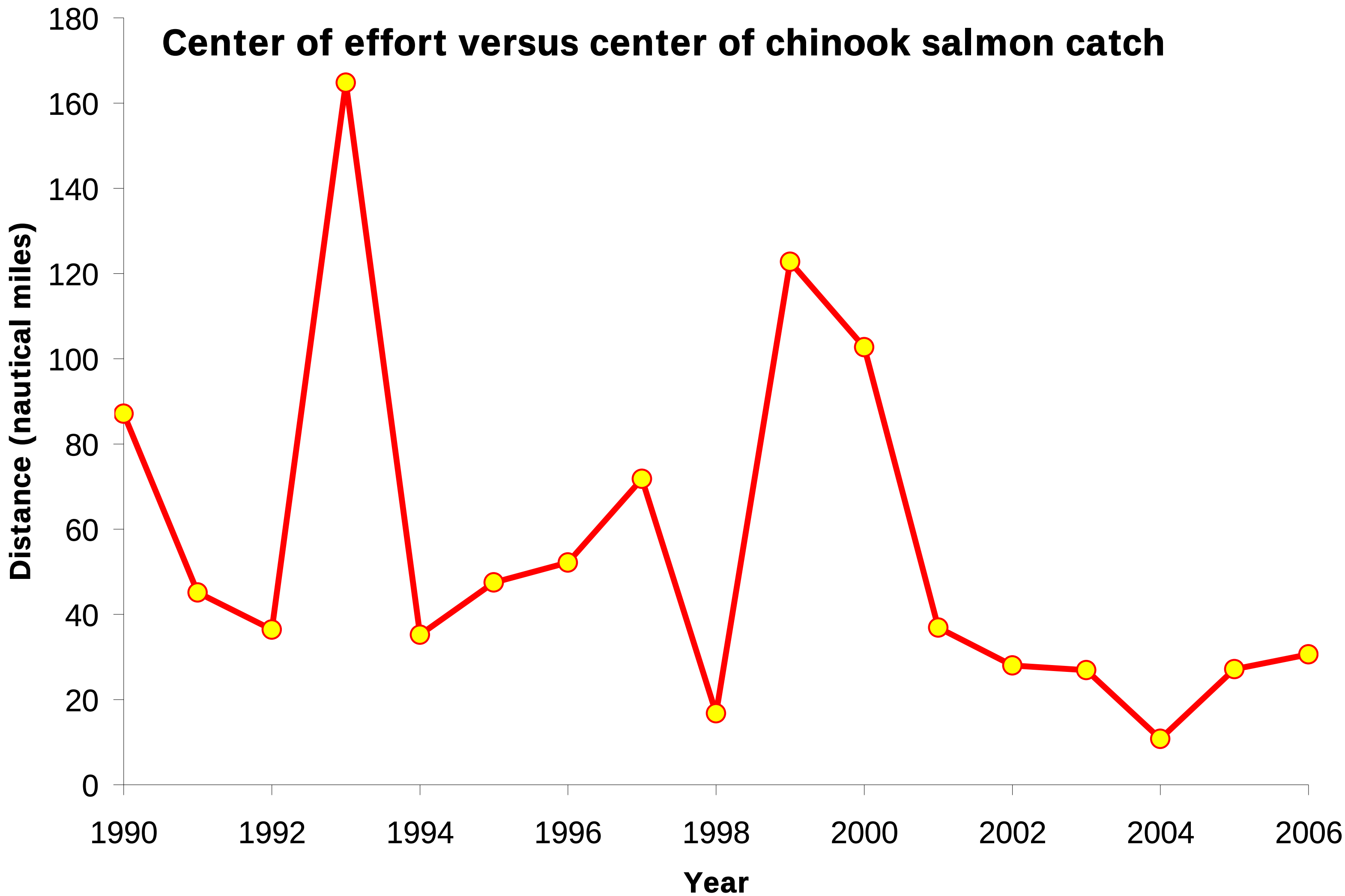








Center of mass…



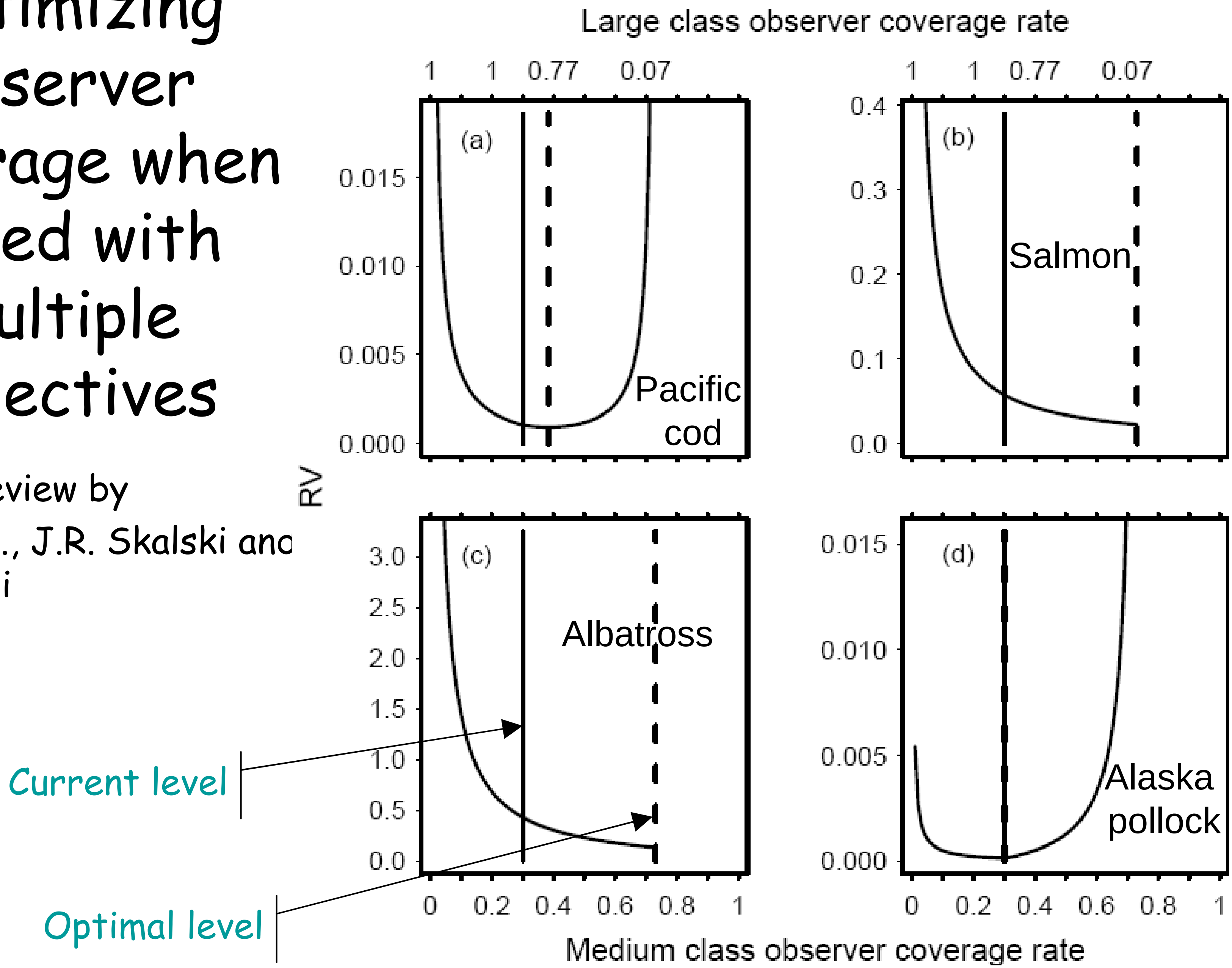
Optimal observer coverage

- Extending to other applications…
- Shuffling existing observer levels

Optimizing observer coverage when faced with multiple objectives

Paper in review by

Miller, T.J., J.R. Skalski and J.N. Ianelli



Conclusions

- Vessel selection bias possible to operator behavior
  - But very unlikely
- Pollock fishery patterns are variable
  - But show little trend related to salmon bycatch rates
  - Some diurnal patterns are evident
  - Spatial patterns of salmon bycatch difficult to predict