

Exhibit E.1.a
Attachment 2
June 2005

**Recommendations for U.S. West Coast
Highly Migratory Species Observer Programs
with Options for Levels of Significance**

Final Report

Prepared by

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DEFINITIONS OF TERMS

Bycatch

Fish and sea turtles, that are caught in a fishery but not sold or kept for personal use, including economic and regulatory discards.

Incidental Catch

Species caught and retained while fishing for the primary purpose of catching a different species.

Note, this differs from bycatch which are discarded at sea.

Incidental Take

The take of marine mammals or seabirds during fishing operations.

Target Species/Fish

Species that are specifically fished for catch and retention.

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EXECUTIVE SUMMARY

This project was commissioned pursuant to the Pacific Fisheries Management Council's development of the Fishery Management Plan for U.S. west coast fisheries targeting highly migratory fish species (HMS). Based on the FMP, observer programs are necessary for the coastal purse seine, pelagic longline, albacore troll, charter/party recreational and private recreational fleets to assess bycatch characteristics in these HMS fishery sectors. Bycatch has not been well investigated in west coast based HMS fisheries, and it is important that this component of fishing mortality be incorporated into future HMS management. The proposed programs were developed to provide statistically reliable indices of bycatch that will assist fisheries managers to select observation levels based on expected costs in west coast based HMS fisheries.

General observer program guidelines, including protocols for program funding and management, observer training and assignment, vessel selection and database administration are provided for application across all five recommended programs. Within each HMS program description, geographic, economic and biological factors relevant to further program development and implementation are reviewed and evaluated. Specifically the five observer program designs presented herein were developed to provide the fishery managers with detailed evaluations of the following elements:

- The number of species likely to be encountered as a function of various coverage levels.
- Program costs based on number of observation days/trips as a function of selected levels of fishing effort coverage.
- Recommended coverage levels based on cost versus statistical reliability considerations.
- Observer coverage relative to total fleet effort and fishery specific characteristics.
- Stratification of observer coverage proportional to fleet effort across five factors including port, vessel class, fishing area, season, and fishing gear.
- Alternative observation techniques for small, private recreational vessels.

The primary goal of the observer programs will be to produce, in a timely manner, HMS fishery based data needed to produce initial estimates of bycatch levels in these HMS fisheries. The designs proposed in this plan will also allow for a thorough assessment of bycatch data variability as a function of vessel characteristics or geographic areas fished and, if necessary, amendments to proposed coverage stratification designs can be undertaken. In addition to these initial goals, the observer programs should substantially increase the accuracy and quantity of HMS fisheries data, allowing for improved effectiveness in estimating total HMS catch, developing harvesting guidelines, producing stock assessments, and providing other information critical to management decisions.

INTRODUCTION

During the last six-seven years, the Pacific Fisheries Management Council (PFMC) has developed a Fishery Management Plan (FMP) for U.S. west coast fisheries that pursue highly migratory species (HMS) of fishes including: billfish, tunas, sharks, and dorado. The Council's development team, charged with preparing the FMP, wished to ensure a smooth transition for the council and National Marine Fisheries Service (NMFS) into managing these fisheries with particular attention paid to bycatch. Therefore, the team co-chairs commissioned Hanan & Associates, Inc. to develop fishery observer programs for five of the six HMS fisheries included in the FMP: coastal purse seine, pelagic longline, surface hook and line/troll, and recreational fishing in both private and charter/party vessels. The sixth HMS fishery, the Oregon California shark swordfish drift gillnet fishery already has a functioning observer program in place under authority of the Marine Mammal Protection Act. For the preparation of these recommendations and report, we relied extensively on the fishery descriptions in the HMS FMP.

NMFS will likely administer these HMS observer programs by direct supervision or by contract for services in one or more of the programs. NMFS Southwest Region (SWR) has previously coordinated observer programs in the eastern tropical Pacific tuna fisheries, Oregon/California shark swordfish drift gillnet fishery, and the nearshore set net fisheries. Currently SWR contracts for observer coverage in the swordfish/shark drift gillnet fishery, places observers on some vessels in the west coast based pelagic longline fishery and HMS purse seine fishery with a few voluntary observations of the albacore troll fishery. Within the PFMC jurisdiction, NMFS Northwest Region administers an observer program in the groundfish trawl fisheries. Also in the Pacific, NMFS administers observer programs in the Hawaii swordfish/tuna longline fishery, the North Pacific/Bering Sea groundfish trawl and fixed gear fisheries, the Pacific whiting fishery, and in salmon fisheries off Alaska.

OBSERVER PROGRAMS SUMMARY

In the United States and other fishing countries, there are numerous fishery observer programs in

existence (Appendix A.). The U.S. programs are operated by the federal government under authority of the Magnuson-Stevens Fishery and Conservation Act of 1976. There are additional fishery observer programs operating under the authority of the Marine Mammal Protection Act of 1972 to monitor incidental take of marine mammals. Some individual states also have observation programs and substantial observer programs exist in Canada, other fishing countries, and by fisheries management agencies such as the Inter-American Tropical Tuna Commission, Secretariat Pacific Community, and International Commission for the Conservation of Atlantic Tunas. Most of these programs were initiated to address specific issues regarding bycatch of unwanted and discarded fish or incidental take of marine mammals, sea turtles, or sea birds. For comparison and reference, Appendix A presents a brief summary table of U.S., Canadian, and other international observer programs. The profiles for each observer program are presented, if available, along the following parameters: voluntary/mandatory, funding, observer provider, target species, bycatch, incidental take, active vessels, gear; effort, percentage of effort observed and number of observers.

ENCOUNTER/BYCATCH OVERVIEW AND LEVELS OF SIGNIFICANCE

Our proposed observer programs are designed to utilize species encounter rates determined from prior observer programs as a basis for choosing desired observer coverage rates. The expected number of target fish and bycatch observed according to varying levels of observer coverage are presented from three existing observer programs: the CA/OR shark/swordfish drift gill net fishery, the California and the Hawaii based longline fisheries, and the Atlantic longline fishery. We hope that these results will provide guidance for other observer programs and particularly for determining desired coverage rates for the five HMS observer programs addressed in this project.

Estimates of the number of species which would be observed given a particular coverage level were determined from fisheries data by first noting, for each trip, the presence or absence of a particular species in the logbook or observers' data. The estimated distribution of number of species encountered by observers at a given level of fishing effort observations was then

determined using a bootstrap re-sampling procedure that selected, with replacement, the specified sample fraction (coverage level) of trips from the existing database. The species encountered from each of the trips was recorded in a database and the results are displayed in graphical form below (Figures 1 – 30).

It should be noted that because the modeled observer programs did not use a consistent species identification protocol, different databases from similar fisheries (i.e. longline) could not be combined to increase sample sizes. Therefore, five separate databases represented the three fisheries modeled in this exercise. Specifically, the OR/CA drift gillnet (DGN) and Atlantic longline (ALL) observations were each represented by one database while the Pacific longline observations were divided among three separate databases (WCLL1, WCLL2, HALL).

In the first set of bootstrap analyses, the observed catch from each of the five databases was sampled until five thousand trips were simulated. Histograms of species “observed” in the re-sampling exercise are presented by coverage levels from 5 to 75 percent of fishing effort (in trips) observed (Figures 1-30). For example, the histogram generated for the Drift Gillnet 5% coverage plot (Figure 1), shows the distribution of the number of species identified by percentage of trips observed after 5,000 re-samples of the 1082 actual samples. The 10% coverage plot shows results for a simulated 108 observed trips of the 1082 total observed trips re-sampled 5,000 times (Figure 2).

The histograms of the re-sampled Drift Gillnet observer data illustrate a positive relationship between observer coverage levels and the total number of species observed (Figures 1-6). The proportion of the total number of catch and bycatch species identified ranges from 36 of 77 species (47%) at the 5% observer coverage level to 67 of 77 species (87%) at the 75% coverage level (Figures 1-6, Table 1). **The greatest improvement in the proportion of total species observed occurred between the 10% to 20% coverage levels with an incremental increase of 10 percent of the overall number of species.** If the fishery managers choose 20% observation/coverage level as the percentage of effort for a given observation program, they would expect to encounter/observe, on average, 51 of 77 total species (66%) encountered.

The three Pacific longline databases indicate similar positive relationships between observer coverage levels and the number of species observed (Figures 7-24, Table 1). In the west coast based longline fishery, the percentage of all species identified ranged from 19 of 34 species (56%) at the 5% observer coverage level, to 33 of 34 species (97%) at 75% coverage for the WCLL1 dataset. These results ranged from 18 of 28 species (64%) at the 5% observer coverage level, to 27 of 28 species (96%) at 75% coverage for the WCLL2 dataset (Table 1). In the Hawaii based longline fishery, the percentage of all species identified ranged from 31 of 40 species (78%) at the 5% observer coverage level, to 39 of 40 species (98%) at 75% coverage. **In all three Pacific longline datasets, the greatest improvement in the proportion of total species observed occurred between the 10% to 20% coverage levels with an incremental increase ranging from seven to 10 percent of the overall number of species.** If the fishery managers choose 20% observation/ coverage level as the percentage of effort for a given observation program, they would expect to encounter/observe, on average, 27 of 34 total species (79%) based on the WCLL1 database, 25 of 28 total species (89%) based on the WCLL2 database, and 36 of 40 total species (90%) based on the HALL database.

The Atlantic longline database also depicts the consistent positive relationship between observer coverage levels and the number of species observed (Figures 25-30, Table 1). The proportion of the total number of catch and bycatch species identified ranges from 61 of 110 species (55%) at the 5% observer coverage level, to 105 of 110 species (95%) at the 75% coverage level (Figures 25-30, Table 1). **The greatest improvement in the proportion of total species observed occurred between the 10% to 20% coverage levels with an incremental increase of 11 percent of the overall number of species.** If the fishery managers choose 20% observation/coverage level as the percentage of effort for a given observation program, they would expect to encounter on average 84 of 110 total species (76%) encountered.

These results (Figures 1 – 30) are summarized as rates of encounter curves, plotted as the cumulative number of species observed per total trips observed; they were generated based on a bootstrap procedure where catch data was sampled until two thousand trips were simulated.

These curves may be most useful to fisheries managers for choosing desired results based on selected levels of coverage and resultant observer costs because they are less detailed than Figures 1-30 and show overall cumulative results of the bootstrap estimates. The encounter curves generated for the drift gillnet and Pacific longline fisheries provide “reliable” estimates of catch and bycatch in terms of the 95% confidence levels and minimum and maximum values around a sample mean (Figures 31-35). The encounter curves illustrate a rapid and consistent increase in the number of species observed during the first portion of the sampling period and a gradual increase, reaching a near asymptote, during the second half of the sampling period. For example, the encounter curve generated from the drift gillnet database indicates that a majority (81%, $n = 66$) of the species identified during the sampling period were observed by the 500th survey (Figures 31, 32). Observations of new or previously unobserved species continued throughout the sampling period (1081 trips), although only 15 previously unobserved species (19%) were identified during the remaining 581 trips. The encounter curves generated for the Pacific databases indicate a similar pattern with a majority of species identified before 50% of the trips were completed (Figures 33, 34, 35). While the rate of increase in the number of new species declined during the latter portion of the sampling period, observations of novel species did continue throughout the monitoring phase.

These results indicate that rare species, those that appear in only a few of the trip records, will likely only be encountered when sample levels (coverage) are quite high. Catch rates relative to coverage levels indicate that more commonly encountered species will have lower CVs when compared to those species encountered infrequently. In order to reduce the CV for rarely encountered species, higher observation rates are necessary and, for some species, may approach 90-100 percent of the effort. Additionally, in fisheries with relatively low effort (i.e. HMS coastal purse seine), sampling rates may also have to approach the 90-100 percent level to get meaningful results (Bravington *et al.* 2003). This fact is particularly important if the fisheries monitoring objective is to estimate important parameters such as mortality rates. The objective of this project is to recommend pilot observer programs that will provide information necessary to determine the levels of observer coverage required to estimate parameters such as the encounter and mortality rates of protected species. If these species are encountered frequently,

then the coverage rates required to meet mandates will be lower than they will be if encounter rates are low. When the results from this pilot program are available, a detailed analysis examining the coefficients of variation (CV) for each species caught should be completed to evaluate and amend desired coverage levels (Bravington *et al.* 2003).

It should be noted that increases in the coverage rate beyond 20-30 percent result in smaller incremental improvements in the CV of estimates of catch per-unit effort (see Figures 1-30, Table 1). If financial or other constraints limit the feasible level of observer coverage, then the fact that the reliability of estimates of CPUE improve less rapidly with increasing coverage, once observer coverage rates of 20-30 percent are achieved and this should be considered in determining coverage rates (Lawson 2003).

RECOMMENDED OBSERVER PROGRAMS

These observer program plans are being presented to the Pacific Fishery Management Council's Highly Migratory Species Fishery Management Development Team. Several options for the development of each observer program are presented for Team and Council consideration. The programs are modeled on the West Coast Groundfish, California Set Net and Shark/Swordfish Drift Gillnet Observer Programs. Because NMFS has been observing some of the California-based longline vessels, IATTC has existing observer programs for west coast purse seine fisheries, NMFS has an existing logbook program for the albacore troll fishery, and the Marine Recreational Fisheries Statistics Survey (MRFSS) intercept program collects recreational data at the docks (and occasionally at sea), we recommend including or incorporating existing forms and manuals where possible and appropriate. This will ensure continuity of data collection and facilitate continuation of existing data bases.

PROGRAM GOALS

1. Identify and monitor bycatch in these fisheries.
2. Gather at-sea fishery specific data on fishing techniques and fishing effort necessary to estimate total bycatch by species.

3. Obtain data to be evaluated for prevention or potential mitigation of bycatch.
4. Provide fishery managers with current data required for meaningful and realistic management options.

PROGRAM OVERVIEW

To establish new programs or enhance existing programs, we are proposing:

- Observation levels based on expected detection rates of bycatch.
- Observer assignment regimes.
- Data collection protocols.

PROGRAM ADMINISTRATION

The recommended observer programs will be administered by NMFS. There are several organizational paradigms that could be implemented with NMFS oversight:

- Alternative 1. Establish a program supervised by NMFS and staffed by NMFS observers.
- Alternative 2. Establish a program utilizing contracts to the states of California, Oregon and Washington.
- Alternative 3. Establish a program utilizing the services of an outside contractor.
- Alternative 4. Establish a program in coordination with the IATTC.

PROGRAM FUNDING

- Alternative 1. Observers are chosen by vessel operators or fishery association, approved by NMFS, and all expenses paid by vessel operators.
- Alternative 2. Observers are NMFS or State employees and the observer program is funded respectively or shared.
- Alternative 3. Observers are supplied by a federal contractor through NMFS.

The dollar per day values used for estimating costs in the five proposed HMS observer programs are based on expenses incurred by the current West Coast Drift Gillnet Observer Program and the North Pacific Albacore Troll Observer Program. These two observer programs are administered by NMFS but operated through an outside contractor that charges NMFS for per

day observer costs. If the fishery managers select alternative 2 above, daily observer costs may be reduced as they use state or federal employees for fisheries monitoring and may be less expensive than utilizing the services of an outside contractor.

Among the five HMS fishery sectors in this program, only albacore surface hook and line and albacore CPFV vessels were distributed along the entire west coast. The remainder of the HMS fisheries assessed for this project had vessels whose principal ports were almost exclusively in Southern California (PFMC HMS FMP 2003 s2.3.4). This fact needs to be considered when assessing funding and/or management regimes for the proposed programs as the great majority of observers and support staff would be based in California and within the jurisdiction of NMFS SWR.

OBSERVER QUALIFICATIONS

Existing fisheries observer programs typically require that observers possess a bachelors degree in biology or related field, have a minimum amount sea time, can pass a full medical examination, have the ability to legibly record observations, and the ability to get along with people in confined living spaces for periods of up to one month.

OBSERVER TRAINING

In existing observer programs, a one- to two-week training course is typically required to prepare observers for at-sea monitoring. Topics generally include: fishery operations; fish, marine mammal, sea turtle, and sea bird identification; data collection methods and forms, first aid and emergency procedures, conflict resolution, and specific needs for the observer program.

Observers should be required to participate in annual refresher courses lasting about five days.

OBSERVER INSURANCE

The selected program administrator needs to provide adequate insurance for injury, liability, and accidental death for observers the entire employment period, during training, travel to and from port, at-sea, and during debriefing. The typical observer program insurance requirements include workers compensation and employer's liability; maritime employer's liability adequate to cover

observer, vessel owner and contractor; commercial general liability; maintenance, wages, and transportation; Longshore and Harbor Workers' Compensation Act; and automobile liability.

COMMUNICATIONS AND OUTREACH

The observer programs proposed under this plan should maintain toll free numbers, email, FAX, and a web page to afford constant free flow of schedules, vessel requirements, observer deployment, and rapid assimilation of data. Skipper workshops and/or newsletters will keep the fleet informed of observer program goals, progress, and provide periodic summaries of observer program findings.

OBSERVER ASSIGNMENT

- Alternative 1. Skipper determines when they will be fishing HMS and obtains an observer from a pre-approved group of observers.
- Alternative 2. Observers are assigned by NMFS or State supervisor based on sampling plan.
- Alternative 3. Observers are assigned by contractor based on sampling plan.

Note that Alternative 1 allows the skipper to simply pick an observer from a list. Experience in other observer programs indicates that this provides the opportunity for collusion in falsification or failure to record negative data. The assignment of observers should be independent of skipper/owner to ensure that any biases or opportunities for data falsification are minimized. Depending on the council's selection of a funding source, Alternatives 2 or 3 are recommended to the council and should be utilized pursuant to the specific HMS fishery observer program sampling design selected by the council.

VESSEL SELECTION

There is broad discretion when selecting a method of choosing the vessels to be observed. Three alternatives are presented here for Council /NMFS consideration.

- Alternative 1. Require that a predetermined percentage of each vessel's trips be observed with the skipper selecting those trips which will be monitored. The number of trips observed

would be based on the total estimated number of fleet trips and the representative number of trips each vessel must be observed in order to achieve the desired coverage.

- Alternative 2. Require that each fleet vessel have its first, second, or third, etc. trip observed according to random selection. Based on the desired level of observer coverage, the vessel would be allowed to fish a predetermined number of trips with no observer aboard until the next required observation trip. The captain would call to request an observer from the program administrator or from an approved list of observers. Documentation would be based on landing receipts.
- Alternative 3. The program administrator (NMFS, State, or contractor) will randomly select vessels from those not yet observed and assign observers to those vessels until the desired level of coverage for a given fishing season is achieved or maintained.

We do not recommend that Alternative 1 be used as it allows the biasing of results based on skipper decisions. The process of observing must keep science at the base and the skipper influence at a minimum. Similarly we do not recommend Alternative 2 as it also allows skippers to anticipate observers and to modify fishing practices based on observer coverage, which may also introduce a potential bias. Thus, Alternative 3 is recommended to the council as it provides a method with controls for bias and randomization to ensure statistically independent data.

If alternative 3 is selected, vessels will be selected randomly from the pool of vessels that have not been observed recently to assure coverage will cycle through all the vessels in an allotted period of time (time period will vary based on coverage level selected and specific fishery being monitored), and to prevent vessels from being drawn in consecutive periods. The initial vessel list will then be reduced so as to place observers on vessels representing a reasonably proportional distribution among strata and to eliminate those vessels that do not plan to fish in the next selection period. For example, an observer program might select 100 fishery vessels and send a written notification to them. The program will determine a vessels' intention to fish and their primary port, and subsequently select a subset of those vessels that represent a proportional coverage of a given strata. Vessel operators will be required to inform NMFS or the observer program 24 hours prior to leaving port for fishing, using a toll free number provided for

that purpose. Vessels that indicate they don't plan to fish in a selected time period will be placed into a holding category, and will be asked to notify NMFS when they next plan to fish so that they can potentially be assigned an observer during that period. Vessels that are selected but do not get an observer in the first period will carry over to the next period.

DATABASE ADMINISTRATION AND MAINTENANCE

Database administration and maintenance protocol for observer programs has recently been the subject of extensive review (Sea Watch 2000, NMFS 2001, 2004). Subsequently, revisions to existing observer program data protocol have been undertaken to address important database issues such as consistency in sampling methods and the reliability of field data. In the development of a database administration protocol for this project, recent workshop council recommendations should be employed and updated protocols from current observer programs modeled, wherever possible.

Observers will follow procedures for obtaining data and collecting samples specified during training and documented in the observer manual for each specific HMS fishery. The goal of at-sea monitoring will be to obtain detailed data on each set during a given fishing trip.

Documentation of bycatch and biological samples from bycatch will be the first sampling priority. Observers will also collect data on catch (species kept for sale), environmental/weather conditions, fishing operations, incidental catch, and any interactions with other fisheries or vessels. These data are intended to substantially augment the data provided from current sampling techniques such as logbooks, landing receipts and shore samples.

Observers will enter data onto paper forms and laptop computers. The observers will conduct preliminary edits of their data while they are at-sea. At the end of an observed trip, edited data will be provided to the program administrator for inclusion in HMS fisheries program data base.

Data collected by observers will include:

- Vessel characteristics
- Beginning and ending port
- Start time, end time and location of set
- Type of set (kelp paddies, floating object, other)

- Gear type and fishing strategy
- Environmental and weather conditions
- Length, weight and number of HMS fish retained by species
- Length, weight and number of bycatch, incidental catch and incidental take by species
- Condition of discard (alive, dead, damaged or injured)
- Reason for discard (size, condition, other)
- Biological samples from catch, bycatch, incidental catch, incidental take
- Landing location
- Landing receipt number

DATA FLOW

The eight steps of data processing that will be conducted prior to analyses are presented below. This data flow model is based on the West Coast Groundfish Observer Program 2001 observer coverage plan.

1. Data are collected at-sea by the observer following the protocols in the HMS fishery observer manuals to be developed.
2. Quality control (QC) of calculations and sampling methods.
 - a. A debriefing person or lead observer will check all computations made by the observer and review forms to ensure that they are complete and that appropriate sampling methods were used.
3. Observer debriefing.
 - a. Observers debrief after a set period per fishery. Debriefing will include:
 - i. Vessel Data – Observers will complete a vessel survey for each vessel that explains vessel set-up and basic sampling strategies (see NMFS 2004).
 - ii. Logbook Review – Observers will keep logbooks detailing the events of each trip, basic deck schematics, sampling method(s) used and communication logs. Any hauls during which sampling problems occurred will be documented in the logbook and reviewed during debriefing.
4. Data are entered into a database system.

- a. The West Coast Groundfish Observer Program has effectively utilized a web-based graphical user interface (GUI) to directly enter data into a centralized Oracle database maintained at the Northwest Fisheries Science Center. This database is accessible via the web-based GUI or by direct queries to the database. It is recommended that a similar system be utilized in the proposed observer programs.
5. Data will be checked and updated in database program.
 - a. Electronic data will be compared to raw data to check for keypunch errors.
6. Quality control queries will be conducted.
 - a. Queries will be run to detect data that fall outside specified ranges or other inconsistencies.
7. Data will be updated in the database system.
 - a. The raw data of all entries that are flagged by the QC queries will be reviewed and the electronic data will be updated.
8. Data will be released to analyst team.
 - a. Data will be considered complete, accurate and ready for statistical analyses.

OBSERVER COVERAGE LEVELS

The key to accurately monitoring bycatch in the proposed observer programs is to collect information over a wide range of conditions, use these data to calibrate statistical relationships, and then apply these relationships to all fishing effort within the sampled segment of a given fishery. Such an approach is tailored to the estimation of bycatch/discard of rare species. Early in the proposed observer programs, the statistical relationships will be relatively simple and it will be necessary to pool information across broad strata. As data accumulate, it will be possible to improve the estimates by including fine details on geographic, seasonal, target species, and other factors in the bycatch model.

The variability in fishing operations and geographic areas utilized within a given fishery fleet leads to differences in bycatch rates, levels and species. It is important to consider these issues when determining the appropriate levels of coverage and data collection methods and to

effectively assess bycatch in each HMS fishery sector. Specifically, the level of precision obtained from a given level of observer coverage depends upon two factors: 1) the number of time, area, environmental condition, and type of set categories that have different bycatch levels; and 2) the level of set-to-set and vessel-to-vessel variability in bycatch, incidental catch and incidental take within each category. The first factor creates the need for stratification of observer coverage across all ports and fishing strategies to cover the breadth of potential bycatch events. The second factor creates the need for a reasonably high level of coverage within each time, area and gear category. These are conflicting factors and we cannot know how they will balance out until we have accumulated substantial amounts of observer data (NMFS 2001).

Established observer programs typically determine observer coverage levels according to a stratification scheme that accounts for known variations in fishing effort and bycatch rates. Due to issues such as the selection of appropriate strata, accurate forecasting of strata effort and variations in species encounter rates, it is not feasible to develop such a model for programs in which little or no previous observer data exists. In order to avoid the possibility that a stratum that was initially expected to have very low bycatch (and therefore receiving low coverage) actually turns out to have high bycatch rates (but with high uncertainty, because of the low coverage), we have aimed for a design that guards against too much under-sampling in strata that might hold a surprise, while otherwise adhering to roughly proportional strata coverage (Bravington *et al.* 2003). To reduce sample variance and gather samples representative of the whole fishing fleet, we propose to observe a broad selection of fishing vessels within each fleet.

Thus, the survey designs presented for consideration here are intended to develop indices of bycatch rates and associated levels of precision among HMS fisheries that have had little or no observer coverage; they should not be considered “optimal” designs. Because pre-existing data are limited, because there are multiple species with different patterns of bycatch in space and time, and because there is likely to be inter-annual variability in local abundance, an “optimal” design is not feasible at this point; the possibilities for improved efficiency (i.e. equal precision for lower cost) can be considered once a few years of reliable data have been collected (Bravington *et al.* 2003).

While bootstrap data from the three fisheries analyzed for this project provide a general model for the determination of coverage levels necessary to detect rare species, the lack of extensive observer data from the five HMS fleets of interest implies that generalized target coverage rates may be appropriate (Lawson 2003). These generalized target coverage rates can be applied in the pilot observer programs, until sufficient bycatch data are available to amend coverage rates and reduce bias.

Observer coverage to sample desired levels of fishing effort is based on modeling exercises. The exercises used computer based re-sampling techniques of observer data from three fisheries to generate histograms of bycatch that might be observed at various levels of sampling. If we assume that bycatch in the five HMS fishery sectors occurs in frequencies similar to those exhibited in the modeling exercises, we can apply the models to predict the proportion of bycatch that would be detected using comparable levels of sampling effort. This information can be used to assist with choosing sampling levels that produce desired observation results given predicted program costs.

El Niño Southern Oscillation Events

Sea surface temperatures vary widely along the west coast, both seasonally and geographically. In contrast to the rest of the California coast, the warmest waters in Southern California usually border the coastline, while the cooler waters of the California Current remain offshore. In some years, the south-moving California Current is weakened, resulting in an anomalous northern poleward movement of water. As a result of this change in current strength, some of the warmer Equatorial Countercurrent flows northward into the northeastern Pacific Ocean. The water temperatures off the north American west coast are then several degrees above normal. These occurrences, referred to as El Niño - Southern Oscillation events (ENSO), do not occur yearly, but have been documented in 1911-1912, 1917, 1925, 1932, 1939-1942, 1953, 1957-1958, 1965, 1976-1977, 1982-1983, 1991-1992 and 1997-1998 (Dailey *et al.* 1993). During ENSO events, the range of tropical HMS is extended further northward into the U.S. EEZ, resulting in

increased opportunistic HMS fishing effort in both the recreational and commercial sectors. The proposed coverage levels for the HMS fisheries in this program are based on effort and/or catch rates from databases that, in many cases, do not cover ENSO events and/or do not provide specific ENSO event fisheries data. Therefore, it should be noted that during future ENSO years, it is likely that there will be increased effort among HMS commercial and recreational fishery sectors and these projected increases need to be considered when planning and allocating funds for HMS observer programs. Observer program managers should regularly consult with the National Weather Service to determine the likelihood of ENSO events in upcoming fishing years allowing for adjustments in the levels and stratification of observer coverage, as appropriate.

Fisheries Monitoring Techniques

In addition to at-sea observer monitoring of fishing vessels, there are several other techniques that can be used to provide supplemental data on catch, bycatch and incidental catch. These procedures include the use of daily logbooks, landing receipts and shore-side observers. The HMS fisheries in this program currently incorporate one or more of the monitoring methods outlined below.

Logbooks

As stated in section 5.5.2 of the PFMC HMS FMP, each commercial fishery sector and the CPFV fishery will be required to maintain and submit to the Regional Administrator logbooks that document daily fishing effort, gear used, catch by species and disposition of catch (retained, released alive, released injured, released dead). The HMS fisheries in this program have the following logbook requirements:

1. Coastal Purse Seine – IATTC tuna purse seine logbook
2. Pelagic Longline – NMFS Logbook for High Seas Pelagic Longline
3. Albacore Troll – NMFS U.S. Pacific Albacore Logbook
4. Party/Charter Boats – Southern California and Northern California CFPV
5. Private Recreational Vessels – None

Logbooks provide the advantage that a large amount of fisheries data can be obtained at little

cost to the government or fishers. The disadvantages are that there is little incentive for the fishery to accurately and completely record information and the fishermen may not be able to accurately identify all bycatch and incidental catch. Logbooks alone may not provide reliable data for estimating bycatch, but they can provide information about total fleet effort (a component of estimating total catch and bycatch) and allow for comparisons between reported and observed bycatch levels. Logbook records can be checked against the observers' data records to determine if there are any consistent biases in logbooks that need to be assessed and corrected. Currently, some logbooks only list those fish species landed and discarded; the condition of discarded fish is not noted. Listing the condition (alive, dead or injured) of fish in logbooks is essential to fulfilling requirements of Magnuson-Stevens for determining bycatch mortality (PFMC HMS FMP 2003 s5.5.2).

Landings Receipts

Landings receipts generally record and report amount of fish by species in the landing, gear used, the price paid per pound for the fish sold and in some cases the areas fished. The advantages of landings receipts are that they are tax documents, which fishermen are familiar with and appear to be comfortable with the receipt process, and they appear to provide a generally reliable account of landings. The disadvantages are that bycatch are not recorded or reported, that area of fishing is generally not going to be accurate for trips that covered more than one statistical area and that species composition of mixed landings may not be accurately reported (PFMC HMS FMP 2003 s5.5).

Shoreside Samplers

Shoreside samplers and interviewers have been used to refine estimates of catch and bycatch through inspections of landings and questions of anglers regarding details of their trip and catch. Records collected by shoreline sampling and interviews will ensure more accurate species identification of landed species. When viewed in conjunction with observers' records, as well as, landing and/or logbook records of similar vessels and gear types that carry observers, shore based methods can be used to confirm logbook records of catch and discards that were not directly monitored. Port samplers can also question the captain or crew to determine if there were any unusual conditions on the trip or if there were substantial discards and, if so, of what

species. Interview information can be especially useful while reviewing a logbook for completeness and accuracy.

The review of fisheries monitoring techniques above is intended to demonstrate that **while some data on HMS fisheries bycatch can be collected through logbooks, landings receipts and shoreside samplers, at-seas observers are the most reliable method to determine total catch and disposition of catch.** Observers can accurately report catch, effort and operational conditions as well as, they can be relied on for more complete and accurate species identification data and can take and record biological samples that could not be reasonably expected of the crew. In the following sections, options for expanding the monitoring of bycatch in HMS fisheries using at-sea observers are presented and other potential methods of obtaining estimates of bycatch and catch information.

Pacific Coastal Purse Seine Fishery

The California Coastal Purse Seine Fishery has a fleet of about 70 vessels that primarily operate out of San Pedro, California. The Southern California HMS Purse Seine fishery typically occurs from May through October with individual vessels making a series of one-day trips during the season. Purse seiners typically harvest small schooling pelagic fish (Pacific sardine, northern anchovy, and Pacific mackerel); however, when tuna become available, as many as 15 of these fishing vessels will fish for bluefin, yellowfin and albacore tuna. In some years, landings of bluefin and albacore have been made by purse seiners in Oregon, but this is not a significant fishery and the number of fishing vessels participating is small. There is no appreciable tuna seining off Washington.

Coastal seiners fishing for bluefin tuna usually set on free-swimming fish and thus encounter little bycatch (PFMC HMS FMP 2003 s5.3.6). If sets are conducted while fish are working a bait ball, other species of tuna along with some sharks might be taken, but bycatch is probably limited to blue shark because other sharks (mako and thresher) and tunas are marketable. Some vessels set on floating objects (usually kelp paddies), and this likely results in some bycatch as

anecdotal information suggests that yellowtail, dorado and sunfish are often with the yellowfin and skipjack tuna observed around kelp paddies. Under California law, the yellowtail would have to be discarded since it is illegal to land this fish with purse seine gear. Observations of this fishery have been limited and there are little or no data quantifying catches or discard of small or damaged tunas and other fish. This program would allow collection of bycatch by species, size, condition and number caught. Interactions with other fisheries and fishing activities would also be documented.

Atlantic Menhaden Purse Seine

A NMFS-funded study conducted a profile of shark bycatch in the menhaden purse seine fishery. Sharks were caught incidentally in approximately 30 percent of the purse seine sets. Blacktip sharks were the numerically dominant species. An estimated 30,000 sharks are taken in this fishery annually (deSilva *et al.* 2000). Industry workers in this fishery employ a fish excluder device to reduce the retention of sharks and other large species (Rester and Condrey 1999). These devices vary in effectiveness and no standards exist for such bycatch reduction measures in this fishery. In addition, there are currently no reporting requirements for takes of sharks in the menhaden purse seine fishery (NMFS 2002).

Atlantic Tuna Purse Seine

Observer program data collected in 1996 indicated minimal interaction with demersal species. In an effort to gather information on the interaction of tuna purse seine gear with demersal species, and to allow the purse seine fleet to utilize their allocated quota of bluefin tuna as well as avoid conflicts with other gear types, NMFS issued Experimental Fishing Permits to the purse seine fleet and placed observers on the vessels. This allowed the purse seine vessels to fish in the closed area and successfully prosecute the tuna fishery, and provided NMFS with additional data on purse seine operations and gear interactions. Only five observed purse seine sets were made in the closed areas during the 2000 fishing season, and there was no bycatch of groundfish reported on these sets (NMFS 2002).

Program Costs/Coverage Levels

The estimated daily cost for observers in this HMS fishery sector is derived from the \$500 per day incurred by the current California based pelagic longline observer program. Based on this rate approximation, annual program costs relative to various coverage levels coverage and the associated number of species observed were projected (Table 2). The estimated program expenses range from \$500 at the 5% observer coverage level to \$10,500 at 100% coverage. If the fishery managers choose the recommended 100% observation/coverage level as the percentage of effort for this observation program, the annual cost estimate is \$10,500.

Recommended Coverage Level

Several potential levels of observer coverage with the associated costs and the percentage of total species that may be observed are presented for the council's review. The selection of an appropriate coverage level is invariably linked to finding a suitable balance between cost efficiency and sample size requirements. Because this fishery is comprised of less than 15 vessels that conduct a limited number of annual HMS trips, small sample sizes are inherent, even with high levels of coverage. To obtain the largest possible sample from this limited data pool, and to reduce the large sample variance associated with small sample sizes, we recommend that the council select the 100% observation/coverage level. The selection of the 100% coverage level will ensure comprehensive monitoring of this HMS fishery at relatively low cost to NMFS.

Observer Placement and Coverage

The logistics of observer placement within the Southern California HMS purse seine fishery are simplified by its small fleet, seasonal nature, short trip duration and use primarily of one port.

Number of Observers

The number of observers required to conduct monitoring of the Southern California HMS Purse Seine fishery ranges from one at the 5% coverage level to four at the 100% coverage level (Table 2). If the fishery managers choose the recommended 100% observation/coverage level as the percentage of effort for this observation program, we estimate that four observers will be required to cover approximately the 21 sea days occurring across 21 trips (1 day per trip)

annually. This estimate is based on the average number of HMS purse seine landings reported in the PacFIN data base during the years: 2001 (42 landings), 2002 (10 landings), and 2003 (12 landings). Each observer in the program would typically participate in 10-11 trips per year. Due to the very limited number of potential monitoring opportunities, observers for this fishery sector will need to be cross-trained to conduct monitoring activities in other HMS sectors based out of Southern California such as the pelagic longline fishery.

Stratification of Observer Coverage

Development of an observer coverage stratification scheme was based on balancing the desire to cover the breadth of all potential bycatch events with the need for a reasonably high level of coverage within each time, area and gear category. Potential differences in bycatch characteristics relative to port, vessel class, fishing area, fishing season and fishing gear were examined to determine which, if any, of these factors could be stratified. Based on the specific characteristics of the Southern California HMS purse seine fleet, we developed an observer coverage stratification model that provides the recommended percentage of observer coverage allocated to each stratified factor (Figure 36). Details on the number of days and trips allotted to the levels of each stratified factor are also provided for the recommended 100% observation/coverage level. Specific details on our assessment of these five factors are provided below.

Port Stratification

No port stratification of this HMS fishery sector is necessary. Observers should be based out San Pedro, California where 95% and 97% of the catch from this fishery was landed in 2002 and 2003, respectively (Table 3). If tuna are available and seining opportunities develop northward, observers may be sent to monitor vessels departing from Central and Northern California ports.

Vessel Class Stratification

Vessel class is not a factor that we believe needs to be stratified for this observer program. Because this HMS fishery sector is comprised of less than 15 vessels that conduct only a small number of annual trips, small sample sizes are inherent. If the council selects less than 100% coverage of this fishery, stratification according to vessel class could further limit sample sizes

and potentially increase variability. If post-hoc analyses of pilot program data indicate any variability in catch or bycatch characteristics as a function of vessel class, refinements to the proposed vessel stratification design will be undertaken.

Fishing Area Stratification

Fishing area is not a factor that we believe needs to be stratified for this observer program. Because this fleet covers a limited geographic range on one-day trips from San Pedro, fishing activities tend to be focused within nearshore waters of the southern California bight (SCB). It will be assumed for this pilot program that no biologically important differences in bycatch and catch species and/or levels exist at the locations fished by different vessels. If pilot program data indicates fishing area variation in bycatch, necessary amendments to this model will be made.

Seasonal Stratification

If the council selects less than 100% coverage, it is recommended that observer trips be stratified within the fishing season, to the greatest extent possible, according to two periods: 1) May-July, 2) August-October (Figure 36). This seasonal stratification scheme will allow for monitoring of this fishery sector from spring through fall, which will be useful in detecting any shifts in catch and bycatch species and/or levels that may occur during the season. In practice, if a total of 21 trips occurred, and a level of 50% coverage was selected, an attempt would be made to place observers on five trips during each of the two time periods; if a level of 25% coverage was selected, an attempt would be made to place observers on two or three trips during each of the two time periods, etc.

Fishing Gear Stratification

Fishing gear is not a factor that we believe needs to be stratified for this observer program. Coastal purse seine gear utilized in this fishery is generally of similar mesh size and composition. Although preferences of individual fishermen for particular gear configurations may lead to some variability in bycatch and catch species levels, a thorough analysis of the influence of individual gear styles is not currently possible. Pilot program data will allow for a detailed assessment of the purse seine gear used by different vessels in this fleet and any associated bycatch differences.

Data Collection

To facilitate data collection and ensure continuity with existing or previous programs, we recommend adopting the Inter-American Tropical Tuna Commission observer field manual and using data sheets from the existing IATTC purse seine observer program.

Pelagic Longline Fishery

The Pelagic Longline Fishery is composed of vessels from the west coast and Hawaii that fish the high seas for swordfish and tuna (PFMC HMS FMP 2003 s2.2.5). California law prohibits pelagic longlining within the 200 mile EEZ, but longline vessels may fish the high seas and land at California ports. The catch of the west coast based pelagic longline fishery is almost entirely landed at California ports, where fish are sold “fresh” to wholesale dealers. In 2003, there were 22 vessels active in the California based longline fishery that participated in a total of 80 trips (Ito *et al.* 2004). While few data are available on bycatch for the California based longline fishery, experimental fishing, logbooks and limited observations suggest that blue sharks, mako sharks, sea turtles, and pelagic stingrays are the primary bycatch species in this fishery. There has been some observer coverage of longline fishing out of west coast ports, although longline vessels that initiate their trips in Hawaii often do have fisheries observers aboard. Observer data from the Hawaii program indicates the total fish bycatch rate in the California-Hawaii-based longline fishery was 21% in 2003, with blue shark comprising 67% of this total. Tunas were the second largest component of bycatch at 18%, followed by billfish at 5% (Ito *et al.* 2004). Based on observations in the Central and Western Pacific, it is certain than there would be significant bycatch in the longline fishery, but there are limited data to estimate what levels and species composition would be for vessels fishing out of the west coast ports (PFMC HMS FMP 2003 s5.5.1.3). Differences in oceanic temperatures, temperature fronts, and currents between areas fished by western Pacific vessels and areas fished by west coast vessels suggests that catch and catch rates by species in waters close to the west coast would differ from those farther west. Therefore, observer data are needed to generate initial estimates of bycatch for west coast vessels that will serve as the foundation for long-term monitoring of this fishery.

Program Costs/Coverage Levels

The estimated daily cost for observers in this HMS fishery sector is derived from the \$500 per day incurred by the current California based pelagic longline observer program. Based on this rate approximation, annual program costs relative to various coverage levels and the associated number of species observed were projected (Table 4). The estimated program expenses range from \$74,000 at the 5% observer coverage level to \$1,480,000 at 100% coverage. If the fishery managers choose 20% observation/coverage level as the percentage of effort for this observation program, the annual cost estimate is \$296,000.

Recommended Coverage Level

Several potential levels of observer coverage for the California based pelagic longline fishery with the associated costs as well as the percentage of total species that may be observed in similar fisheries have been presented for the council's review. To obtain the largest possible sample within a reasonable range of cost, we recommend that the council select the 20% observation/coverage level. Expanding coverage to the recommended 20% level from the current 10% level is important for obtaining reasonable bycatch samples as demonstrated by the modeled longline fisheries where the greatest improvement in the proportion of total species observed occurred between the 10% to 20% coverage levels (see Table 1). The statistical reliability of incidental take estimates, as measured by the CV, is considerably improved when coverage levels are extended from 10% to 20% (Barlow 1999). Expansion of current coverage levels are also important because this fishery is comprised of less than 25 vessels that conduct a limited number of annual trips, and relatively small sample sizes are expected, even with higher levels of coverage. **In summary, to obtain the largest possible sample from this limited data pool, and to reduce the large sample variance that can result from small sample sizes, we recommend that the council select the 20% coverage level.**

Observer Placement and Coverage

Similar to the HMS Coastal Purse Seine Fishery, logistics of observer placement for the

California based longline fishery are simplified by its small fleet and primary use of one port.

Number of Observers

The number of observers required to conduct monitoring of this HMS fishery sector ranges from two at the 5% coverage level to 40 at the 100% coverage level (Table 4). If the fishery managers choose the recommended 20% observation/coverage level as the percentage of effort for this observation program, we estimate that eight observers will be required to cover approximately 590 seas days occurring across 16 trips (37 days per trip on average). Each observer in the program will typically participate in two trips per year.

Stratification of Observer Coverage

Development of an observer coverage stratification scheme was based on balancing the desire to cover the breadth of all potential bycatch events with the need for a reasonably high level of coverage within each time, area and gear category. Potential differences in bycatch characteristics relative to port, vessel class, fishing area, fishing season and fishing gear were examined to determine which, if any, of these factors could be stratified. Based on the specific characteristics of the California based longline fleet, we developed an observer coverage stratification model that provides the recommended percentage of observer coverage allocated to each stratified factor (Figure 37). Information on the number of days and trips allotted to levels of each stratified factor are provided for the recommended 20% observation/coverage level. Details on our assessment of these five factors are provided below.

Port Stratification

No port stratification of this HMS fishery sector is necessary. Observers will be based out San Pedro, California where the great majority of the catch from this fishery was landed from 2001 – 2003 (Table 5), and approximately 90 percent of the fleet is based.

Vessel Class Stratification

Vessel class is not a factor that we believe needs to be stratified for this pilot observer program. Because this HMS fishery sector fleet is currently comprised of only 22 vessels and each conducts relatively long trips (30-45 days), small sample sizes of the number of vessels observed are inherent. If the council selects less than 100 percent coverage of this fishery, any possible

stratification according to vessel class could further limit sample sizes and potentially increase variability. If post-hoc analyses of program data indicate any variability in catch or bycatch characteristics as a function of vessel class, refinements to the current design will be undertaken.

Fishing Area Stratification

Fishing area is not a factor that we believe needs to be stratified for this observer program. While California based longline vessels fish over a large geographic area, current data does not allow for an assessment of vessel-based differences in bycatch composition and levels relative to areas fished. Because vessels may not leave port with a particular geographic area targeted, the stratification of fishing area will need to be assessed through post-hoc analyses.

Seasonal Stratification

The pelagic longline fishery typically conducts operations during fall and winter months over a large geographic area. To ensure an even distribution of observations throughout the fishing season and because observer coverage levels may be set at less than 100%, it is recommended that observer trips be stratified, to the greatest extent possible, according to two seasonal periods: 1) September – October, and 2) November – December (Figure 37). This seasonal stratification scheme will be useful in detecting any seasonal shifts in catch and bycatch species and/or levels that may occur during the active fishing period. It will also ensure that observation effort not be concentrated in any particular portion of the fishing season. For example: if a total of 1000 trips occurred, and a level of 20% coverage was selected an attempt would be made to place observers on 100 trips during each of the two time periods; if a level of 10% coverage was selected, an attempt would be made to place observers on 50 trips during each of the two time periods, etc.

Fishing Gear Stratification

Fishing gear is not a factor that we believe needs to be stratified for this observer program. Although preferences of individual fishermen for particular longline gear configurations may lead to some variability in bycatch and catch species levels, a thorough analysis of the influence of individual longline styles is not currently possible. Additional observer program data will allow for a detailed assessment of the longline gear used by different vessels in this fleet and any associated variance in bycatch characteristics.

Data Collection

To ensure continuity with the existing California based longline and Hawaii based longline observer programs, we recommend utilizing the NMFS Hawaii Pelagic Longline Observer Program's Observer Field Manual and associated data collection forms.

Albacore Surface Hook-and-Line Fishery

The Albacore Surface Hook-and-Line Fishery is comprised of vessels that troll for albacore tuna using jigs, and occasionally live bait (PFMC HMS FMP 2003 s2.2.1). The west coast based troll fleet is composed of approximately 800 vessels ranging from 16 feet to 100 feet in length, with most measuring 25 feet or greater. The albacore troll fishery operates across the North Pacific and along the U.S. west coast both inside and outside of the EEZ. The majority of vessels fishing outside the EEZ are 50 feet or greater in length, whereas both large and small (<50 feet) vessels troll inside the EEZ. Small, coastal "ice boats" usually make nine to 15 day trips, whereas larger freezer ships are typically at sea for 25 days or more. During the 2002 North Pacific Albacore troll season, a total of 670 U.S. vessels conducted 2361 fishing trips that accounted for 20,662 fishing days with 302 of those trips documented in logbooks (Childers 2003).

Although few data are available on bycatch for this fishery, logbooks and scant observer data suggest that bycatch consists of skipjack tuna, bluefin tuna, dorado, and billfish (PFMC HMS FMP 2003 s5.3.2). The observer data for this fishery comes from an extremely restricted voluntary observer program run by NMFS (27 trips in 8 years) in which not all observers collected data on bycatch, and observer placement was not conducted in a systematic manner. Thus, a complete analysis of bycatch for this fishery has not been possible. The proposed program would allow for the first comprehensive assessment of bycatch in this fishery through an analysis of bycatch species, size, condition and quantity.

Program Costs/Coverage Levels

The estimated daily cost for observers in this HMS fishery sector is derived from a combination of the \$500 cost per day incurred by the current California based pelagic longline observer program and the \$1200 cost per travel day incurred by the current west coast based drift gillnet observer program. Because the albacore fishery is based along the entire west coast, observer travel, hotel, per diem and associated logistics will increase expenses on days when observer are in transit to selected ports of departure. When observers reach their specified ports and initiate at-sea observations, costs should decrease to approximately \$500 per day. Therefore, per day cost for this fishery was calculated based on an estimate of three travel days (\$1200/day) and seven at-sea days (\$500/day) for each 10 days of observer activity. Using this model, daily observer costs for the albacore fishery will be \$710. Based on this estimate, annual program costs relative to various coverage levels coverage and the associated number of species observed were projected (Table 6). The estimated program expenses range from \$146,260 at the 1% observer coverage level to \$14,670,020 at 100% coverage. If the fishery managers choose the recommended 5% observation/coverage level as the percentage of effort for this observation program, the annual cost estimate would be \$733,430.

Recommended Coverage Level

Several potential levels of observer coverage with the associated costs and the percentage of total species that may be observed are presented for the council's review. Because this fishery is comprised of more than 800 vessels that conduct over 2,000 annual trips, observer coverage levels beyond 10% are likely not feasible due to current limits in funding. Despite the potential for limited fleet coverage, application of a stratified, random sampling design that covers all fleet strata relative to effort should provide adequate sample sizes. Therefore, we recommend the 5% observation/coverage level for fishery as it provides a relatively good balance between cost and sample size/effort.

Observer Placement and Coverage

Number of Observers

The number of observers required to conduct monitoring of this HMS fishery sector ranges from

four at the 1% coverage level to 400 at the 100% coverage level (Table 6). If the fishery managers choose the recommended 5% observation/coverage level as the percentage of effort for this observation program, we estimate that 20 observers will be required to cover approximately 1,033 seas days occurring across 118 trips (9 days per trip on average). Each observer in the program would go to sea an average of six trips per year.

Stratification of Observer Coverage

Development of an observer coverage stratification scheme was based on balancing the desire to cover the breadth of all potential bycatch events with the need for a reasonably high level of coverage within each time, area and gear category. Potential differences in bycatch characteristics relative to port, vessel class, fishing area, fishing season and fishing gear were examined to determine which, if any, of these factors could be stratified. Based on the specific characteristics of the west coast albacore troll fleet, we developed an observer coverage stratification model that provides the recommended percentage of observer coverage allocated to each stratified factor (Figure 38). Details on the number of days and trips allotted to the levels of each stratified factor are provided for the recommended 5% observation/coverage level. An observer coverage stratification model for Ilwaco, Washington for the 5% coverage level was also developed to illustrate how this coverage design might be applied to a specific albacore port (Figure 39). Details on our assessment of differences in port, vessel class, fishing area, fishing season and fishing gear are provided below.

Port Stratification

Vessels making up the albacore surface hook and line troll fleet are based at numerous small and large ports along the entire west coast, suggesting the need for geographic stratification of observer coverage. Data collected from 2001-2003 PacFIN databases indicate that vessels based in Washington accounted for the majority of the overall fleets' catch (52% of total fleet revenue) with most landings occurring at the ports of Westport and Ilwaco; small landings also occur at several little ports within Puget Sound. In Oregon, the majority of albacore landings occur at Newport, Astoria and Coos Bay. The primary albacore ports in California are Moss Landing and Morro Bay (Table 7). The ports utilized by the albacore surface hook and line fleet can be divided into three geographic zones or port groups: California, Oregon and Washington. These

arbitrary port groups are not intended to be used for stratification of observer effort; they are simply designed to serve as geographic centers for observer activities, allowing for specific observers to become familiar with regional ports and vessels. Observer effort would be distributed across albacore ports based on fishing effort as measured in catch landed. The distribution of the percentage of total fleet revenue by port provides an effective model for determining port stratification of observer coverage (Tables 7, 8). Based on these data, a stratification design of coverage levels according to port effort was established (see Table 8, Figures 38, 39). The port stratification scheme presented is designed to balance the proportion of observer coverage allocated to each port with the proportion of the total catch landed there. Pilot observer program data will allow for a detailed assessment of the proposed port stratification scheme relative to other strata and, if necessary, refinements to the proposed design.

Vessel Class Stratification

The albacore surface hook and line fleet is made up of two distinct vessel classes: 1) small, coastal vessels under 50 feet, and 2) larger, offshore vessels greater than 50 feet. It is important to differentiate between vessels that primarily fish in coastal waters and vessels that make offshore trips across the north Pacific as both bycatch rates and species composition are likely to vary by area. Logbook data collected from 1990-2004 indicate that vessels over 50 feet in length accounted for 63% of the total albacore troll fleet effort, while those vessels under 50 feet accounted for 37% of the total effort (Table 9). These data provide a model for the distribution of observer coverage among these two fishery sub-sectors as coverage needs to be allocated proportionally to the fishery effort exhibited by each vessel class (see Figures 38, 39). The interaction between the port stratification and vessel stratification schemes presented here will warrant further evaluation after the proposed pilot program is completed.

Fishing Area Stratification

The albacore fleet consists of small vessels operating in coastal and large vessels typically operating in offshore regions of the North Pacific. Bycatch species composition and levels from coastal and offshore areas likely differ to a large extent; thus vessels that utilize areas inside versus outside the EEZ need to be monitored independently. Because the vessels in this fleet that utilize coastal versus offshore areas can also generally be stratified by size (<50 feet vs. >50

feet, see Table 9), the vessel class stratification scheme described also provides for a balanced sampling of these two distinct oceanographic regions (Figure 38, 39).

Seasonal Stratification

The albacore troll fleet typically conducts operations from April – November over a large geographic area and from a number of different west coast ports. Because the fleet is composed of several hundred vessels, and observer coverage levels will likely be at less than 100%, it is recommended that observer trips be stratified, to the greatest extent possible, according to two periods: 1) April – July, and 2) August – November. This seasonal stratification scheme will be useful in detecting any shifts in catch and bycatch species and/or levels that may occur during the active fishing period. It will also ensure that observation effort not be concentrated in any particular portion of the fishing season. For example: if a total of 1000 trips occurred in a year, and a level of 20% coverage was desired, an attempt would be made to place observers on 100 trips during each of the two time periods; if a level of 10% coverage was selected, an attempt would be made to place observers on 50 trips during each of the two time periods, etc.

Fishing Gear Stratification

The albacore fleet typically deploys jigs for trolling, but occasionally fishermen will utilize live bait during fishing operations. The decision to use live bait instead of jigs typically occurs without much advance notice as this factor is based on prevailing environmental conditions. In addition to the occasional use of live bait by modern trolling vessels, there are a few traditional live bait vessels still operating in the U.S. albacore fleet. In order to assess potential differences in bycatch as a function of bait type, coverage of this fleet should include opportunities for monitoring live bait events. In this pilot program, random selection of albacore vessels across time, port and vessel size should allow for opportunistic monitoring of live bait operations. We believe these observations will provide sufficient data for analyses of any differences in bycatch and/or catch rates as a function of bait type. If significant differences in bycatch levels and/or species as a function of bait type are identified, or if opportunistic monitoring of live bait operations produces limited samples, necessary amendments to the current fishing gear stratification design should be undertaken to ensure samples from this portion of fishing effort.

Data Collection

To facilitate data collection and guarantee continuity with the recently initiated North Pacific Albacore Troll Observer Program, we recommend utilizing the data sheets and event descriptions that were incorporated during the primary 2004 monitoring season.

Recreational Fishery

The west coast recreational HMS fishery is active throughout the year with peaks in fishing for tuna, billfish, dorado, and pelagic sharks during spring summer and fall (PFMC HMS FMP 2003 s2.2.8). The fleet is composed of charter vessels and commercial passenger fishing vessels (CPFV) known as party boats, as well as, privately owned vessels. The fishery is centered in Southern California and originates primarily from San Diego to Santa Barbara. There are limited HMS recreational fisheries off the coasts of Oregon and Washington that are solely albacore hook and line operations.

Biological and economic data for HMS recreational fisheries are limited in comparison to those for HMS commercial fisheries. State administered logbook programs are an important source of data on CPFV fishermen. In California, CPFV vessels are required to submit logbooks from each trip detailing the number of anglers, as well as, catch and discard according to species. The California logbook program provides the data necessary to develop estimates of bycatch, although none have ever been published. Washington has an ocean boat sampling program and a voluntary logbook program that collects bycatch and catch data. The state of Oregon also collects catch data from recreational fisherman during the summer months of July and August. In addition to these state logbook programs, MRFSS, sponsored by NMFS and administered by the Pacific States Marine Fisheries Commission on the west coast, collects recreational effort and catch data as well as socioeconomic data. The data collected through MRFSS and the state recreational fishery monitoring programs are provided to the recreational fishery network (RecFIN), administered by PSMFC, where they are integrated into a comprehensive coastwide marine recreational fishery database. RecFIN database provides reliable estimates of take and discards for species that are commonly caught, but because the directed take of most HMS is a

relatively rare event, catch and discard estimates tend to have a high degree of variability.

MRFSS is a recreational survey that has been conducted since 1979 with a hiatus from 1990 through 1992. MRFSS consists of an angler field survey (for estimating catch) paired with a randomized telephone survey (for estimating total effort). This program was designed to provide information on catch and effort trends over time and over broad geographic areas. This program is comprehensive as it provides over 20 years of recreational fisheries data across all major modes of fishing along the west coast. The MRFSS program has been criticized for collecting insufficient sample sizes resulting in over estimates of catches and of imprecise estimates of effort. To overcome criticisms about overestimation, NMFS has initiated a program to call CPFVs directly to determine the number of passengers and frequency of trips. This new data collection technique has produced much lower estimates which have been correlated more closely with data from the California logbooks.

Due to concerns regarding the reliability of MRFSS data and a lack of data to make within season management decisions, the state of California recently implemented the California Recreational Fisheries Statistics Survey (CRFSS) program in coordination with PSMFC and NMFS. This program includes both the comprehensiveness of MRFSS with a high-frequency sampling regime. The goal of the CRFSS program is to increase the timeliness and accuracy of recreational fisheries data so that they can be more effectively used for in season monitoring, estimating take of species of concern, developing harvest guidelines, producing stock assessments, and providing other critical management information.

Charter/Party Boat Fleet

The tropical tunas, billfish and sharks become available off the west coast as they move seasonally eastward from oceanic waters in the Pacific Ocean and northward from the waters of Mexico. Except during periods of unusually warm water, recreational catches of these tropical HMS are almost exclusively from Southern California based CPFVs. In contrast to the tropical tunas and billfish, albacore are distributed along the entire west coast during summer and fall.

The wide distribution of this HMS has, in recent years, led to the development of an active CPFV albacore fishery from Central California north to the Canadian border. The timing and extent of HMS distribution off the west coast is dependant on seasonal development of oceanographic and environmental conditions such as water temperature, coastal upwelling, the strength of the California Current and ENSO events (PFMC HMS FMP 2003 s2.2.8.1).

The Southern California based fleet is clearly distinguished from CPFVs north of Morro Bay, where HMS fishing is limited to one species (albacore), seasons are relatively short, and the number and diversity of vessels is restricted relative to the Southern California CPFV fishery for HMS. Because these two CPFV fleets have distinctly different seasonal, geographical and temporal fishing patterns, we believe the Southern California fleet and the northern albacore fleet need to be monitored independently to account for distinct differences in program coverage levels and costs. Therefore, throughout the remainder of this report, those CPFVs based from San Diego to Morro Bay will be referred to as the Southern California CPFV fleet and those vessels based from Monterey, California to Westport, Washington will be referred to as the albacore CPFV fleet. In the following sections, two distinct fleets will be assessed independently for observer effort stratification, coverage levels and associated costs.

Southern California CPFV Fleet

The Southern California CPFV fleet includes approximately 300 vessels ranging in length from 45 to 120 feet operating out of 23 landings along the coastline from San Diego to Morro Bay (Table 10, Figure 40). This fleet carries upwards of 600,000 passengers annually to Southern California and Mexican fishing grounds. CPFVs can generally be subdivided into three classes based on passenger load and trip distance/duration. Smaller and faster HMS sport fishing boats which are typically designed to carry six passengers or less are known as “six-packs.” Six-pack vessels target tunas, billfish and other pelagic species on one or two day trips. Larger CPFVs often carry 20 - 40 or more passengers and target albacore, bluefin, yellowfin, skipjack, dorado, and coastal pelagic species on two types of trips: 1) short one- or two-day trips in the SCB and Northern Baja California waters, and 2) long-range, multiple day trips into Mexican waters.

Short range trips can be further subdivided into half day, full day and night/anchored fishing. San Diego Bay serves as the major hub for long-range HMS fishing in Mexican waters with a fleet of approximately 54 long-range vessels (see Table 10). An average of 143,634 angler trips departed annually from San Diego County ports (Zone 1, Figure 40; Table 11) during the period from 1985-2003, with approximately 43% of those anglers fishing in U.S. waters and the remaining 57% fishing in Mexican waters (London Group 1999). Annual catches during the period from 1990-1998 averaged 85,400 yellowfin, 41,000 skipjack and 11,000 bluefin tuna with 87%, 66%, and 87% respectively landed on vessels operating in Mexican waters. California's CPFV catch by CDFG block indicates the highest catches in the SCB, and south of San Clemente Island for albacore, yellowfin, bluefin, bigeye, skipjack, and dorado (PFMC HMS FMP 2003 s2.2.8.1).

While information on the retention and discard of fish landed in the Southern California CPFV fleet is limited, the MRFSS data base indicates that skipjack tuna and blue shark make up the majority of bycatch in this fishery. Skipjack is discarded because they are often taken when fishing for more desirable tuna species. The bycatch of blue sharks usually occurs while fishing for tunas or dorado. Because blue sharks are not a desirable catch, this species is usually released alive.

Determination of Effort

Fishing effort for the Southern California CPFV fishery was calculated using the following model. The average annual number of anglers that fished on CPFVs from San Diego to Morro Bay from April-November during the period 1985-2003 was determined from the *Los Angeles Times* landings data that was re-analyzed and made available by the SWFSC (see Dotson and Charter 2003). This database provides an index of the number of anglers that fished on the Southern California CPFV fleet distributed across month, year, and geographic zone. The average annual number of HMS trips across the Southern California region was then estimated based on the following assumptions: 1) each angler represented one fishing day, 2) 50% of all angler trips occurring from April through November were directed at HMS, 3) 57% of anglers who embarked from San Diego Ports (Zone 1, Figure 40) fished in Mexican waters (London

Group 1999), and 4) the average number of anglers per vessel is 35. Based on this operation, we estimate that on average 6,143 HMS trips are conducted by the Southern California CPFV fleet annually (Tables 11, 12); subsequent cost and coverage figures were based on this estimate.

Program Costs/Coverage Levels

Based on daily observer rates for the current west coast based drift gillnet and pelagic longline observer programs, the estimated daily cost for observers in this fishery ranges from \$700 - \$1,000 depending on associated travel costs. Because the Southern California CPFV fleet is based throughout Southern California, expenses for observer travel, hotel, per diem and associated logistics need to be considered. The Southern California CPFV fleet primarily conducts one or two day fishing trips, requiring that observers have nightly accommodations near their specified ports. We recommend that, whenever possible, observers be placed at a portside hotel in a location such as San Diego where access to multiple CPFVs over a five to seven day period is feasible. When observers reach their specified ports and initiate daily observations, we estimate costs at approximately \$700 per day. Thus, per day cost for this fishery was calculated based on an estimate of two travel days (\$1000/day) and five in port (\$700/day) for each seven days of observer activity. Using this model, daily observer costs for the Southern California CPFV fishery will be \$785 per day.

Based on this rate approximation, annual program costs relative to various coverage levels coverage and the associated number of species observed were projected separately for the Southern California CPFV fleet (Table 12). The estimated program expenses for the Southern California CPFV fleet range from \$240,995 at the 5% observer coverage level to \$3,616,495 at 75% coverage. If the fishery managers choose the recommended 10% observation/coverage level as the percentage of effort for this observation program, the annual cost estimate is \$481,990.

Recommended Coverage Level

Several potential levels of observer coverage with the associated costs and the percentage of total species that may be observed are presented for the council's review. The selection of an appropriate coverage level is linked to finding a suitable balance between cost efficiency and

sample size requirements. Because the Southern California CPFV fleet is comprised of more than 300 vessels that conduct a large number of annual trips, high levels of coverage are not currently feasible due to funding limitations. To obtain the largest possible sample from this fishery, and to reduce the large sample variance associated with very low levels of coverage, we recommend that the council select the 10% observation/coverage level. The selection of the 10% coverage level will ensure a reasonable level of monitoring of this HMS fishery without exorbitant expense.

Observer Placement and Coverage

Number of Observers

The number of observers required to conduct monitoring of the Southern California HMS CPFV fishery ranges from three at the 5% coverage level to 61 at the 100% coverage level (Table 12). If the fishery managers choose the recommended 10% observation/coverage level as the percentage of effort for this observation program, we estimate that six observers will be required to cover approximately 614 seas days occurring across 614 trips (1 day per trip) annually. Each observer in the program would typically monitor 102 trips/days per year.

Stratification of Observer Coverage

Our development of an observer coverage stratification scheme was based on balancing the desire to cover the breadth of all potential bycatch events with the need for a reasonably high level of coverage within each time, area and gear category. Potential differences in bycatch characteristics relative to port, vessel class, fishing area, fishing season and fishing gear were examined to determine which, if any, of these factors could be stratified. Based on the specific characteristics of the Southern California CPFV fleet, we developed an observer coverage stratification model that provides the recommended percentage of observer coverage allocated to each stratified factor (Figure 41). Details on the number of days and trips allotted to the levels of each stratified factor are also provided for the recommended 10% observation/coverage level. An example observer coverage stratification model for San Diego, California was also developed to illustrate how this coverage design might be applied to a specific Southern California CPFV

port (Figure 42). Details on our assessment of differences in port, vessel class, fishing area, fishing season and fishing gear are provided below.

Port Stratification

Because vessels making up the Southern California HMS CPFV fleet are based at numerous ports along the coast, we believe there is a need for port stratification of observer coverage. The ports utilized by the Southern California fleet can be logically divided into four geographic zones roughly representing different fishing areas (Figure 40, Table 11) (see Dotson and Charter 2003). Zone 1 includes San Diego, Mission Bay and Oceanside, with fishing areas including the waters off Baja California, Mexico, San Diego north to Camp Pendleton, and offshore waters in the southern region of the SCB. Zone 2 includes five ports from Dana Point to San Pedro, with fishing areas encompassing the coastal waters off San Clemente, the flats off Huntington Beach and Newport Beach, waters off Long Beach, around the islands of San Clemente, San Nicholas and Santa Catalina, and the central region of the SCB with occasional tuna trips into Mexican waters. Zone 3 includes seven ports from Redondo Beach Marina to Santa Barbara Harbor, with fishing areas encompassing regions of Santa Monica Bay and Ventura flats, islands of Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, and San Miguel, and the northern portions of the SCB. Zone 4 includes the ports of Morro Bay and Avila Beach, with fishing areas north of Point Conception in coastal waters and on Santa Lucia Bank as well as offshore waters (Dotson and Charter 2003). These zone definitions are general and by no means indicate that vessels don't fish in areas outside their general zone definition if conditions allow.

Angler effort for the Southern California CPFV fleet was determined using a database of daily fish reports from the *Los Angeles Times* from 1985-2003 that was revised and made available online by NMFS SWFSC (see Dotson and Charter 2003). The database includes data in the number of fish caught by species, landing port, landing date and the number of anglers. Comparison between this database and the logbook database maintained by CDFG indicate that they are highly correlated (Dotson and Charter 2003). Angler effort is expressed as the average number of anglers per year for each of the four geographic zones (Table 11). Within Zone 1, the average annual number of anglers was further subdivided based on the percentage of anglers that

reportedly fished in Mexican waters versus those that fished in U.S. waters (London Group 1999); subsequent calculations of angler effort for Zone 1 were conducted using only the effort reported for U.S. waters. For purposes of allocating observer coverage relative to angler effort, it was assumed that each angler represented one day of fishing. In order to develop an index of the number of annual CPFV trips per zone, the estimated number of days fished was divided by a value of 45, which is the average number of anglers reported per Southern California CPFV trip. The resulting values were utilized in determining the overall annual number of CPFV trips and the associated coverage levels and costs (Table 12).

It is recommended that observer coverage be distributed across the four Southern California geographic zones proportional to HMS angler effort (Table 11, Figures 40, 41, 42). This stratification scheme is designed to balance the proportion of observer coverage allocated to each region and port with the proportion of CPFV HMS fishing effort represented there. Vessels will be selected on a random basis from a complete list of CPFVs from the four geographic zones. Once a list of randomly selected vessels is developed, CPFV operators will be telephoned to determine their fishing trip schedule. If a selected vessel is not active during the given sampling period, successive vessels on the list will be contacted until the desired number of trips (level of coverage) has been secured. Criteria needs to be determined for estimating the number of trips from the original pool that may be cancelled due to factors such as bad weather, lack of HMS fish or mechanical problems; additional “backup” trips can then be planned to compensate for possible missed monitoring opportunities. Pilot observer program data will allow for further assessment of these factors and subsequent revisions to the coverage regimes will then be possible.

Vessel Class Stratification

The Southern California CPFV fleet is made up of three distinct vessel groups: 1) six-packs, 2) short-range, one or two day vessels, and 3) long-range, multiple day vessels. Long-range vessels based out of Southern California ports typically conduct most, if not all, fishing activities in Mexican waters, and thus do not fall under the guise of this observer program (see Tables 10, 11). The remaining two vessel classes need to be observed independently as six-pack vessels are

more likely than short-range CPFVs to spend the extra time to catch billfish if requested by their clientele. Few CPFV vessels with more than six passengers will take the time necessary to catch billfish or pelagic sharks because it limits the fishing activity of other passengers. In order to accurately assess bycatch rates/levels from the six-pack and short range CPFV recreational fishery sub-sectors, observer coverage should be allocated proportionally across these two vessel types according to fishing effort within U.S. waters. Current data; however, does not allow for a complete assessment of this variable. Thus, based on available information, we estimate that approximately 10% of HMS CPFV fishing effort occurs on six pack vessels (Table 10, Figures 41, 42).

Fishing Area Stratification

The Southern California CPFV fleet consists of numerous vessels operating from ports along the Southern California coastline. Bycatch species composition and levels from different SCB fishing areas such as coastal regions versus offshore islands likely differ to some extent; thus vessels that utilize different geographic areas need to be monitored independently. This monitoring goal will be accomplished through the application of the Southern California CPFV port stratification design (see Figures 40, 41, 42), which provides for a balanced sampling of the various SCB fishing areas based on the number of anglers utilizing each port from 1985-2003 (Table 11).

Seasonal Stratification

The Southern California CPFV fleet operates year round, although HMS fishing is concentrated from April through November (Table 13). We recommend observer coverage of this fleet be stratified into four two-month periods: 1) April-May, 2) June-July, 3) August-September, and 4) October-November. The proportion of observer effort allocated to each of the four two-month strata is based on the percentage of overall angler effort that occurred during each bimonthly period from 1985-2003 (Table 13, Figures 41, 42). This time stratification scheme will be useful in detecting any seasonal shifts in catch and bycatch species and/or levels that may occur as a result of variations in current systems, water temperatures and other oceanographic conditions (Dailey *et al.* 1983), and will allow for analyses of potential changes in HMS seasonal distribution and abundance relative to ENSO events. It will also ensure that observation effort

not be concentrated in any particular portion of the fishing season. In practice, if a total of 1,500 trips occurred, and a level of 20% coverage was selected an attempt would be made to place observers on 75 trips during each of the four time periods; if a level of 10% coverage was selected, an attempt would be made to place observers on 37 trips during each of the four two-month time periods.

Fishing Gear Stratification

Fishing gear is not a factor that we believe needs to be stratified for this observer program. Although preferences of individual fishermen for particular gear configurations may lead to some variability in bycatch and catch species levels, a thorough analysis of the influence of individual fishing styles is not currently possible. Additional observer program data will allow for a detailed assessment of the gear used by different anglers/vessels in this fleet and any associated variance in bycatch characteristics.

Data Collection

To facilitate data collection and ensure continuity existing Southern California CPFV fisheries data collection programs, we recommend that the selected observer program contactor implement a sampling protocol consistent with the current CDFG logbook program and recently amended MRFSS/CRFSS port sampling program. It is essential that all data forms are designed with an emphasis on collecting detailed information on HMS bycatch species and levels.

Albacore CPFV Fleet

The albacore CPFV fleet is comprised of fewer than 100 vessels ranging in length from 30 to 60 feet operating out of 13 landings from Central California north along the Oregon and Washington coastlines (Table 14). In Washington, the major port for CPFVs is Westport, which has seven charter offices with an average of 15 vessels that routinely fish for albacore from July through September. The importance of albacore tuna to the CPFVs in this fleet has risen in the last decade as other fishery opportunities (e.g. salmon and rockfish) declined. According to one Westport charter operator, the number of anglers reserving tuna trips on his vessel nearly doubled from 1992 to 1998. The amount of tuna caught in Washington has also increased in

proportion to the number of anglers, from about 1,300 tons in 1992 to about 3,000 tons in 1998 (PFMC HMS FMP 2003 s2.2.8.1). Based on the 2000 Washington voluntary logbook program data, over 8,000 albacore were caught by over 1,300 anglers. In Oregon, the majority of CPFV albacore catch and effort is concentrated along the central part of the Oregon coast with Newport serving as the major port for the albacore CPFV fleet. Albacore fishing has also increased in Oregon in recent years due to improvements in navigational aids and marine equipment and greater appreciation of albacore as game fish (PFMC HMS FMP 2003 s2.2.8.1). Albacore is the primary target of Northern California sportfishing and is also an important species for the Southern California CPFV fleet (Table 15). It should be noted that strong ENSO events and possibly decadal shifts in oceanographic conditions have a strong influence on albacore movement and distribution patterns as reported albacore CPUE increased in the 1980s and late 1990s when ENSO events occurred (PFMC HMS FMP 2003 s2.2.8.1).

There is very little information on the level or species composition of bycatch landed in the CPFV albacore fleet, although based on information from similar recreational fisheries we assume that overall bycatch levels are low. The proposed monitoring program would allow for the first assessment of bycatch in this fishery through the placement of onboard observers to collect data on bycatch species, size, condition and quantity.

Program Costs/Coverage Levels

Based on daily observer rates for the current west coast based drift gillnet and pelagic longline observer programs, the estimated daily cost for observers in this fishery ranges from \$700 - \$1,000 depending on associated travel costs. Because the albacore CPFV fleet is based along most of the west coast, expenses for observer travel, hotel, per diem and associated logistics need to be considered. The albacore CPFV fleet primarily conducts one day fishing trips, requiring that observers have nightly accommodations near their specified ports. We recommend that, whenever possible, observers be placed at a portside hotel in a location such as Westport, Washington, where access to multiple CPFVs over a five to seven day period is feasible. When observers initiate daily observations, we estimate costs at approximately \$700 per day. Thus, per day cost for this fishery was calculated based on an estimate of two travel days (\$1,000/day) and

five at-port (\$700/day) for each seven days of observer activity. Using this model, daily observer costs for the Southern California CPFV fishery will be \$785 per day.

We were not able to identify any sources for information on effort for the albacore CPFV fleet, and thus had to estimate port and fleet effort using the following approximation. Using available information, we estimated that each albacore CPFV conducted approximately 20 trips per year with an average of 10 anglers per trip. With a total of 98 albacore vessels included in our analyses, we estimated that this fleet conducted approximately 1,960 trips (1,960 fishing days) with a total of 19,600 anglers participating. Using this approximation, annual program costs relative to various coverage levels coverage and the associated number of species observed were projected for the albacore CPFV fleet (Table 16). The estimated program expenses range from \$76,930 at the 5% observer coverage level to \$1,153,950 at 75% coverage. If the fishery managers choose the recommended 20% observation/coverage level as the percentage of effort for this observation program, the annual cost estimate is \$307,720.

Recommended Coverage Level

Several potential levels of observer coverage with the associated costs and the percentage of total species that may be observed are presented for the council's review. Because the albacore CPFV fleet is comprised of less than 100 vessels that conduct a limited number of annual trips, we recommend the 20% observation/coverage level be adopted for this fishery. The selection of the 20% coverage level suggests a relatively large proportion of all species caught will be observed (66% to 89%, Table 1), allowing for effective statistical analyses without exorbitant expense.

Observer Placement and Coverage

Number of Observers

The number of observers required to conduct monitoring of the albacore CPFV fishery ranges from four at the 5% coverage level to 80 at the 100% coverage level (Table 16). If the fishery managers choose the recommended 20% observation/coverage level as the percentage of effort for this observation program, we estimate that 16 observers will be required to cover approximately 392 seas days occurring across 392 trips (1 day per trip) annually. Each observer

in the program would typically monitor 25 trips/days per year.

Stratification of Observer Coverage

Our goal in the development of an observer coverage stratification scheme was to balance coverage across port, vessel class, fishing area, fishing season and fishing gear in order to cover the breadth of all potential bycatch events. Because current data on effort for the albacore CPFV fleet is very limited, precise stratification of these five factors was not possible. Based on the known characteristics of the albacore CPFV fleet, we developed an observer coverage stratification model that provides the recommended percentage of observer coverage allocated to each stratified factor (Figure 41). Specifics on the number of days and trips allotted to the levels of each stratified factor are also provided for the recommended 20% observation/coverage level. The development of a more precise observer coverage model will require further data collection. Details on our assessment of differences in port, vessel class, fishing area, fishing season and fishing gear for the private recreational fleet are provided below.

Port Stratification

Because vessels making up the albacore CPFV fleet are based at numerous ports along the west coast, we believe there is a need for port stratification of observer coverage. The ports utilized by the albacore CPFV fleet can be logically divided three geographic zones or port groups. Zone A includes 8 California ports from Monterey north to Crescent City with the fishing activity occurring in waters from Big Sur north to the Oregon border. Zone B includes the Oregon ports of Newport, Brookings and Winchester Bay with fishing activity focused primarily off the Central Oregon coastline. Zone C represents the Washington port of Newport with fishing areas outside of Puget Sound north to the Canadian border. These arbitrary port groups are not intended to be used for determining stratification of observer effort; they are designed to serve as geographic boundaries for regionally based observers, allowing them to become familiar with local ports and vessels. Observer effort will be distributed across albacore CPFV ports based on fishing effort. These zone definitions are general and by no means indicate that vessels don't fish in areas outside their general zone definition if conditions dictate or allow.

Vessels will be selected on a random basis from a complete list of albacore CPFVs operating in

the various geographic zones. Once a list of randomly selected vessels is developed, CPFV operators will be telephoned to determine their fishing trip schedule. If a selected vessel is not active during the given sampling period, successive vessels on the list will be contacted until the desired number of trips (level of coverage) has been secured. Criteria needs to be determined for estimating the number of trips from the original pool that may be cancelled due to factors such as bad weather, lack of albacore or mechanical problems; additional “backup” trips can then be planned to compensate for possible missed monitoring opportunities. Pilot observer program data will allow for further assessment of these factors and subsequent revisions to the coverage regimes will then be possible.

Vessel Class Stratification

Vessel class is not a factor that we believe needs to be stratified for this pilot observer program. The albacore CPFV fleet is comprised less than 100 vessels that typically conduct one-day trips with 10 or fewer anglers aboard. Because there are no apparent differences in fishing strategies or areas targeted by the short range and six pack vessels that make up the albacore CPFV fleet, there is a low probability of potential variations in catch or bycatch levels as a function of vessel class. Therefore, division of this factor is not necessary for this pilot program. If post-hoc analyses of program data indicate any variability in catch or bycatch characteristics as a function of vessel class, refinements to the current design should be undertaken.

Fishing Area Stratification

The albacore CPFV fleet consists of numerous vessels operating from ports ranging from Central California north into Oregon and Washington. Bycatch species composition and levels from different fishing areas such as waters off San Francisco Bay versus those outside Puget Sound likely differ to some extent; thus vessels that utilize different geographic areas need to be monitored independently. This monitoring goal will be accomplished through the application of the albacore CPFV port stratification design (see Figure 43) which, once the necessary data becomes available, will provide for a balanced sampling of the various albacore fishing areas based on the albacore fishing effort at each port.

Seasonal Stratification

The albacore CPFV operate on a limited seasonal basis from July through October, with peaks in effort occurring during August and September. Because this HMS fishery sector operates during a limited time period each year, stratification of fishing activity relative to season is not a factor we believe needs to be stratified. Further division of the two to four month active fishing period may induce small sample sizes and potentially increase variability. If post-hoc analyses of pilot program data indicate any variability in catch or bycatch characteristics as a function of season, refinements to the proposed time stratification design should be undertaken.

Fishing Gear Stratification

Fishing gear is not a factor that we believe needs to be stratified for the albacore CPFV fleet. Although preferences of individual fishermen for particular gear configurations may lead to some variability in bycatch and catch species levels, a thorough analysis of the influence of individual fishing styles is not currently possible. Additional observer program data will allow for a detailed assessment of the gear used by different anglers/vessels in the albacore CPFV fleet and any associated variance in bycatch characteristics.

Data Collection

To facilitate data collection and ensure continuity with existing albacore CPFV fisheries data collection programs, we recommend that the selected observer program contactor implement a sampling protocol with consistent elements from the current CDFG logbook, Washington logbook and Oregon logbook programs as well as the recently amended MRFFS port sampling program. High priority should be placed on developing a consistent data form to be used across the entire albacore CPFV fleet and it is essential that all data sheets are designed with an emphasis on collecting detailed information on HMS bycatch species and levels.

Future Program Development

In order to acquire more specific information about the fishing patterns of both the Southern California and albacore CPFV fleets, we recommend that a written questionnaire be sent to each CPFV operator asking for details on vessel size, number of annual/seasonal trips, types of trips (i.e. half day, full day, night), areas fished and typical target species. These data can be used to develop a more comprehensive database of the west coast CPFV fleet that will assist in making

any necessary amendments to the proposed pilot program. Specifically, more and better data is needed in order to accurately categorize all CPFVs based on their fishing patterns, allowing for a subset of vessels representing a proportional cross section of vessel strata to be included for random selection.

Private Sport Fishing Fleet

The California recreational, rod and reel, fishery for tuna, striped marlin and swordfish has been popular among recreational anglers since the early 1900's. More than 6,000 privately owned vessels based in Southern California are active in the recreational HMS fishery annually, with peaks in effort occurring during the spring and summer lasting into fall. The private sportfishing fleet ranges from 17 foot skiffs to 90 foot luxury yachts, with the majority under 30 feet. In 2000, this fleet made approximately 1,760,000 fishing trips, of which 1,318,000, 75% resulted in HMS catches(PFMC HMS FMP 2003 s2.2.8.2). The fishing areas utilized by this fishery sector occur primarily in the SCB from Santa Barbara, south into Mexico. Although recreational catches of tuna and swordfish are assumed to be relatively low in quantity when compared with the commercial catch, observations of the HMS private sportfishing fleet have been particularly limited (PFMC HMS FMP 2003 s2.2.8.2).

Based on estimates compiled from the MRFSS data base, the great majority of bycatch in the private recreational HMS fishery consists of skipjack tuna, striped marlin and sharks (blue, mako and thresher). Skipjack tuna likely has a large bycatch because they are often taken while fishing for more desirable tuna species. There is little fishing directed toward blue sharks, but they are often caught while anglers are pursuing thresher or mako sharks. The bycatch of mako and thresher sharks in this fishery is high because most sharks caught are juveniles which are typically discarded alive. Because the condition of sharks released alive in this fishery is not typically recorded, and little follow up information is available (i.e. tags), the impact of the private recreational fishery on HMS shark populations is not well understood. Monitoring of HMS shark bycatch in this fishery should be a high priority for the proposed program as observer data will provide much needed information on HMS shark species catch and bycatch levels as well as distribution and abundance.

OBSERVER PLACEMENT

One potential method for identifying and quantifying bycatch in the west coast private recreational HMS fishery is placing observers on small vessels, that to date have not had observers deployed on them. However, because observer placement on small boats presents unique deployment obstacles such as lack of working space, limited accommodations and large fleet size, other potential methods for monitoring catch and bycatch on small vessels should be explored. The NMFS small boat workshop summary report noted that monitoring goals and objectives for small boat fleets could potentially be achieved using alternative methodologies that do not require the physical location of observers on board (Cusick *et al.* 2003). For example, recent advances in digital imaging technology have made electronic monitoring (EM) a viable option in some cases. Other potential monitoring techniques include independent at-sea observation platforms, collaboration with sportfishing clubs, and improvements to and expanded use of fishing information postcards and logbooks.

ELECTRONIC MONITORING

Electronic monitoring of fishing vessels is a technology that has recently been explored as a viable alternative to the use of human observers. This technology has been successfully tested to document bycatch on small vessels in the British Columbia halibut longline fishery. Vessel position monitoring was conducted using GPS, hydraulic and winch sensors; catch monitoring was performed through digital video recording of catch retrieval operations. The EM system was designed for autonomous operations and to be tamper-proof. In contrast to an observer being aboard a vessel for 24 hours per day, the video monitoring system only needs to be active during catch retrieval operations and can thus reduce the time needed to analyze the catch. For example, in the halibut logline fishery, the average line retrieval time was 21% of vessel time and analysis of video is 70% - 80% of real time. In addition, catch estimates from EM were within two percent of observer estimates. Through the use of EM, it is possible to cover all vessels in a given fishery and reduce the potential monitoring cost by one-half (Sea Watch 2000). One of the major disadvantages with EM is the inability of the system to collect data on catch size and weight, which are important factors in developing reliable estimates of bycatch mass.

For a detailed summary of the pros and cons of EM versus observer programs see Tables 4 and 5 of Cusick *et al.* (2003).

INDEPENDENT OBSERVATION PLATFORMS

Collecting catch and bycatch data from an alternative platform, such as an observer research vessel, is one option for monitoring small private recreational vessels that has recently been explored. The Alaska Marine Mammal Observer Program for coastal gillnet fisheries has successfully used independent research vessels for conducting monitoring activities. In order to cover an extensive geographic area, the program has operated skiffs from a land-based camp and off two larger chartered vessels that serve as transportation platforms for observers and their equipment (Cusick *et al.* 2003). Using the larger chartered vessels, observers can be quickly transported to fishing areas selected at random for observer coverage.

An assessment of the Alaska Marine Mammal Observer Program indicated that the cost to NMFS over the long-term might be less if NMFS owned its own vessels, rather than using chartered vessels. During the 2002 season, the cost per observer day was approximately \$2,400. This cost included observer pay, supplies, lodging, insurance, transportation, training, data entry, statistical analysis and all management staff salaries and overhead. Placing observers directly on fishing vessels rather than on a chartered platform could substantially reduce costs. It was noted; however, that small fishing vessel size often makes this difficult, safety is a major issue and the probability of detecting marine mammal entanglement is higher if the observer is viewing fishing operations from a research skiff (Cusick *et al.* 2003).

In New South Wales, Australia, the Fisheries Department developed an observer program that conducted monitoring of small vessels (< 6 m) operating in estuarine fisheries. An assessment of the fisheries identified a number of logistical problems/constraints unique to conducting observations aboard small fishing vessels. These can be summarized as follows: 1) lack of space to carry an observer, 2) lack of working space, 3) insurance issues, 4) observer safety issues, 5) increased cost to fishers, 6) inclement weather and dynamic nature of small vessel fisheries and, 7) management compliance. In order to avoid the difficulties summarized above, government research vessels were used to follow commercial vessels, observe their operations,

approach upon retrieval of gear and serve as the platform for sampling the catch. One disadvantage of this method was that the use of a small research vessel increased costs because of the necessity to have two personnel on board in order to conduct observer operations (Cusick *et al.* 2003).

Because of the logistical constraints associated with placing observers aboard small (<30 feet), private sportfishing boats and because other observer programs have successfully conducted fisheries monitoring using independent observation platforms, we recommended that this observation technique be explored for the current program. As an alternative to utilizing the mainland or a “mother vessel” as a base for observer operations, the possibility of using existing facilities at an offshore location such as Catalina Island should be explored. Catalina Island, which serves as a major destination for weekend anglers from mainland Southern California ports, has extensive public facilities and is easily accessed from the mainland. In addition, Catalina has several existing marine education/conservation organizations such as the Wrigley Marine Institute that could be examined as possible collaborators in providing housing, vessels and/or vessel facilities for observer monitoring activities.

SPORTFISHING CLUBS

Collaboration with Southern California sportfishing clubs such as The Balboa Angling Club (Newport Beach), The San Diego Marlin Club and the Tuna Club (Avalon, Santa Catalina Island) in the collection of bycatch and catch data on HMS is a viable alternative to the use of human observers. Fishing records from these clubs, which include catches in numbers and individual sizes for striped marlin and swordfish, have proven useful to fishery biologists and managers in assessing stocks of these species. The SWFSC’s angler-based Billfish Tagging program, which provides data on the movement, geographic distribution patterns and survivability of billfish caught of the west coast, provides another example of a how collaboration with sportfishing clubs can an effective means of collecting fisheries data. In 1999, 486 individual anglers and 158 captains reported tagging at least one billfish (Holts and Prescott 2001). The success of this collaborative method is demonstrated in Southern California sportfishing club records that indicate the number of striped marlin released or tagged and

released has increased from 20% to 50% in the 1980s to over 90% in recent years.

The rarity of billfish encounters and difficulties of capture suggest that an alliance between anglers and scientists is an effective means of expanding databases on the catch and bycatch levels for these species. Participants in the Pacific Federal Angler Affiliation for Billfish (Hunter and Holts 1999) recommended that the SWFSC's existing billfish tagging program be expanded to encourage anglers conduct additional scientific information during tag and release operations. For example, the collection of small tissue and blood samples from released fish can greatly improve stock assessments by providing important information on population structure, growth rate, age, sex, reproductive state and nutritional condition. Section 2.2.8.3 of the PFMC HMS FMP recommends that the expansion of current collaborative projects to include more detailed information on HMS bycatch and catch levels can be implemented through several protocols:

- Construct an internet web site for information exchange with the sportfishing community.
- Expand fishing tournament data recording to include details on bycatch and catch levels per vessel and information on total fishing effort.
- Obtain historic club records for analysis of long-term trends in abundance.
- Implement tissue sampling for genetic and physiological studies.
- Develop advanced methods of fish measurement and tagging methods.

POSTCARDS AT BAIT DOCKS

Postcards provided to recreational anglers at bait docks have proven to be a useful means of collecting information on species caught and discarded. The continued and expanded use of this data collection method is important for monitoring bycatch within this HMS fishery sector. We propose that the current bait dock postcard program be reviewed by the fishery managers and the method assessed for the breadth of its distribution, usage, accuracy and costs. One alternative that should be further explored is the construction of an internet web site for anglers to enter bycatch and catch information typically recorded on postcards. Web site data submission would eliminate postage costs, reduce the number of errors and potentially increase the likelihood of response among those anglers who prefer electronic over traditional communication.

DMV Registration

A thorough analysis of the characteristics of the private recreational HMS fleet is hindered by the fact that there is limited information available on the 6,000 private vessels that fish for HMS annually. In order to develop effective port and vessel stratification schemes, specific information on vessel length, vessel type, areas fished and species targeted is necessary. One viable means of collecting this information is through the California Department of Motor Vehicles (DMV) boat registration system. Private recreational vessel owners operating out of California ports are required by law to annually renew their vessel registration through the DMV unless their vessel is registered with the U.S. Coast Guard. We recommend that the current DMV vessel registration protocol be expanded to include a questionnaire requesting detailed information on past and upcoming fishing activities as well as data on vessel characteristics, home port and owner contact information. To reduce errors and associated costs, the current web-based DMV registration system could be expanded to include an option for electronic submission of private recreational vessel fishing information as part of the annual registration renewal protocol.

Stratification of Observer Coverage

Our goal in the development of an observer coverage stratification scheme was to balance coverage across port, vessel class, fishing area, fishing season and fishing gear in order to cover the breadth of all potential bycatch events. Because current data on effort for the private recreational fleet is very limited, accurate stratification of these five factors was not possible. Based on the known characteristics of the private recreational fleet, we developed a coverage model for that provides observer coverage stratification for vessels equal to or greater than 30 feet and alternative options for vessels less than 30 feet (Figure 44). The development of more precise allocation of observer coverage across various strata will require further data collection using one or more of the methods outlined above. Details on our assessment of differences in port, vessel class, fishing area, fishing season and fishing gear for the private recreational fleet are provided below.

Port Stratification

Vessels making up the private recreational fleet are based at numerous small and large ports

along the Southern California coast, suggesting the need for geographic stratification of monitoring efforts. The port stratification scheme utilizing four geographic zones for the CPFV fleet provides an appropriate model for the HMS private recreational fleet as both fisheries utilize the similar ports and fishing areas (Figure 45). Similar to the CPFV port stratification scheme, the observer coverage design for this fleet needs to balance the proportion of observer coverage allocated to each port and fishing area with the associated levels of HMS angler effort (Figure 44). Current private recreational HMS catch data does not allow for thorough analyses of angler effort relative to port location, areas fished or species targeted; however, this information is necessary for the development of an accurate stratification design. We believe that, if implemented, the methods for expansion and development of the private recreational vessel HMS database described above will allow for proper stratification of Southern California ports.

Vessel Class Stratification

The private recreational fleet is made up of vessels that range from 17 foot skiffs to 90 foot luxury yachts, with the majority under 30 feet. Small vessels (< 30 feet) typically engage in one day coastal fishing trips whereas larger vessels (> 30 feet) often take overnight trips to offshore regions of the SCB and around the Channel Islands. While there are several logistical challenges which may preclude the placement of observers on small private vessels, it is feasible to position observers aboard larger private recreational HMS boats (Figure 44). Within the private recreational fleet, larger vessels typically conduct the majority of HMS fishing activities because they can make trips to offshore waters further from port that may extend over multiple days. In order to equally assess bycatch in the private recreational fishery, observer coverage should be allocated, wherever possible, across a broad range of large vessels (30 ft short range coastal vessels – 90 ft long range offshore yachts).

Fishing Area Stratification

The private recreational fleet consists of over 6,000 vessels operating from numerous ports along the Southern California coastline. Bycatch species composition and levels from different SCB fishing areas such as coastal regions versus offshore islands likely differ to some extent; thus vessels that utilize different geographic areas need to be monitored independently (see Figures

44, 45). We believe this monitoring goal can be accomplished through the application of one or more of the fishery monitoring alternative methods presented and through the application of the geographic port stratification design described above.

Seasonal Stratification

The private recreational fleet operates year round, although HMS fishing is concentrated during from spring through fall. We recommend that observer coverage be stratified according to four two-month time periods across the active HMS fishing season: 1) April-May, 2) June-July, 3) August-September, and 4) October-November (see Figure 44). This seasonal stratification scheme will be useful in detecting any seasonal shifts in catch and bycatch species and/or levels that may occur as a result of variations in current systems, water temperatures and other oceanographic conditions (Daily *et al.* 1983), and will allow for analyses of any changes in HMS seasonal distribution and abundance relative to ENSO events. It will also ensure that observation effort not be concentrated in any particular portion of the fishing season. In practice, if a total of 5,000 trips occurred, and a level of 20% coverage was selected an attempt would be made to place observers on 250 trips during each of the four time periods; if a level of 10% coverage was selected, an attempt would be made to place observers on 125 trips during each of the four time periods, etc.

Fishing Gear Stratification

Fishing gear is not a factor that we believe needs to be stratified for this observer program. Although preferences of individual fishermen for particular gear configurations may lead to some variability in bycatch and catch species levels, a thorough analysis of the influence of individual fishing styles is not currently possible. Additional observer program data will allow for a detailed assessment of the fishing methods used by different anglers/vessels in this fleet and any associated variance in bycatch characteristics.

Data Collection

To facilitate data collection and ensure continuity with existing private recreational fisheries data collection programs, we recommend that the selected contactor implement a sampling protocol consistent with the recently amended MRFFS port sampling program. High priority should be

placed on developing a consistent data sheets for the entire private recreational fleet which should facilitate timely and accurate analyses of HMS bycatch data.

LITERATURE CITED

- Barlow, J. 1989. Estimating sample size required to monitor marine mammal mortality in California gill-net fisheries. National Marine Fisheries Service, Southwest Fisheries Science Center Administrative Report LJ-89-08.
- Bravington, M., C. Burridge and P. Toscas. 2003. Design of observer program to monitor bycatch species in the Eastern Tuna and Billfish Fishery. SCTB16 Working Paper SWG-7. Presented at the 16th meeting of the Standing Committee on Tuna and Billfish, Mooloolaba, Queensland, Australia, July 9-16, 2003.
- Childers, J. 2003. Summary of the 2002 North and South Pacific albacore troll fisheries. NMFS SWFSC Administrative Report LJ-03-09.
- Cusick, J., J. LaFargue and G. Parkes. 2003. Summary report of NMFS small boat workshop, Seattle, Washington, March 18-20, 2003.
- Dailey M. D., J. W. Anderson, D. J. Reish and D. S. Gorsline. 1993. The California Bight: background and setting. Pages 1-18 in M. Dailey, D. J. Reish, and J. W. Anderson, eds. Ecology of the Southern California Bight. University of California Press, Los Angeles, CA
- deSilva, J.A., R.E. Condrey and B.A. Thompson. 2001. Profile of shark bycatch in the U.S. Gulf of Mexico menhaden fishery. North American Journal of Fisheries Management 21:111-124.
- Dotson, R.C. and R.L. Charter. 2003. Trends in the Southern California sport fishery. CalCOFI Report 44.
- Holts, D.B. and D. Prescott. 2001. 2001 Billfish Newsletter. National Marine Fisheries Service, Southwest Fisheries Science Center.
- Hunter, J.R. and D.B. Holts. 1999. Pacific federal angler affiliation for billfish: Plan and workshop report. National Marine Fisheries Service, Southwest Fisheries Science Center Administrative Report LJ-99-11.
- Ito, R.Y., D.C. Hamm, A.L. Coan and J. Childers. 2004. Summary of U.S. fisheries for highly migratory species in the Western-Central Pacific Ocean, 1999-2003. Working document presented at the 17th Standing Committee on Tuna and Billfish, Majuro, Marshall Islands, August 8-18, 2004.
- Lawson, T. 2003. Observer coverage rates and the accuracy and reliability of estimates of CPUE for offshore longline fleets targeting South Pacific albacore. SCTB16 Working Paper SWG-4. Presented at the 16th meeting of the Standing Committee on Tuna and Billfish, Mooloolaba, Queensland, Australia, July 9-16, 2003.
- London Group. 1999. Economic impact analysis of the sport fishing industry. San Diego, CA.
- NMFS. 2001. North Pacific groundfish observer program 2001 manual. National Marine Fisheries Service, Northwest Fisheries Science Center.
- NMFS. 2002. Stock assessment and fishery evaluation for Atlantic highly migratory species 2002. National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division.
- NMFS. 2004. North Pacific groundfish observer program data report and summary analyses, January 2004. National Marine Fisheries Service, Northwest Fisheries Science Center.

PFMC HMS FMP. 2003. Fishery management plan and environmental impact statement for U.S. west coast fisheries for highly migratory species. Pacific Fishery Management Council, Portland, Oregon.

Rester J.K. and R.E. Condrey. 1999. Characterization and evaluation of bycatch reduction devices in the Gulf menhaden fishery. Fisheries Bulletin 19:42-50.

Sea Watch. 2000. Workshop report from the proceedings of the 2nd biennial Canada-United States Fisheries Observer Program Workshop, St. John's, Newfoundland, Canada, June 27-29, 2000.

TABLES

Table 1. Summary of species observed as a function of observer coverage levels as determined for the west coast drift gillnet, the west coast longline (two data sets), Hawaii longline and Atlantic longline fisheries.

West Coast DGN			West Coast LL 1		West Coast LL 2		Hawaii LL		Atlantic LL	
Level of Coverage	Number of Species	Percentage of All species	Number of Species	Percentage of All Species	Number of Species	Percentage of All species	Number of Species	Percentage of All species	Number of Species	Percentage of All Species
5%	36	47%	19	56%	18	64%	31	78%	61	55%
10%	43	56%	23	68%	22	79%	33	83%	71	65%
20%	51	66%	27	79%	25	89%	36	90%	84	76%
30%	56	73%	29	85%	25	89%	37	93%	92	84%
50%	63	82%	31	91%	26	93%	38	95%	99	90%
75%	67	87%	33	97%	27	96%	39	98%	105	95%
100%	77	100%	34	100%	28	100%	40	100%	110	100%
77 Total Species			34 Total Species		28 Total Species		40 Total Species		110 Total Species	

Table 2. HMS coastal purse seine estimated observer program cost for the fishery relative to various levels of observer coverage. The percentage of species observed across coverage levels for the three modeled fisheries are provided for reference.

Level of Coverage	Number of Trips	Number of Sea Days	Number of Observers	Estimated Cost*	Percentage of All Species				
					DGN	WCLL1	WCLL2	HLL	ALL
5%	1	1	1	\$500	47%	56%	64%	78%	52%
10%	2	2	1	\$1,000	56%	68%	79%	83%	61%
20%	4	4	1	\$2,000	66%	79%	89%	90%	72%
30%	6	6	1	\$3,000	73%	85%	89%	93%	79%
50%	11	11	2	\$5,500	82%	91%	96%	95%	85%
75%	16	16	3	\$8,000	87%	97%	96%	98%	90%
100%	21	21	4	\$10,500	100%	100%	100%	100%	100%

* Based On \$500/Day Cost Estimate

Table 3. HMS coastal purse seine percentage of fleet revenue and number of landings by port (2001-2003).

Port	2001		2002		2003		OVERALL Percentage of Revenue
	Percentage of Revenue	Number of Landings	Percentage of Revenue	Number of Landings	Percentage of Revenue	Number of Landings	
AST					1.51%	2	<1%
AVL	2.69%	1					1.06%
HNM			0.02%	1			<1%
MOS	12.23%	8			1.10%	1	5.15%
MRO	12.46%	6					4.92%
OSD	0.35%	1					<1%
SD	0.57%	1	1.47%	2			<1%
SP	38.42%	13	44.28%	3	45.99%	6	42.47%
TRM	33.30%	12	54.17%	3	51.41%	3	45.12%
VEN			0.05%	1			<1%
TOTAL	100%	42	100%	10	100%	12	100%

Table 4. West coast longline estimated observer program cost for the fishery relative to various levels of observer coverage. The percentage of species observed across coverage levels for the three modeled fisheries are provided for reference.

Level of Coverage	Number of Trips	Number of Sea Days	Number of Observers	Estimated Cost*	Percentage of All Species				
					DGN	WCLL1	WCLL2	HLL	ALL
5%	4	148	2	\$74,000	47%	56%	64%	78%	52%
10%	8	296	4	\$148,000	56%	68%	79%	83%	61%
20%	16	592	8	\$296,000	66%	79%	89%	90%	72%
30%	24	888	12	\$444,000	73%	85%	89%	93%	79%
50%	40	1480	20	\$740,000	82%	91%	96%	95%	85%
75%	60	2220	30	\$1,110,000	87%	97%	96%	98%	90%
100%	80	2960	40	\$1,480,000	100%	100%	100%	100%	100%

* Based On \$500/Day Cost Estimate

Table 5. West coast longline percentage of fleet revenue by port (2001-2003).

Port	Percentage of Total 2001 Revenue	Percentage of Total 2002 Revenue	Percentage of Total 2003 Revenue	Percentage of Total Revenue
BDG			0.01%	<1%
BRG			0.01%	<1%
COS	0.33%		0.00%	<1%
CRS	0.06%	0.00%		<1%
CRZ	0.00%			<1%
ERK	1.00%			<1%
LGB	0.02%			<1%
MOS	0.24%		0.04%	<1%
MRO	0.00%			<1%
NEW			0.02%	<1%
OCN	0.01%			<1%
OLA	0.00%			<1%
OSD	0.96%		0.00%	<1%
PRN	0.02%		0.01%	<1%
SD	6.20%		0.02%	2.66
SF	1.36%		24.60%	9.02
SP	20.73%	9.10%	1.14%	11.33
TRM	64.98%	84.62%	72.16%	71.96
VEN	4.10%	6.27%	2.00%	3.88
TOTAL	100%	100%	100%	100%

Table 6. North Pacific albacore troll estimated observer program cost relative to various levels of observer coverage. The percentage of species observed across coverage levels for the three modeled fisheries are provided for reference.

Level of Coverage	Number of Trips	Number of Sea Days	Number of Observers	Estimated Cost	Percentage of All Species				
					DGN	WCLL1	WCLL2	HLL	ALL
1%	24	206	4	\$146,260	-	-	-	-	-
2%	48	412	8	\$292,520	-	-	-	-	-
5%	118	1,033	20	\$733,430	47%	56%	64%	78%	52%
10%	236	2,066	40	\$1,466,860	56%	68%	79%	83%	61%
20%	472	4,132	80	\$2,933,720	66%	79%	89%	90%	72%
30%	354	6,198	120	\$4,400,580	73%	85%	89%	93%	79%
50%	1,180	10,331	200	\$7,335,010	82%	91%	96%	95%	85%
75%	1,771	15,497	300	\$11,002,870	87%	97%	96%	98%	90%
100%	2,361	20,662	400	\$14,670,020	100%	100%	100%	100%	100%

* Based On \$710/Day Cost Estimate

Table 7. North Pacific albacore troll percentage of fleet revenue by port (2001-2003).

Port	Percentage of Total 2001 Revenue	Percentage of Total 2002 Revenue	Percentage of Total 2003 Revenue	Percentage of Total Revenue
ALB	0.00%			< 1%
ANA		0.04%		< 1%
ARE	0.00%		0.00%	< 1%
AST	9.08%	5.68%	5.01%	6.59%
AVL	1.03%	1.35%	0.04%	< 1%
BDG	0.46%	0.14%	0.03%	< 1%
BDN	0.11%	0.04%	0.06%	< 1%
BKL	2.00%	0.02%		< 1%
BLL		5.90%	6.09%	3.89%
BRG	0.65%	0.39%	0.03%	< 1%
BRK	0.62%	0.27%	0.45%	< 1%
COS	8.58%	4.23%	4.74%	5.99%
CRS	1.14%	0.62%	0.35%	< 1%
CRZ	0.37%	0.77%	0.26%	< 1%
DNA		0.07%		< 1%
DPO	0.02%	0.04%	0.05%	< 1%
ERK	1.58%	1.38%	1.03%	1.30%
EVR		0.01%		< 1%
FLN		0.09%		< 1%
FLR	0.40%	0.42%	0.53%	< 1%
GLD	0.01%		0.02%	< 1%
GRH	0.09%	0.26%	0.08%	< 1%
GSS			0.01%	< 1%
LAP	0.11%	0.13%	0.03%	< 1%
LGB	0.01%	0.01%		< 1%
LWC	28.67%	43.02%	41.27%	37.18%
MNT	0.13%	0.07%	0.07%	< 1%
MOS	5.01%	1.13%	0.98%	2.44%
MRO	5.42%	1.84%	1.26%	2.86%
NEA		0.02%	0.04%	< 1%
NEW	20.30%	11.29%	14.26%	15.77%
OAK		0.00%		< 1%
OCN			0.01%	< 1%
OHB	0.01%		0.00%	< 1%
OLA	0.00%			< 1%
OMD		0.03%	0.00%	< 1%
ORF	0.08%	0.06%	0.07%	< 1%
OSD	0.00%	0.06%	0.00%	< 1%
OSF			0.00%	< 1%
OWA		0.09%		< 1%
OWC	0.01%	0.01%	0.12%	< 1%
OXN	0.03%	0.06%	0.00%	< 1%

Table 7. (continued) North Pacific albacore troll percentage of fleet revenue by port (2001-2003).

Port	Percentage of Total 2001 Revenue	Percentage of Total 2002 Revenue	Percentage of Total 2003 Revenue	Percentage of Total Revenue
PAG	0.04%	0.08%	0.11%	< 1%
PCC	0.02%	0.01%	0.03%	< 1%
PRN	0.11%	0.39%	0.05%	< 1%
RCH		0.01%		< 1%
SB	0.00%	0.01%		< 1%
SD	0.04%	0.09%	0.01%	< 1%
SEA	2.46%	2.13%	0.12%	1.38%
SF	0.02%	0.03%	0.01%	< 1%
SLT	0.02%	0.00%		< 1%
SP	0.26%	0.17%		< 1%
TAC	0.84%	1.43%	0.61%	< 1%
TLL	0.83%	1.23%	0.88%	< 1%
TNS	0.00%	0.07%	0.01%	< 1%
TRM	0.34%	0.01%	0.01%	< 1%
VEN	0.01%	0.01%	0.09%	< 1%
WIN	0.51%	1.04%	0.77%	< 1%
WLB	0.02%	0.21%	0.34%	< 1%
WLM		0.01%		< 1%
WPT	10.50%	13.53%	20.07%	15.29%
TOTAL	100%	100%	100%	100%

Table 8. North Pacific albacore fishery recommended port coverage levels.

Port Group	Port	Percentage of 2001-2003 Revenue	Percentage of Coverage by Port	Percentage of Coverage by Port Group
CA	Morro Bay	2.9%	3%	10%
CA	Moss Landing	2.4%	2%	
CA	Small Ports	5.0%	5%	
OR	Astoria	6.6%	7%	33%
OR	Coos Bay	6.0%	6%	
OR	Newport	15.8%	16%	
OR	Small Ports	4.0%	4%	
WA	Ilwaco	37.2%	37%	57%
WA	Westport	15.3%	15%	
WA	Small Ports	5.0%	5%	

Table 9. North Pacific albacore vessel effort divided according to vessel class and size (SV=Small Vessel, LV=Large Vessel). Source: NMFS logbook data 1990-2004.

Vessel Length	Vessel Class	Average Days	Number of Trips	Avg. Days x # Trips	Percent of Total Effort	Percent of Vessel Class Effort
20	SV	2.7	3	8	0.0%	0.0%
30	SV	4.3	313	1,333	1.2%	3.3%
40	SV	9.2	1,517	13,941	13.0%	34.8%
50	SV	15.2	1,631	24,791	23.1%	61.9%
TOTAL	SV		3,464	40,073	37%	100%
60	LV	25.6	897	22,990	21.4%	34.1%
70	LV	41.9	363	15,213	14.2%	22.6%
80	LV	50.0	238	11,900	11.1%	17.7%
90	LV	55.4	196	10,858	10.1%	16.1%
100	LV	62.7	41	2,571	2.4%	3.8%
110	LV	55.3	23	1,271	1.2%	1.9%
120	LV	59.8	12	717	0.7%	1.1%
130	LV	110.3	12	1,323	1.2%	2.0%
140	LV	18.8	6	113	0.1%	0.2%
150	LV	51.0	3	153	0.1%	0.2%
160	LV	58.6	5	293	0.3%	0.4%
TOTAL	LV		1,796	67,402	63%	100%
OVERALL TOTAL	SV/LV		5,260	107,475	100%	

Table 10. Distribution of CPFV vessels across Southern/Central California ports and geographic zones.
 LR = Long Range, SR = Short Range, SP = Six Pack, CH = Charter Only.

Zone	Location	Operator	Number of CPFVs	Vessel Class	Number of LR Vesels	Number of SR Vessels	Number of SP Vessels	Number of CH Vessels***
1	San Diego	Lee Palm's Sportfishing	1	LR*	1			
1	San Diego	Fisherman's Landing	20	SR, CH, LR*	7	3		10
1	San Diego	Point Loma Sportfishing	18	SR, LR*	5	13		
1	San Diego	H&M Landing	23	SR, CH, LR*	3	5		15
1	Mission Bay	Seaforth Sportfishing	14	SR, SP, LR*	8	4	2	
1	Mission Bay	Islandia Sportfishing	6	SR, SP, LR*	2	3	1	
1	Oceanside	Helgren's Sportfishing	7	SR, LR*	3	4		
2	Dana Point	Dana Wharf Sportfishing	12	SR, SP		10	2	
2	Newport Beach	Davey's Locker	5	SR, SP		4	1	
2	Newport Beach	Newport Landing	5	SR		5		
2	Seal Beach	Big Fish Sportfishing	1	SR		1		
2	Long Beach	Marina Sportfishing	3	SR		3		
2	Long Beach	Belmont Pier Sportfishing	2	SR		2		
2	Long Beach	Pierpoint Landing	9	SR, SP		5	4	
2	Long Beach	Long Beach Sportfishing	7	SR		7		
2	San Pedro	L.A. Harbor Sportfishing	6	SR		6		
2	San Pedro	22nd Street Landing	5	SR		5		
3	Redondo Beach	Redondo Sportfishing	5	SR		5		
3	Redondo Beach	Rocky Point	2	SP			2	
3	Marina Del Rey	Del Rey Sportfishing	4	SR		4		
3	Port Hueneme	Port Hueneme Sportfishing	3	SR		3		
3	Oxnard	Captain Hook's Sportfishing	8	SR, SP		7	1	
3	Oxnard	CISCO Landing	11	SR		11		
3	Ventura	Harbor Village Sportfishing						
3	Santa Barbara	Wave Walker Charters	1	SP			1	
3	Santa Barbara	Sea Landing	2	SR		2		
4	Avila Beach	Patriot Sportfishing	3	SR, LR**	1	2		
4	Morro Bay	Virg's Landing	7	SR, LR**	1	6		

*Long Range Baja California HMS Fishing

**Long Range Central California Albacore Fishing

***Short Range and Long Range Fishing

Table 11. Distribution of CPFV effort (in number of anglers) across the four Southern California geographic zones from April through November. Proposed observer coverage levels relative to proportion of zonal effort are presented. Source: SWFSC *Los Angeles Times* landings reports database 1985-2003.

Geographic Area	Total Number of Anglers*	Average Number of Anglers per Year*	Estimated Number of HMS Anglers per Year*^	Percent of Total Angler Effort**	Average Number of Trips per Year**	Percent Observer Coverage by Zone
Zone 1	2,429,063	(MEX: 72,871)	N/A	N/A	N/A	N/A
Zone 1		U.S. 54,973	27,487	13%	785	13%
Zone 2	4,122,266	216,961	108,481	50%	3,099	50%
Zone 3	2,497,520	131,448	65,724	31%	1,878	31%
Zone 4	505,669	26,614	13,307	6%	380	6%
OVERALL	9,554,518	429,996	214,998	100%	6,143	100%

*April-Nov. 1985-2003

^50% of Total Effort

**In U.S. Waters

Table 12. Southern/Central California CPFV observer program cost relative to various levels of observer coverage. Number of seas days and number of trips are based on CPFV effort from April through November. The percentage of species observed across coverage levels for the three modeled fisheries are provided for reference.

Level of Coverage	Number of Trips	Number of Sea Days	Number of Observers	Estimated Cost*	Percentage of All Species				
					DGN	WCLL1	WCLL2	HLL	ALL
5%	307	307	3	\$240,995	47%	56%	64%	78%	52%
10%	614	614	6	\$481,990	56%	68%	79%	83%	61%
20%	1,229	1,229	12	\$964,765	66%	79%	89%	90%	72%
30%	1,843	1,843	18	\$1,446,755	73%	85%	89%	93%	79%
50%	3,072	3,072	31	\$2,411,520	82%	91%	96%	95%	85%
75%	4,607	4,607	46	\$3,616,495	87%	97%	96%	98%	90%
100%	6,143	6,143	61	\$4,822,255	100%	100%	100%	100%	100%

*Based on \$785/Day Cost Estimate

Table 13. Distribution of average CPFV HMS effort (in number of anglers) across HMS fishing season and the four Southern California geographic zones. Source: SWFSC *Los Angeles Times* landings reports database 1985-2003.

Month	Average Number of HMS Anglers*				Overall	Overall Percentage
	Zone1**	Zone 2	Zone 3	Zone 4		
April	1,521	7,504	5,662	1,072	15,758	7%
May	2,371	11,843	6,797	1,222	22,232	10%
June	4,295	17,882	9,293	1,665	33,134	15%
July	5,859	23,339	12,605	2,447	44,250	21%
August	6,387	21,370	12,160	2,696	42,612	20%
September	3,797	13,195	8,311	1,815	27,118	13%
October	2,223	8,346	6,126	1,416	18,110	8%
November	1,037	5,003	4,771	976	11,786	5%
Overall	27,487	108,481	65,724	13,307	214,999	100%

*1985-2003

**Excludes Anglers Fishing in Mexican Waters

Table 14. Distribution of albacore CPFV vessels across west coast ports and three geographic zones. For reference, the fishing season, vessel capacity and trip duration is provided. SR = Short Range Vessel, SP = Six Pack Vessel

Zone	State	Location	Operator	Number of CPFVs	Percentage of Fleet	Vessel Class	Albacore Fishing Season	Vessel Capacity (# anglers)	Trip Duration (days)
A	CA	Crescent City	Tidewind Sportfishing	1	1%	SR	Aug-Sep	10	1
A	CA	Eureka	Eureka Fishing Ltd.	1	1%	SR	Aug-Sep	10-15	1
A	CA	Fort Bragg	Noyo Fishing Center	7	7%	3 SR/4 SP	Aug-Sep	6-12	1
A	CA	Fort Bragg	Telstar Charters	1	1%	SR	Aug-Sep	10	1
A	CA	Shelter Cove	Shelter Cove Sportfishing	1	1%	SP	Aug-Sep	6	1
A	CA	Bodega Bay	Bodega Bay Sportfishing	2	2%	SP	Aug-Sep	6	1
A	CA	Bodega Bay	Bodega Bay Charters	1	1%	SR	Aug-Sep	10	1
A	CA	Bodega Bay	Agressor Adventures	1	1%	SP	Aug-Sep	6	1
A	CA	San Francisco	Fisherman's Wharf	9	9%	8 SR/1 SP	Aug-Oct	6-20	1
A	CA	San Francisco Bay	Sausalito	7	7%	6 SR/1 SP	Aug-Oct	6-20	1
A	CA	San Francisco Bay	Emeryville Marina	7	7%	SR	Aug-Oct	10-15	1
A	CA	San Francisco Bay	Berkeley Marina	7	7%	SR	Aug-Oct	10-15	1
A	CA	San Francisco Bay	Point San Pablo	1	1%	SR	Aug-Oct	15	1
A	CA	San Francisco Bay	San Rafael	1	1%	SP	Aug-Oct	6	1
A	CA	San Francisco Bay	Richmond	1	1%	SP	Aug-Oct	6	1
A	CA	Half Moon Bay	Pillar Point Harbor	7	7%	SR	Aug-Oct	10-15	1
A	CA	Santa Cruz	Chartle Charters	1	1%	SP	Jul-Oct	6	1
A	CA	Santa Cruz	Stagnaro's Sportfishing	1	1%	SR	Jul-Oct	10	1
A	CA	Santa Cruz	Santa Cruz Sportfishing	1	1%	SP	Jul-Oct	6	1
A	CA	Santa Cruz	Shamrock Charters	1	1%	SR	Jul-Oct	10-15	1
A	CA	Santa Cruz	Suntan Charters	1	1%	SP	Jul-Oct	6	1
A	CA	Santa Cruz	Reel Sportfishing	1	1%	SP	Jul-Oct	6	1
A	CA	Monterey	Chris's Fishing	4	4%	SR	Jul-Oct	20	1
A	CA	Monterey	Park Place Excursions	1	1%	SP	Jul-Oct	6	1
A	CA	Monterey	Randy's Sportfishing	2	2%	SR	Jul-Oct	20	1
A	CA	Moss Landing	Tom's Sportfishing	1	1%	SR	Jul-Oct	12	1
Zone A Total				68	70%				

Table 14. (continued) Distribution of albacore CPFV vessels across west coast ports and three geographic zones. For reference, the fishing season, vessel capacity and trip duration is provided. SR = Short Range Vessel, SP = Six Pack Vessel

Zone	State	Location	Operator	Number of CPFVs	Percentage of Fleet	Vessel Class	Albacore Fishing Season	Vessel Capacity (# anglers)	Trip Duration (days)
B	OR	Newport	Sea Gull Charters	1	1%	SR	Jul-Oct	10	1
B	OR	Newport	Tradewind Sportfishing	5	5%	SR	Aug-Oct	10	1-2
B	OR	Newport	Black Rocket Charters	1	1%	SP	Aug-Oct	3	1
B	OR	Brookings	Tidewind Sportfishing	2	2%	SR	Jul-Oct	10	1
B	OR	Winchester Bay	Pacific Pioneer Charters	1	1%	SR	Jul-Oct	10	1
Zone B Total				10	10%				
C	WA	Westport	Advantage Charters	1	1%	SR	Aug-Sep	7-10	2
C	WA	Westport	Cachalot Charters	1	1%	SP	Aug-Sep	6	2
C	WA	Westport	Coho Charters	2	2%	SR	Sep-Oct	7-10	2
C	WA	Westport	Deep Sea Charters	7	7%	1SR/6 SP	Aug-Oct	6-10	1-2
C	WA	Westport	Ocean Charters	4	4%	1SR/3 SP	Aug-Oct	6-10	1-2
C	WA	Westport	Westport Charters	4	4%	SR	Aug-Sep	7-10	1-2
Zone C Total				19	19%				

Table 15. Annual statewide fish landings by the California based CPFV fleet in 2001 stratified by port. Source: CDFG

HMS Species	Southern California						Northern California				
	**San Diego Mission Bay	Oceanside Dana Point	Newport Beach	Seal Beach Long Beach San Pedro	Redondo M. Del Rey Malibu	Port Hueneme Oxnard/Ventura Santa Barbara	Avila Morro Bay	Monterey Moss Landing Santa Cruz	Princeton Bodega Bay	San Francisco	Fort Bragg Eureka Crescent City
Dorado	3440	18	66	173	88	11	0	0	0	0	0
Albacore	178843	5191	8916	14096	1262	3509	8902	10961	2520	2205	414
Bluefin	19573	280	234	709	39	141	0	3	0	6	0
Skipjack	7512	240	119	678	101	2	0	0	0	1	0
Yellowfin	30194	58	571	224	0	6	0	0	0	1	0
Yellowtail	57576	1322	5238	13437	153	1404	0	0	0	0	0
Blue Shark	80	26	24	2	70	8	0	0	2	0	0

*Total number of fish retained by anglers for all California and Mexico trips

**Includes landings made in Baja California waters

Table 16. Albacore CPFV observer program cost relative to various levels of observer coverage. The percentage of species observed across coverage levels for the three modeled fisheries are provided for reference.

Level of Coverage	Number of Trips	Number of Sea Days	Number of Observers	Estimated Cost*	Percentage of All Species				
					DGN	WCLL1	WCLL2	HLL	ALL
5%	98	98	4	\$76,930	47%	56%	64%	78%	52%
10%	196	196	8	\$153,860	56%	68%	79%	83%	61%
20%	392	392	16	\$307,720	66%	79%	89%	90%	72%
30%	588	588	24	\$461,580	73%	85%	89%	93%	79%
50%	980	980	40	\$769,300	82%	91%	96%	95%	85%
75%	1,470	1,470	60	\$1,153,950	87%	97%	96%	98%	90%
100%	1,960	1,960	80	\$1,538,600	100%	100%	100%	100%	100%

*Based on \$785/Day Cost Estimate

FIGURES

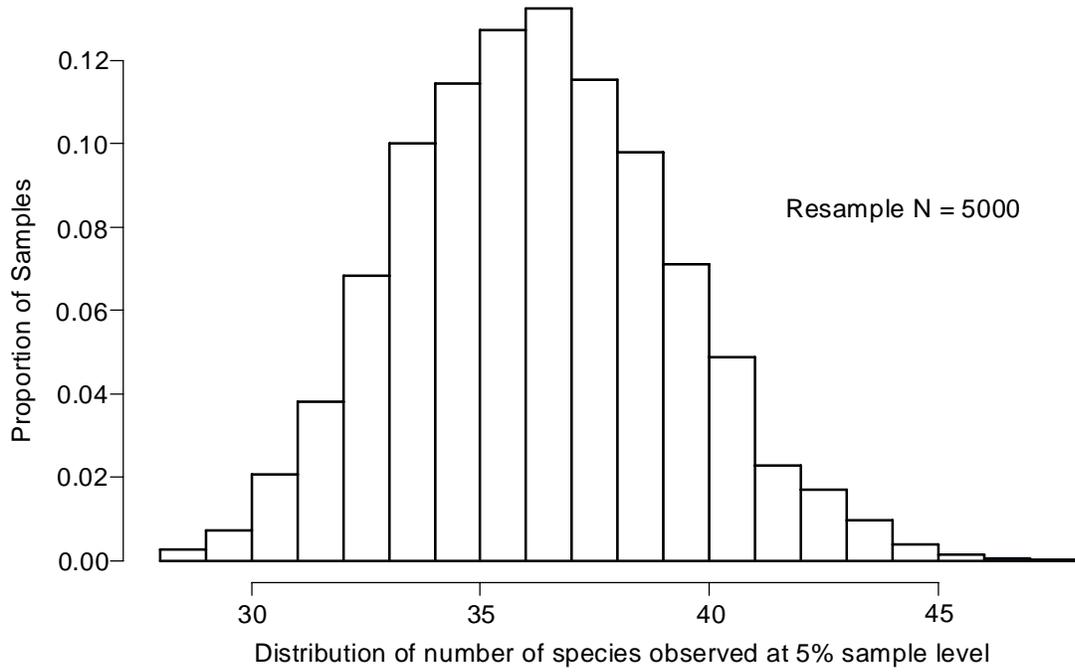


Figure 1. Drift Gillnet distribution of species observed at 5% coverage.

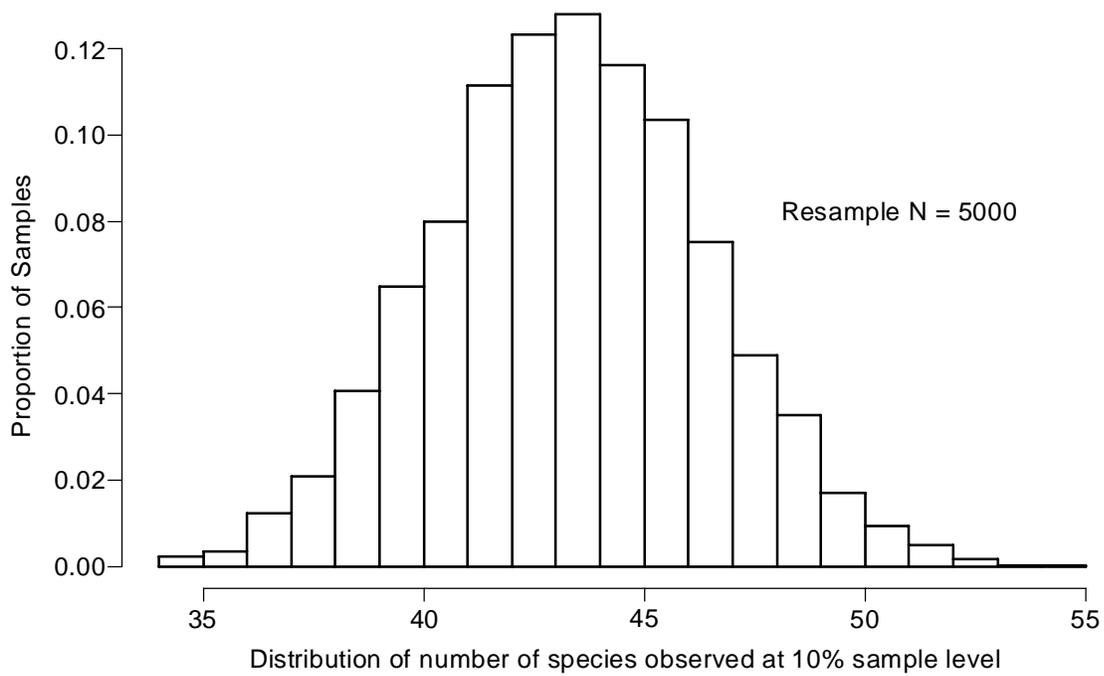


Figure 2. Drift Gillnet distribution of species observed at 10% coverage.

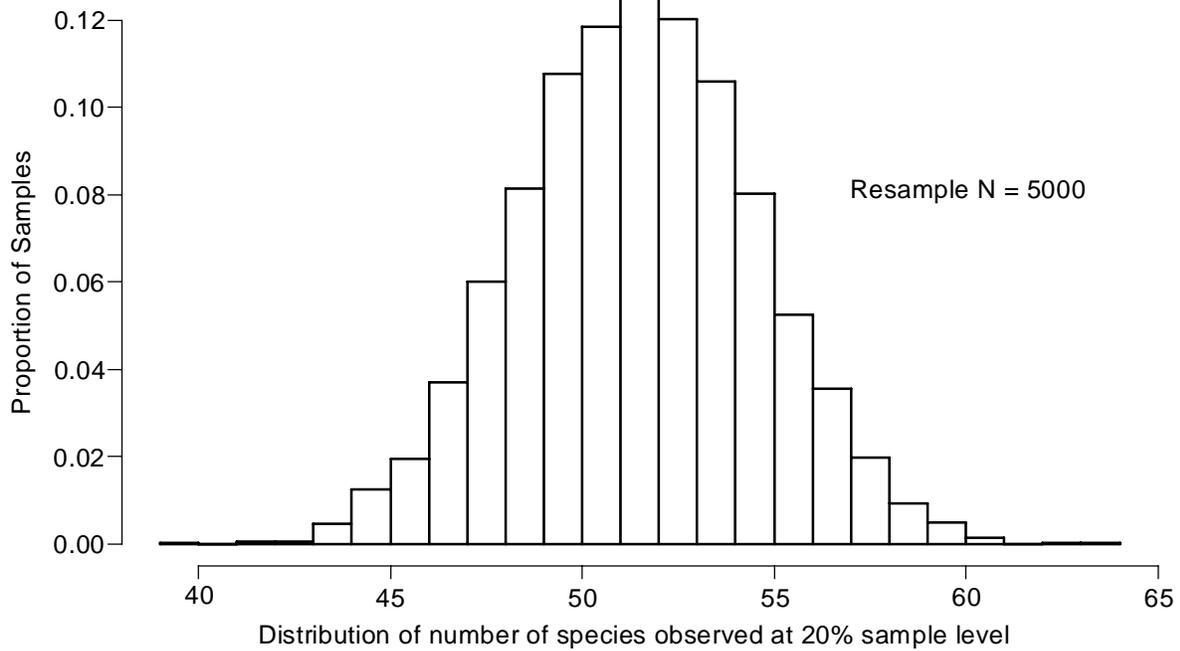


Figure 3. Drift Gillnet distribution of species observed at 20% coverage.

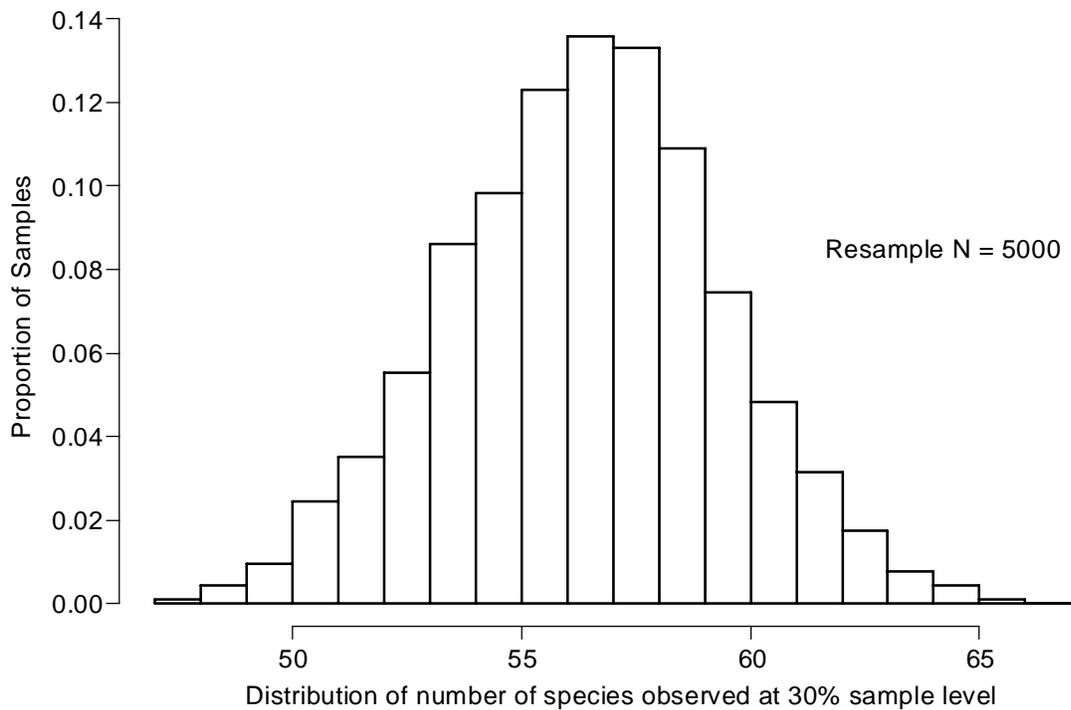


Figure 4. Drift Gillnet distribution of species observed at 30% coverage.

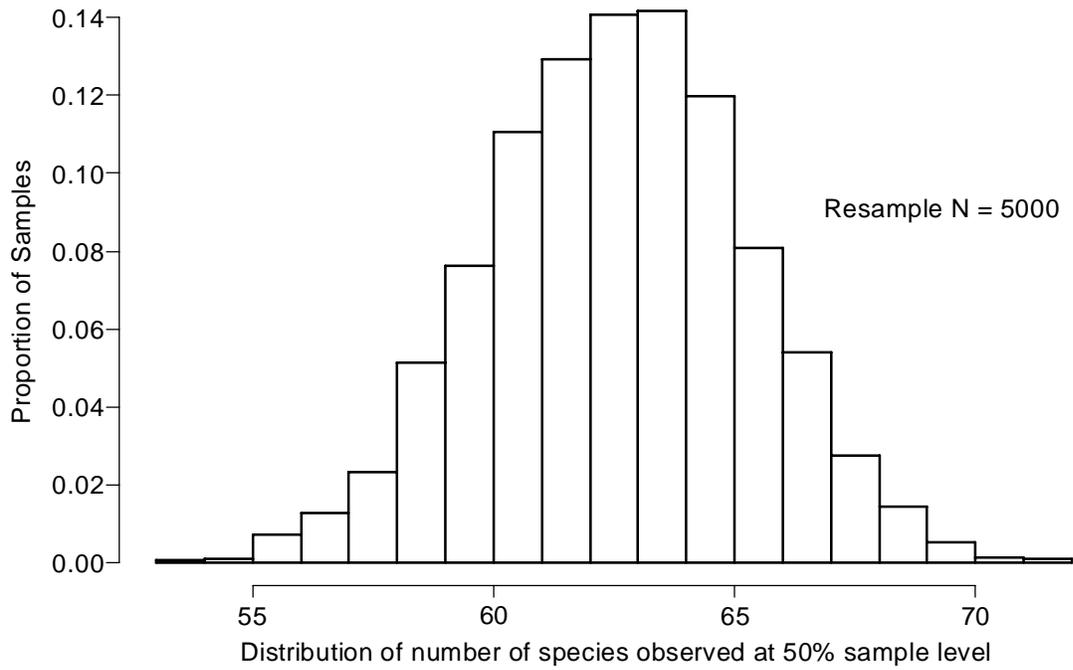


Figure 5. Drift Gillnet distribution of species observed at 50% coverage.

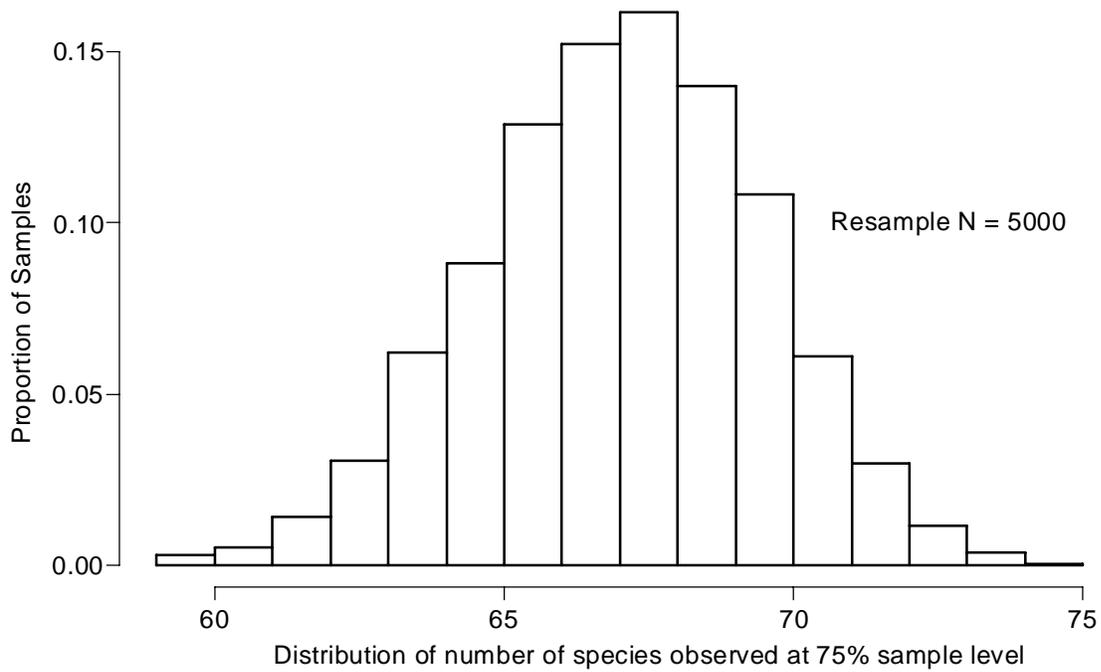


Figure 6. Drift Gillnet distribution of species observed at 75% coverage.

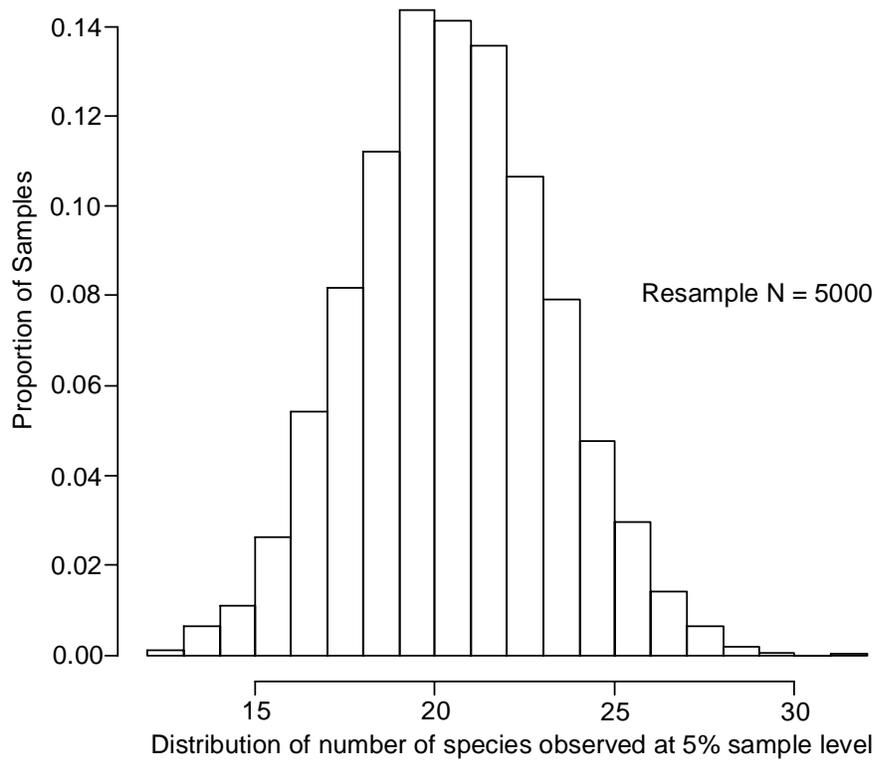


Figure 7. West coast longline (1) distribution of species observed at 5% coverage.

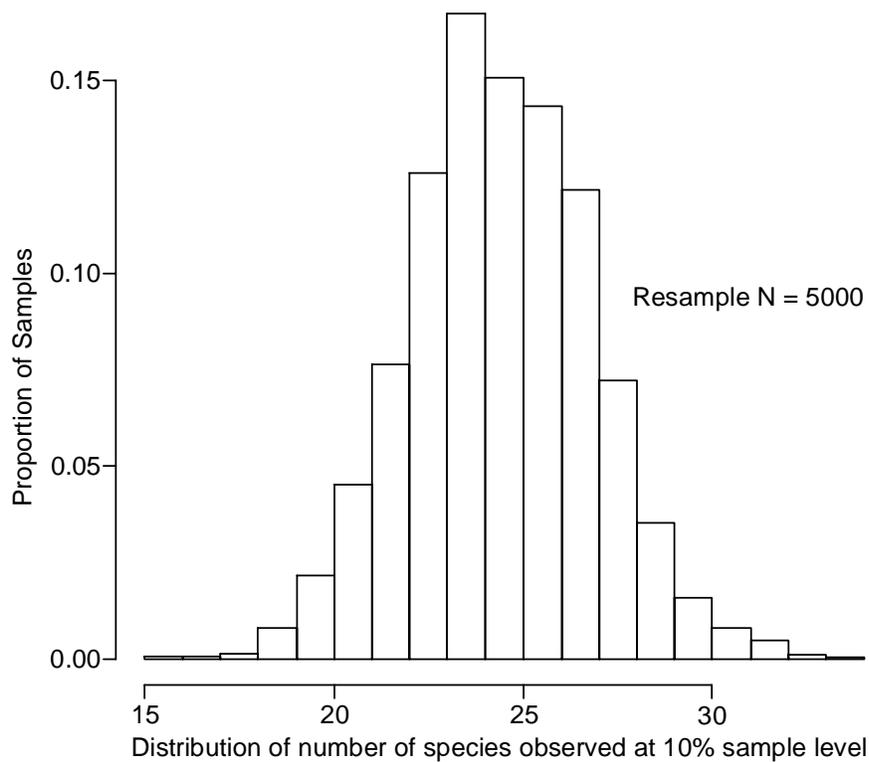


Figure 8. West coast longline (1) distribution of species observed at 10% coverage.

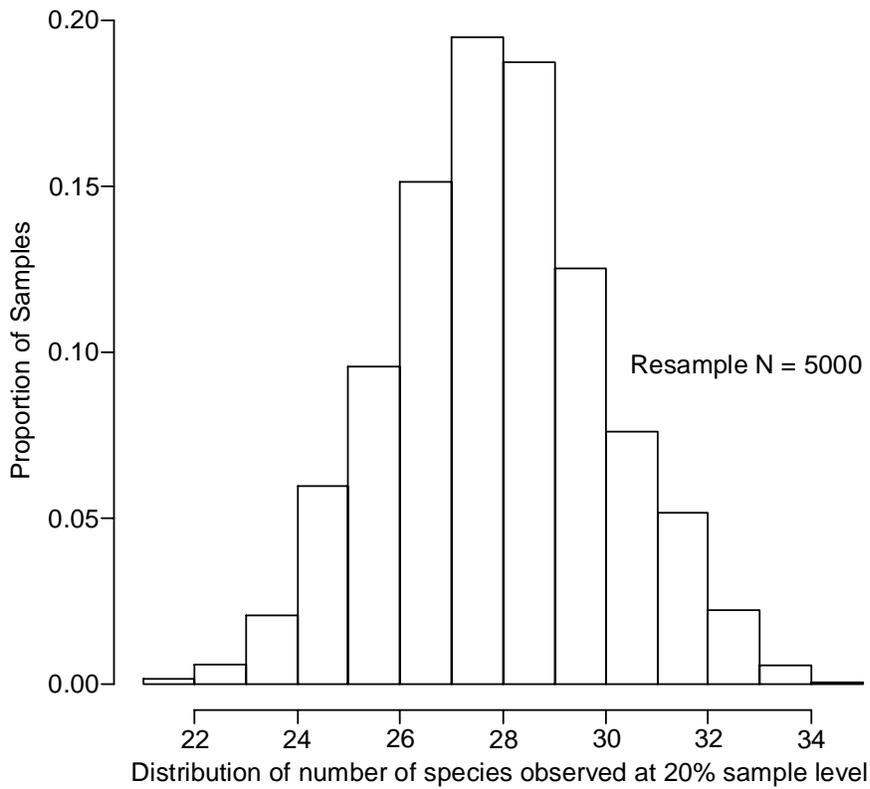


Figure 9. West coast longline (1) distribution of species observed at 20% coverage.

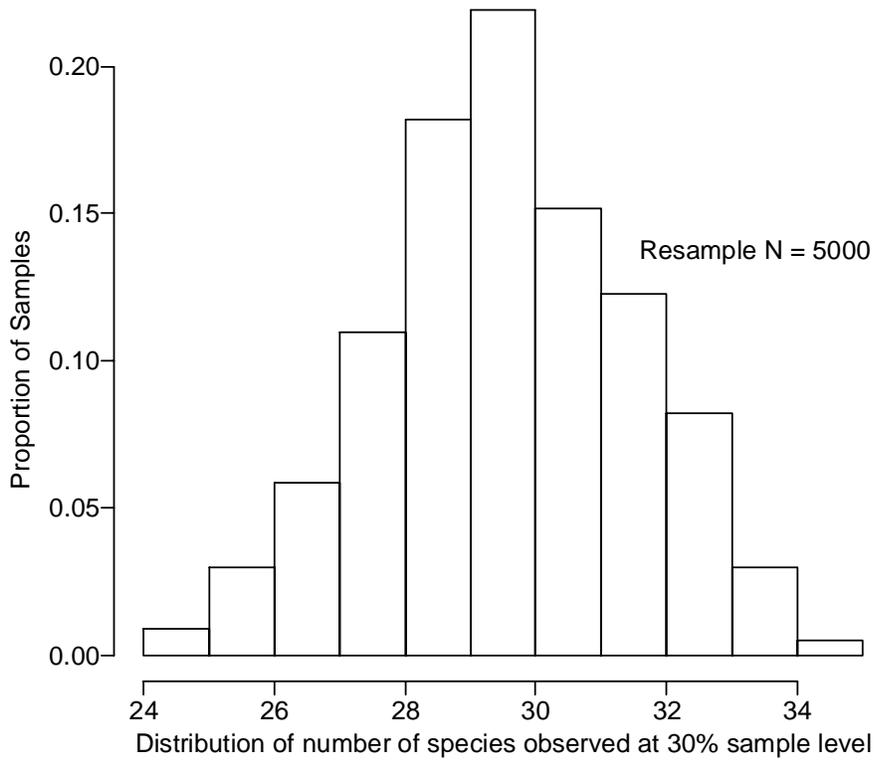


Figure 10. West coast longline (1) distribution of species observed at 30% coverage.

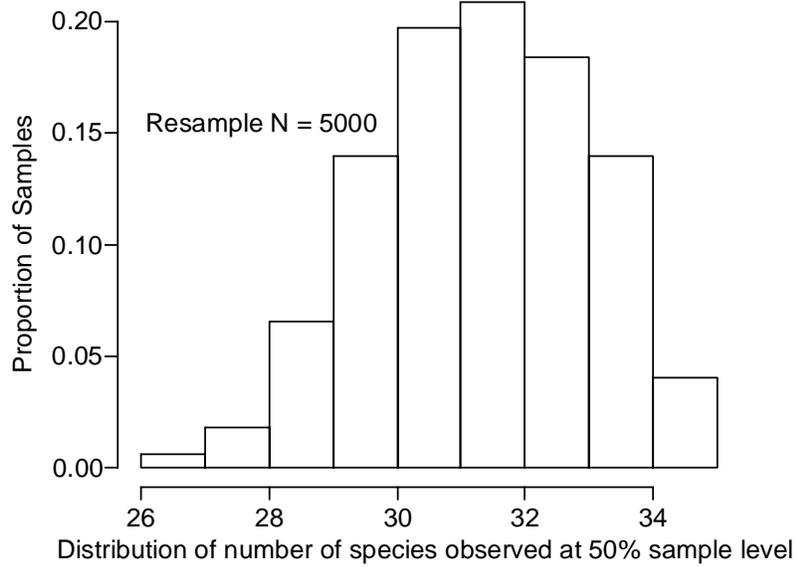


Figure 11. West coast longline (1) distribution of species observed at 50% coverage.

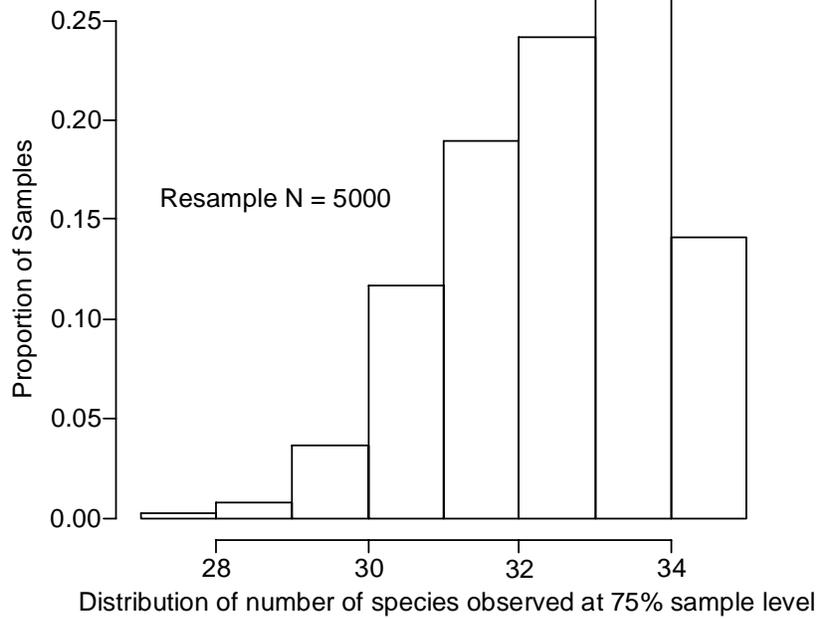


Figure 12. West coast longline (1) distribution of species observed at 75% coverage.

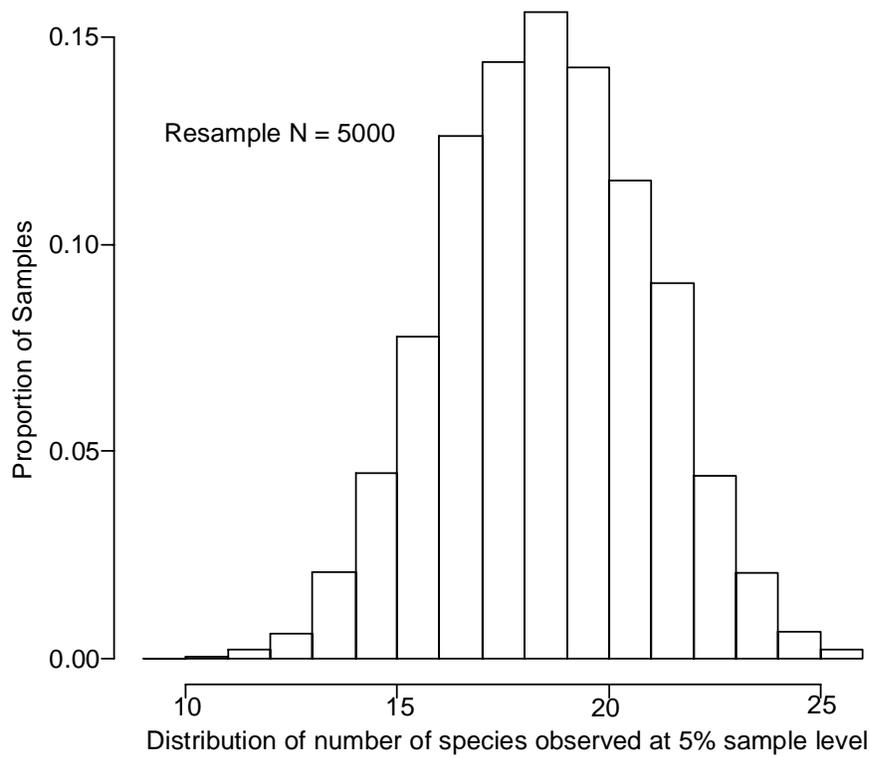


Figure 13. West coast longline (2) distribution of species observed at 5% coverage.

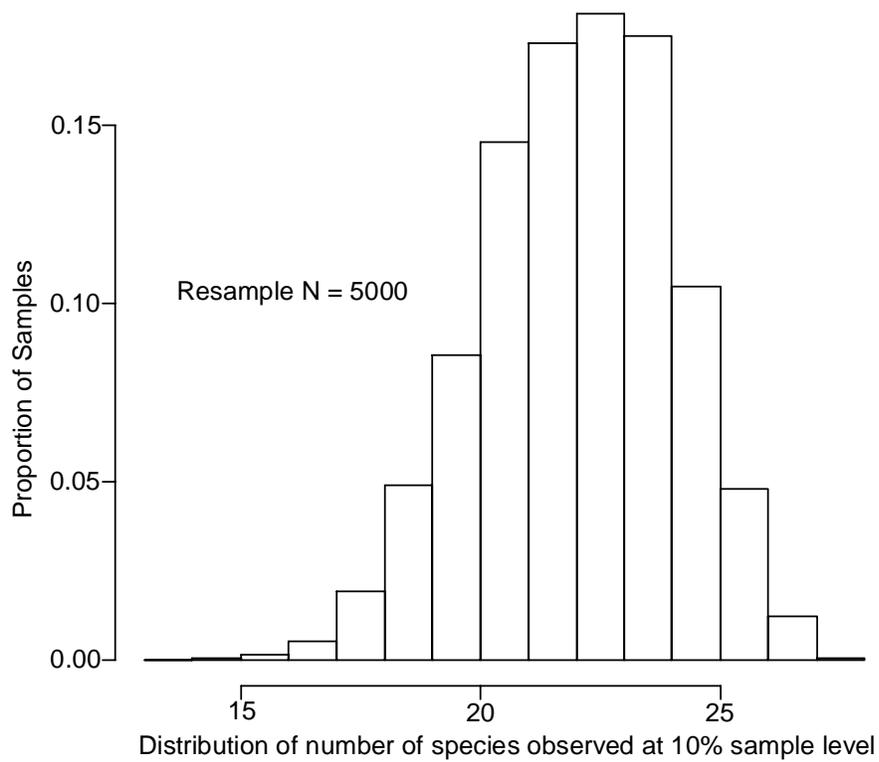


Figure 14. West coast longline (2) distribution of species observed at 10% coverage.

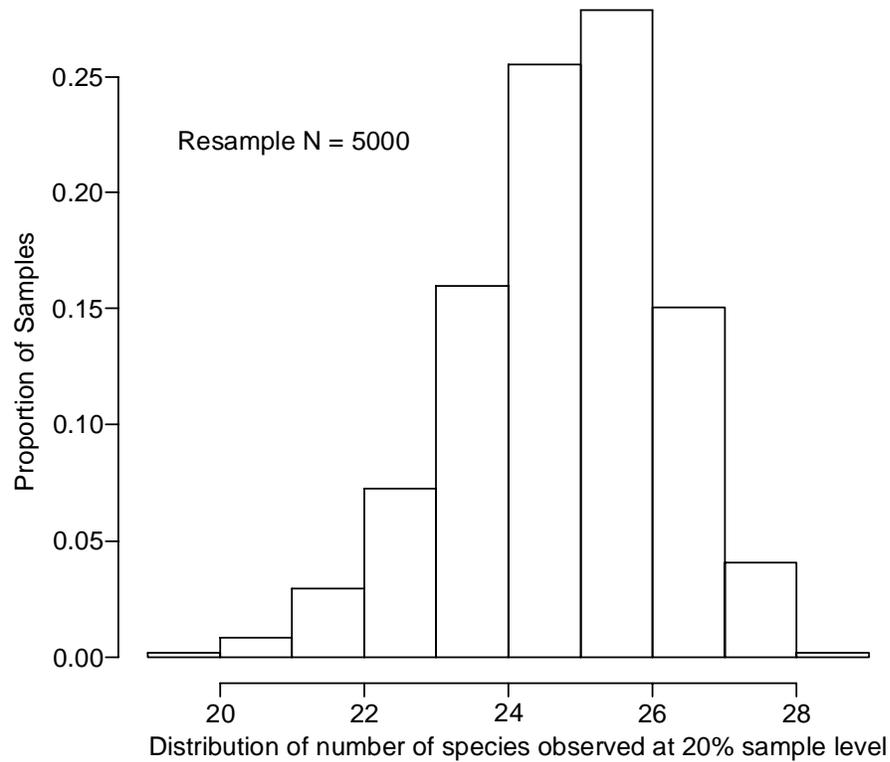


Figure 15. West coast longline (2) distribution of species observed at 20% coverage.

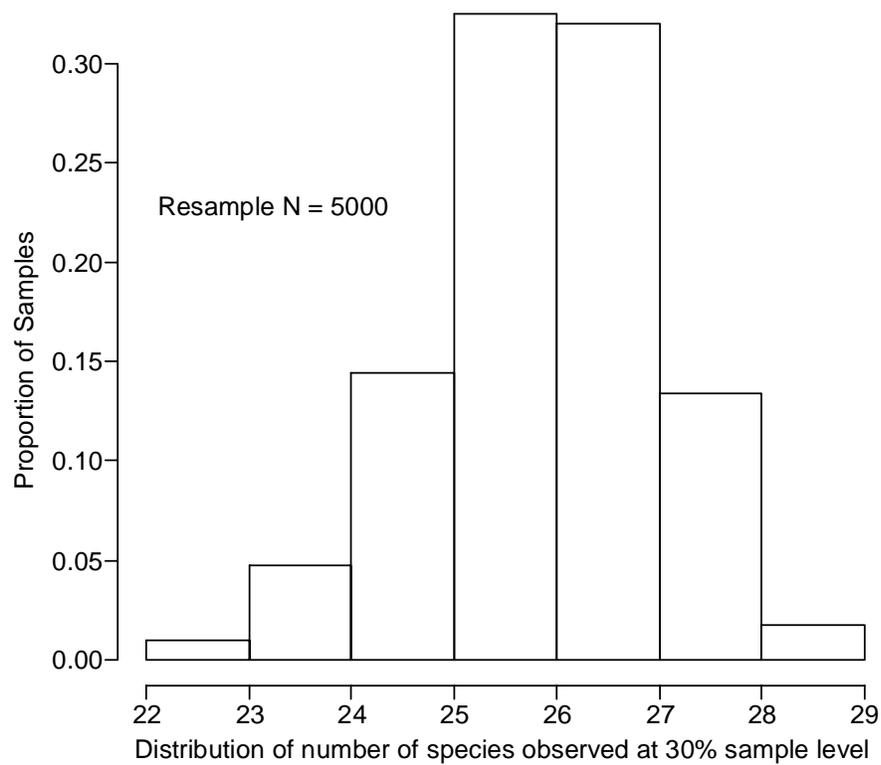


Figure 16. West coast longline (2) distribution of species observed at 30% coverage.

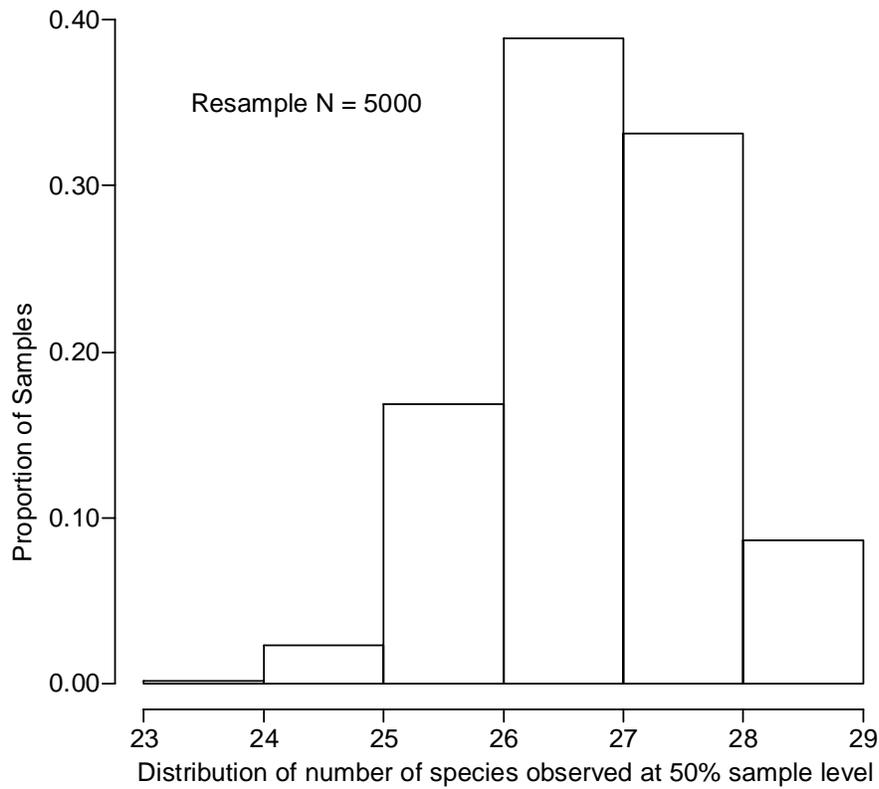


Figure 17. West coast longline (2) distribution of species observed at 50% coverage.

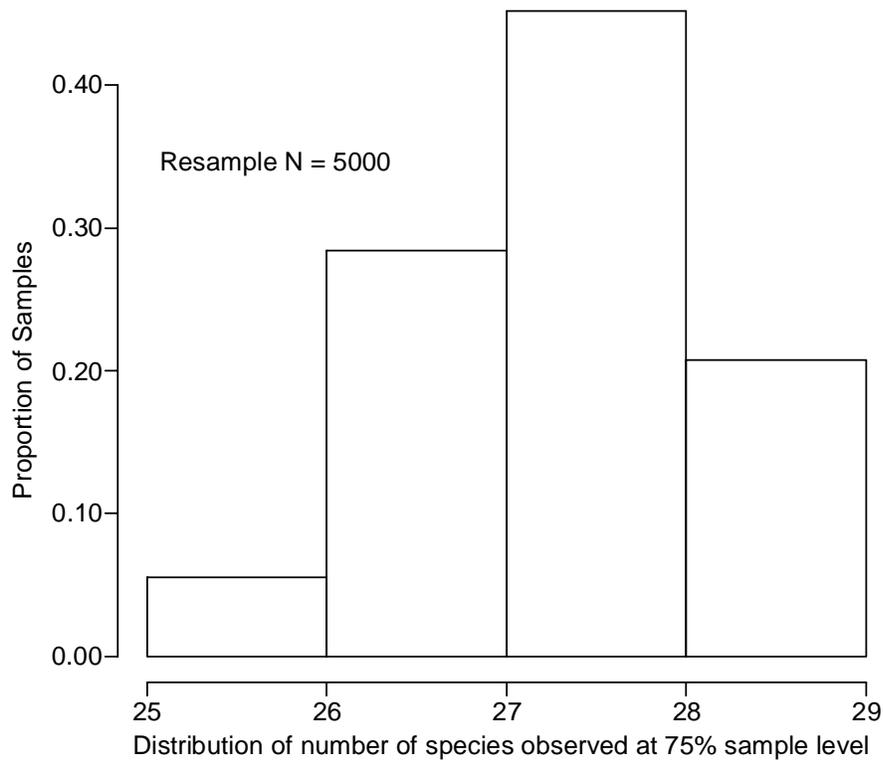


Figure 18. West coast longline (2) distribution of species observed at 75% coverage.

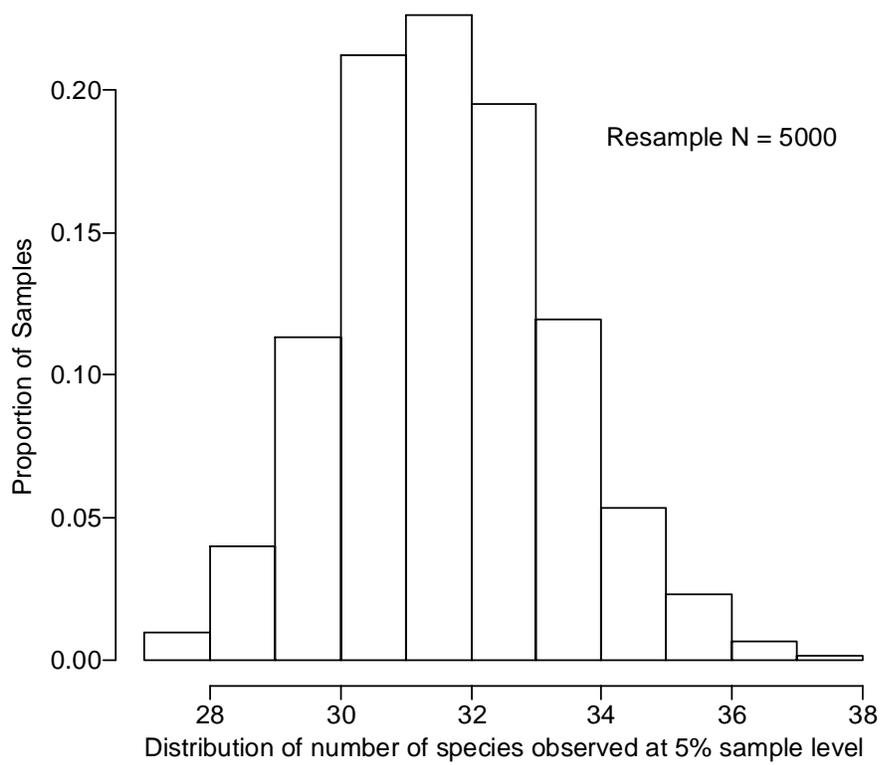


Figure 19. Hawaii longline distribution of species observed at 5% coverage.

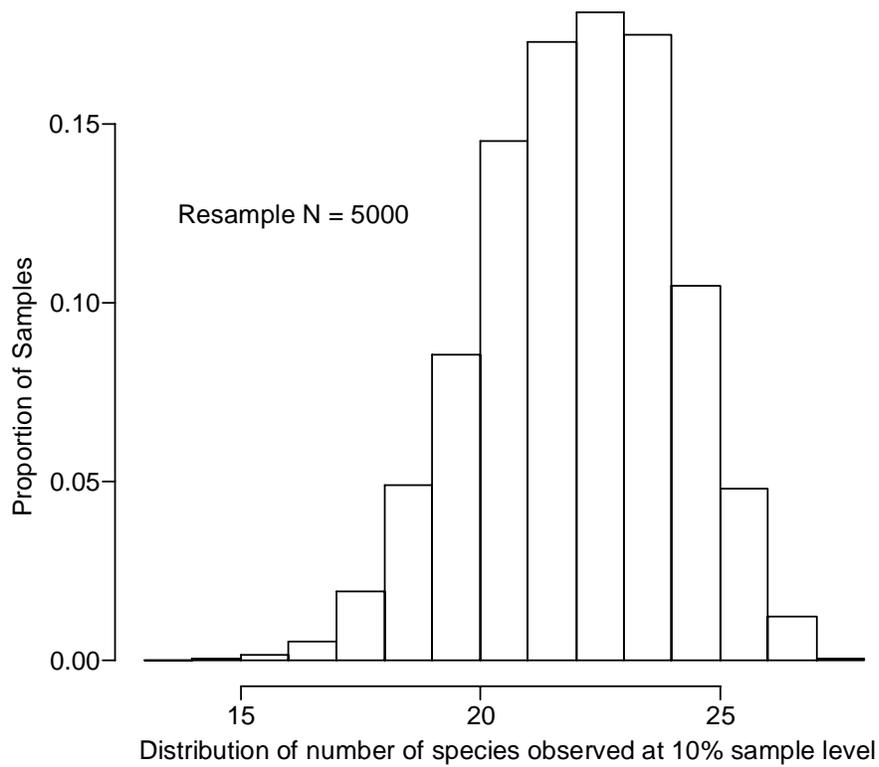


Figure 20. Hawaii longline distribution of species observed at 10% coverage.

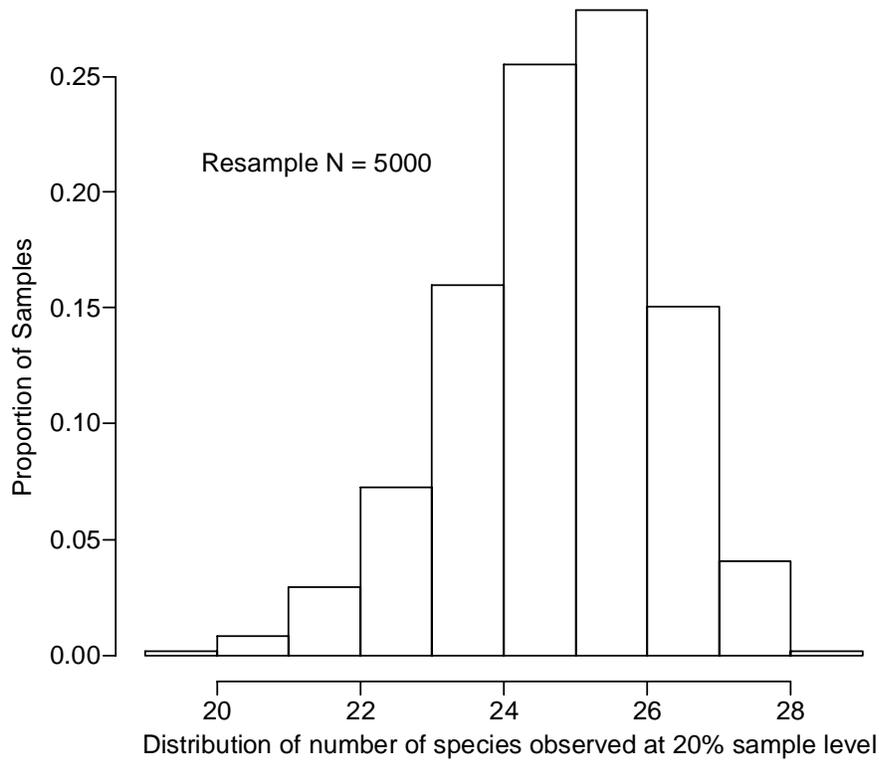


Figure 21. Hawaii longline distribution of species observed at 20% coverage.

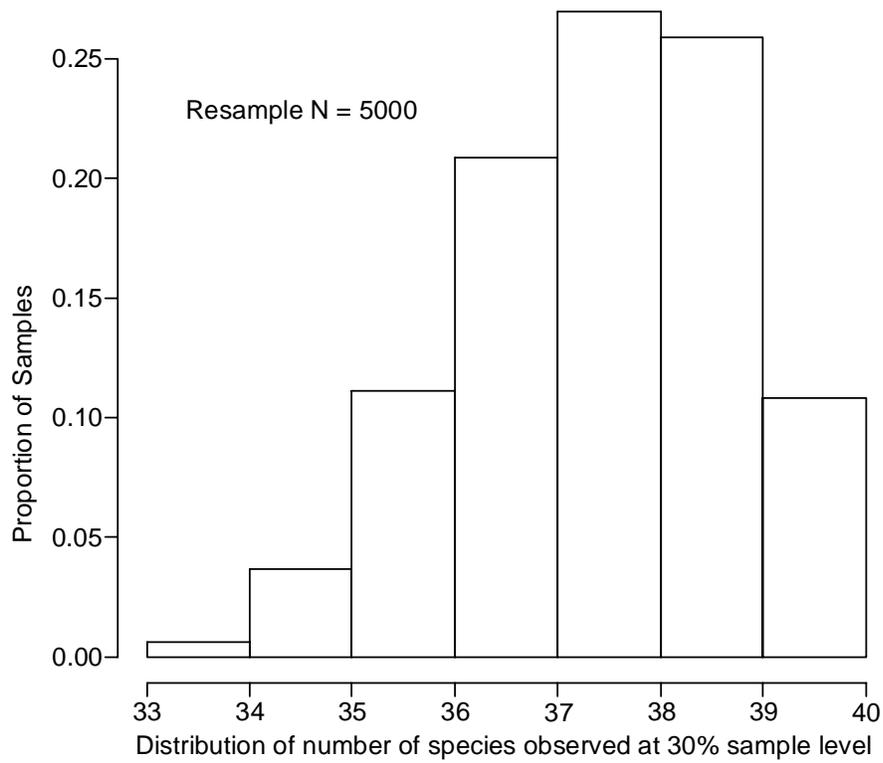


Figure 22. Hawaii longline distribution of species observed at 30% coverage.

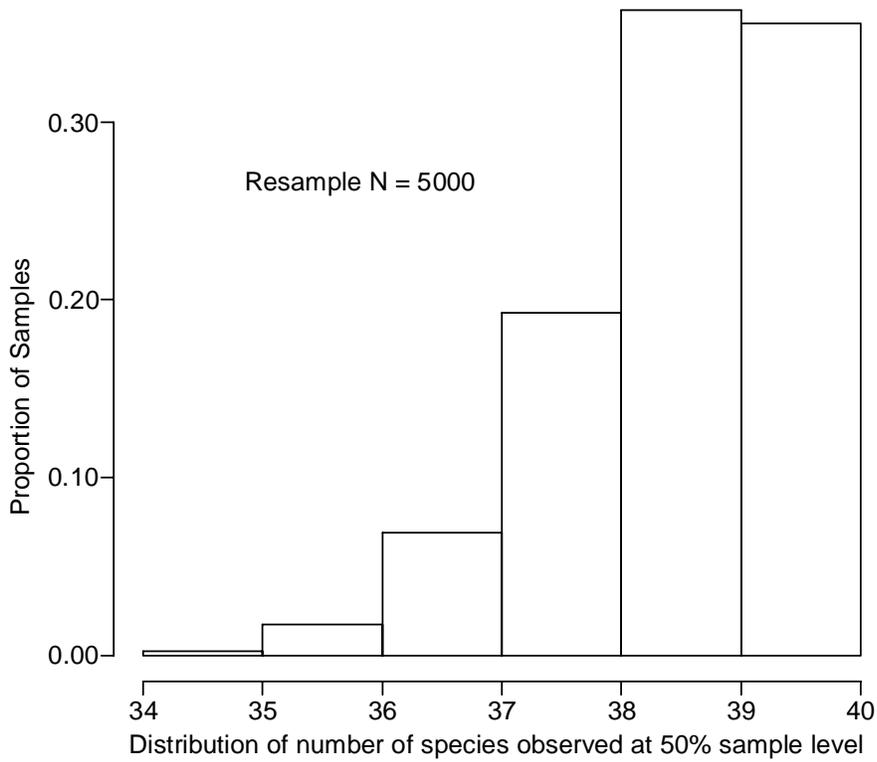


Figure 23. Hawaii longline distribution of species observed at 50% coverage.

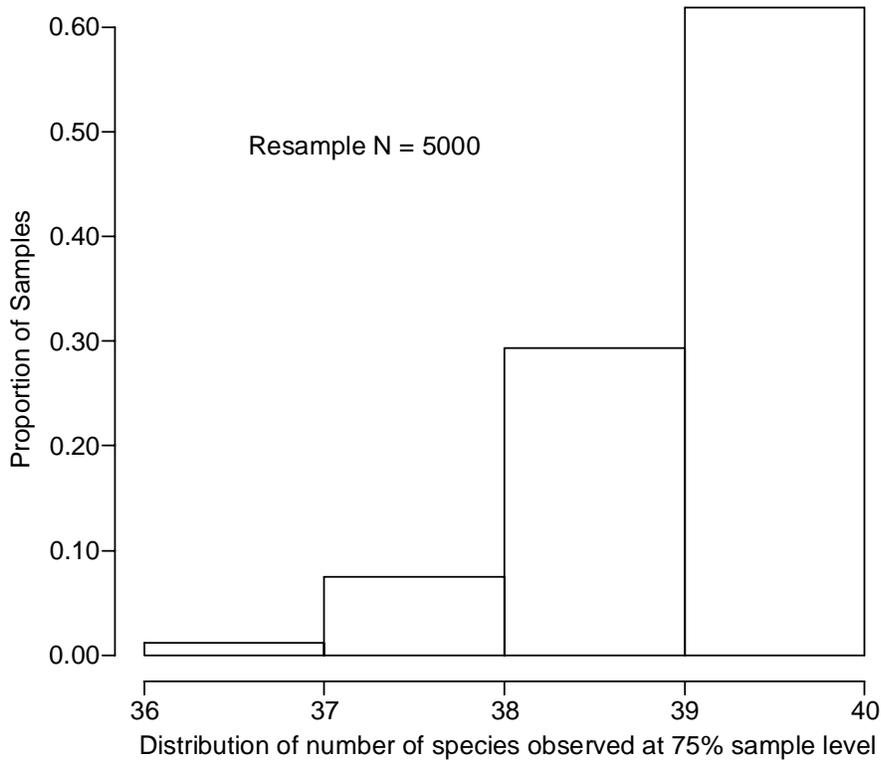


Figure 24. Hawaii longline distribution of species observed at 75% coverage.

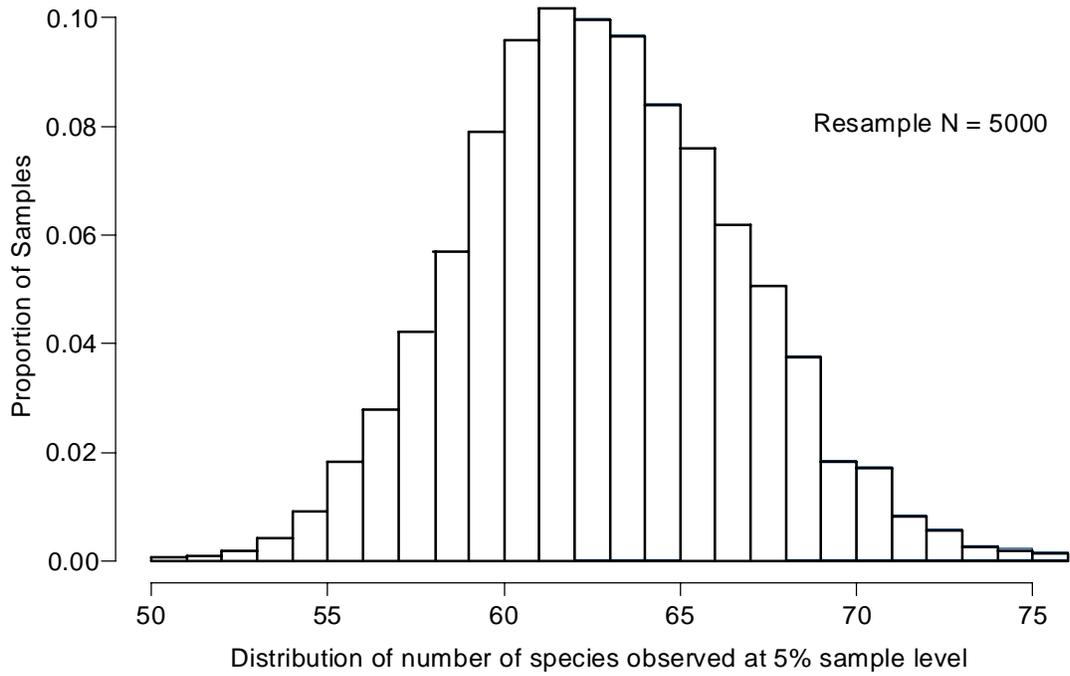


Figure 25. Atlantic longline distribution of species observed at 5% coverage.

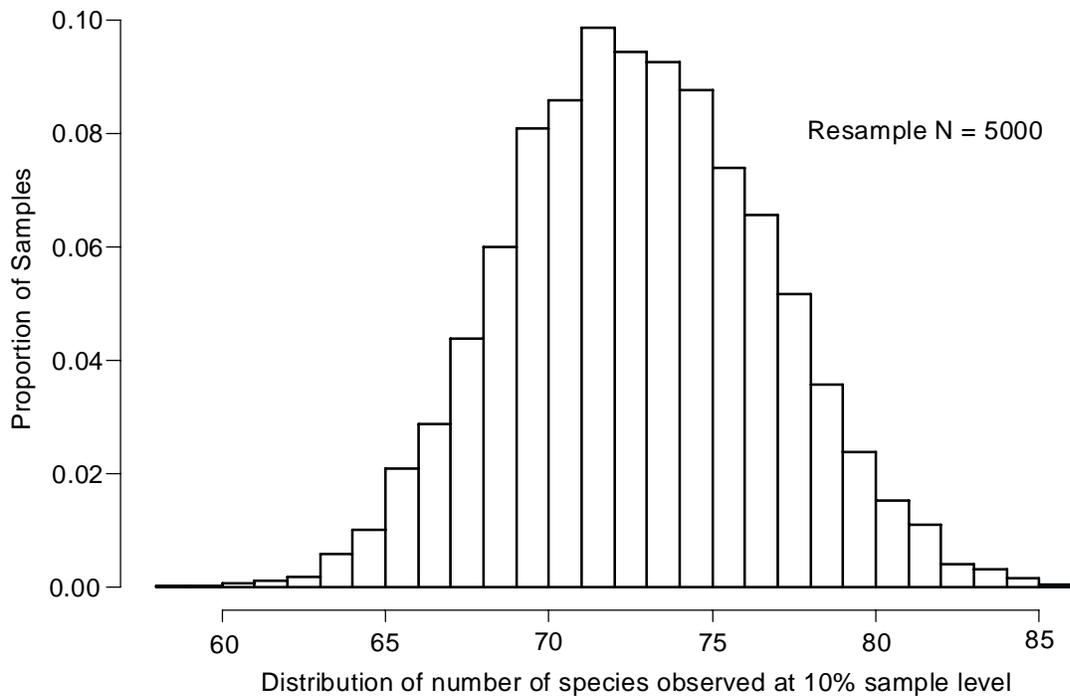


Figure 26. Atlantic longline distribution of species observed at 10% coverage.

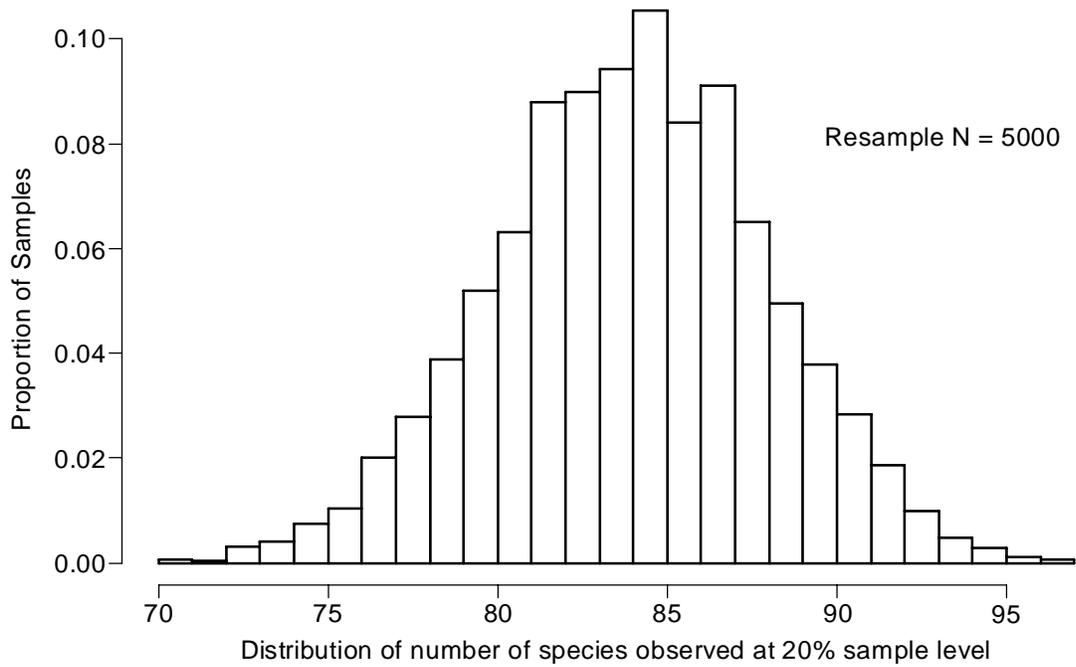


Figure 27. Atlantic longline distribution of species observed at 20% coverage.

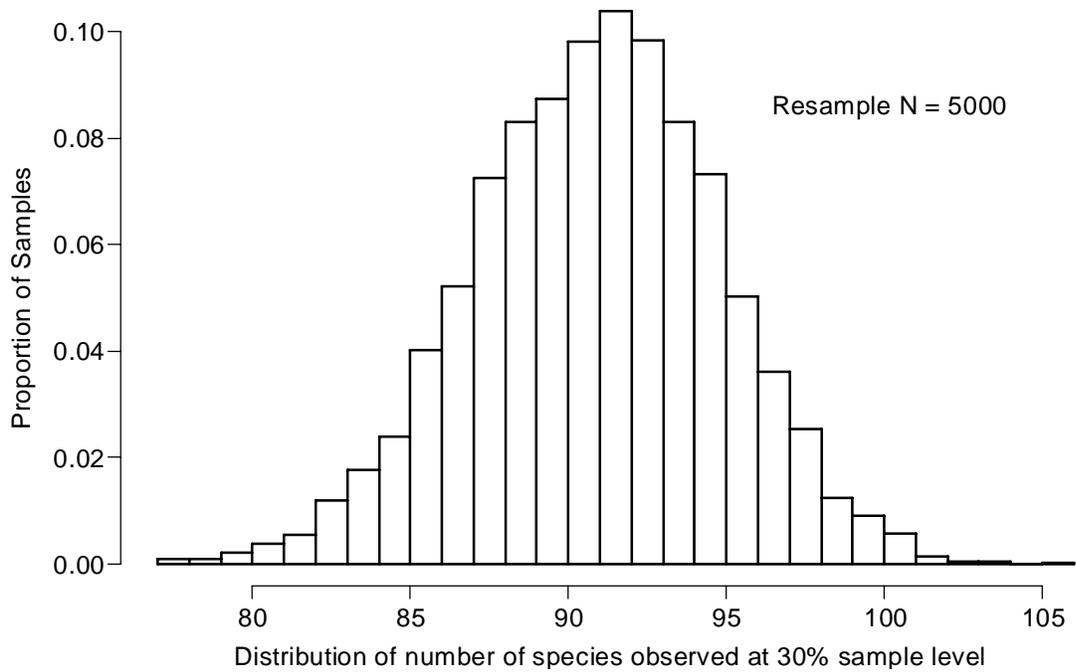


Figure 28. Atlantic longline distribution of species observed at 30% coverage.

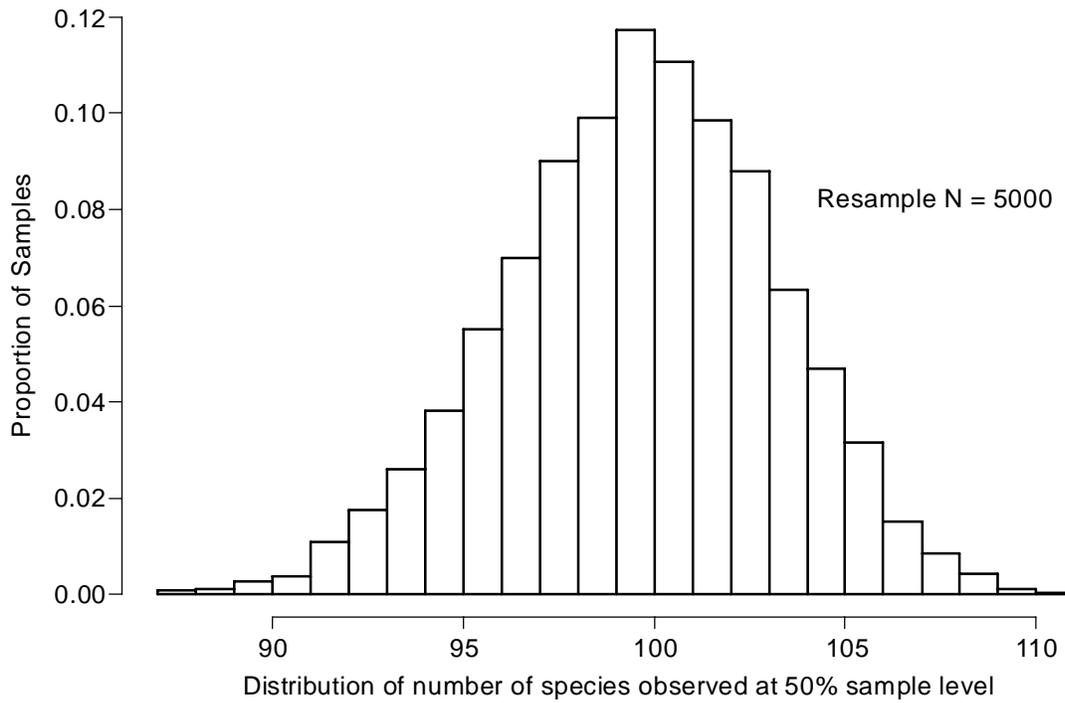


Figure 29. Atlantic longline distribution of species observed at 50% coverage.

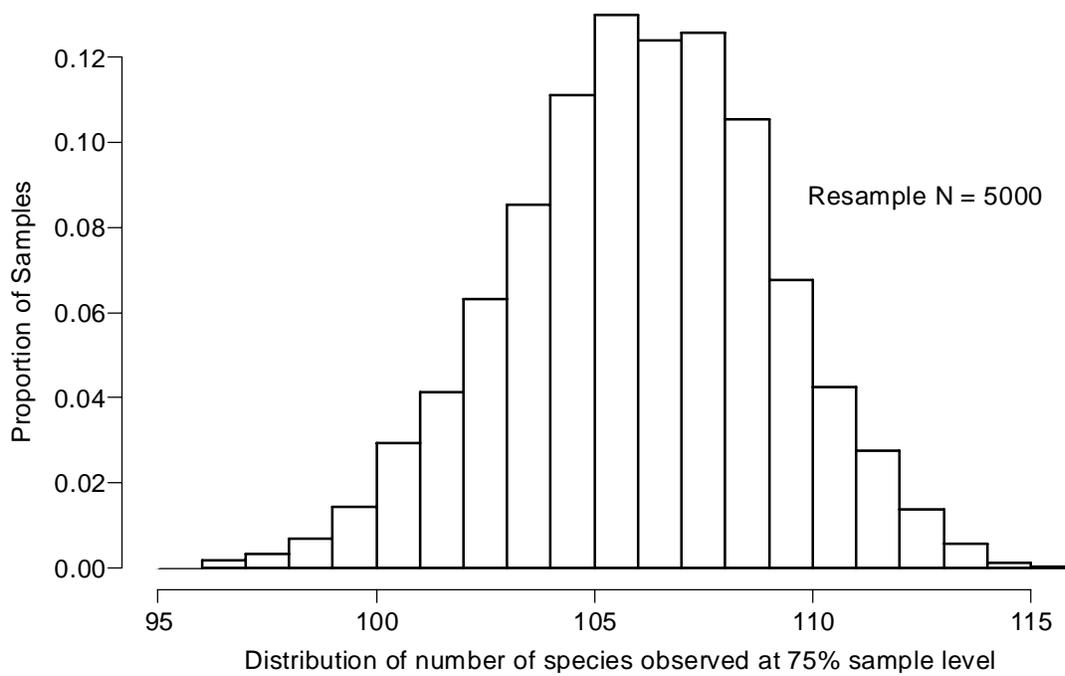


Figure 30. Atlantic longline distribution of species observed at 75% coverage.

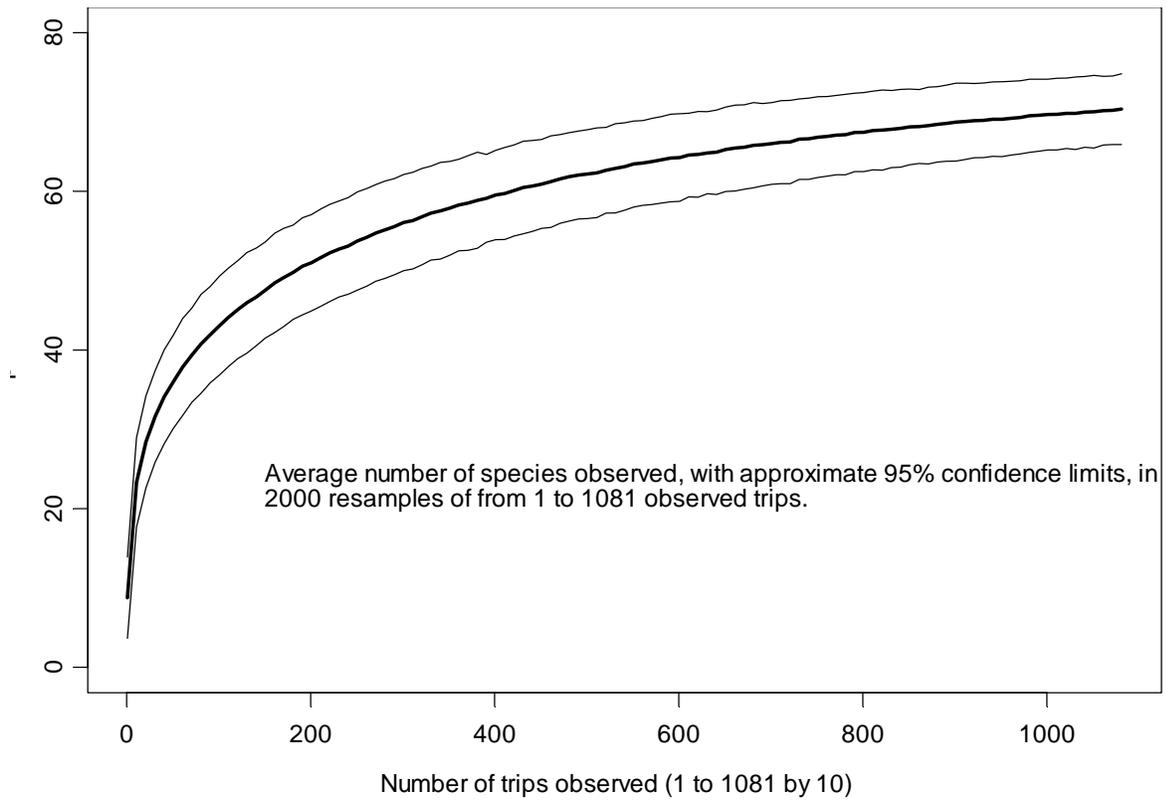


Figure 31. Rate of encounter, plotted as the cumulative number of species observed per total trips observed for drift gillnet observer program.

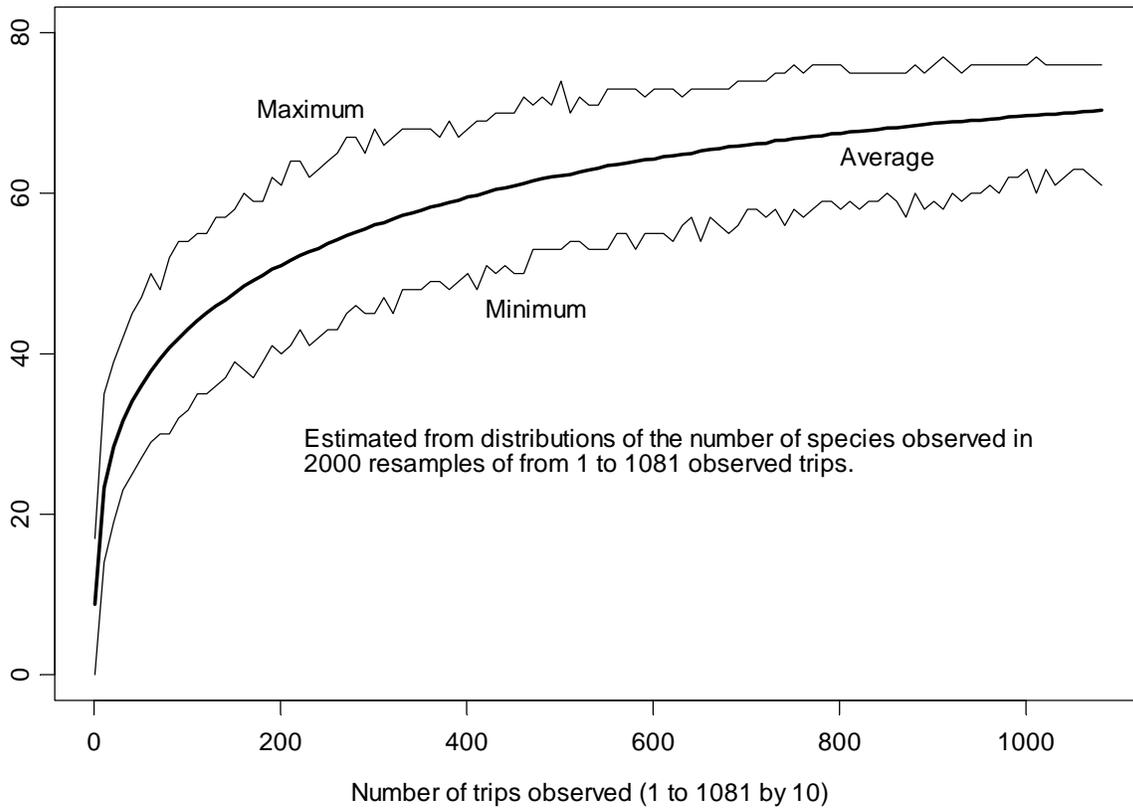


Figure 32. Rate of encounter, plotted as the cumulative number of species observed per total trips observed for drift gillnet observer program.

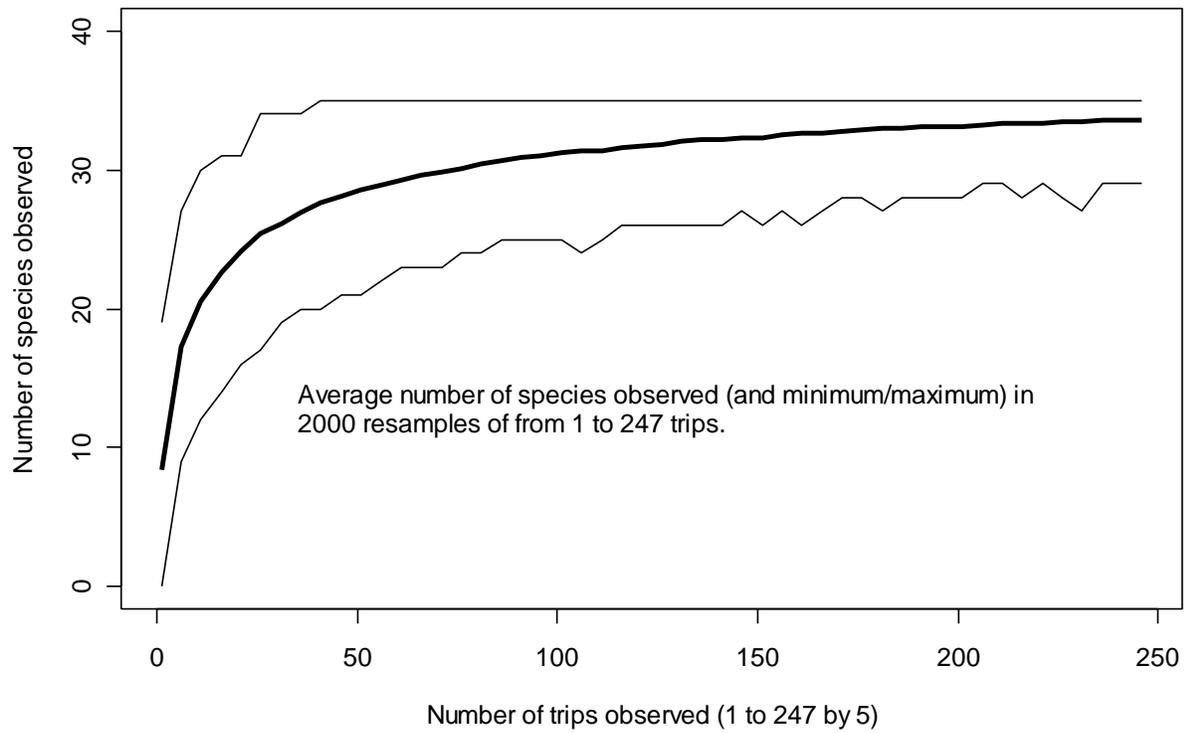


Figure 33. Rate of encounter, plotted as the cumulative number of species observed per total trips observed for the west coast pelagic longline (WCLL1) observer program.

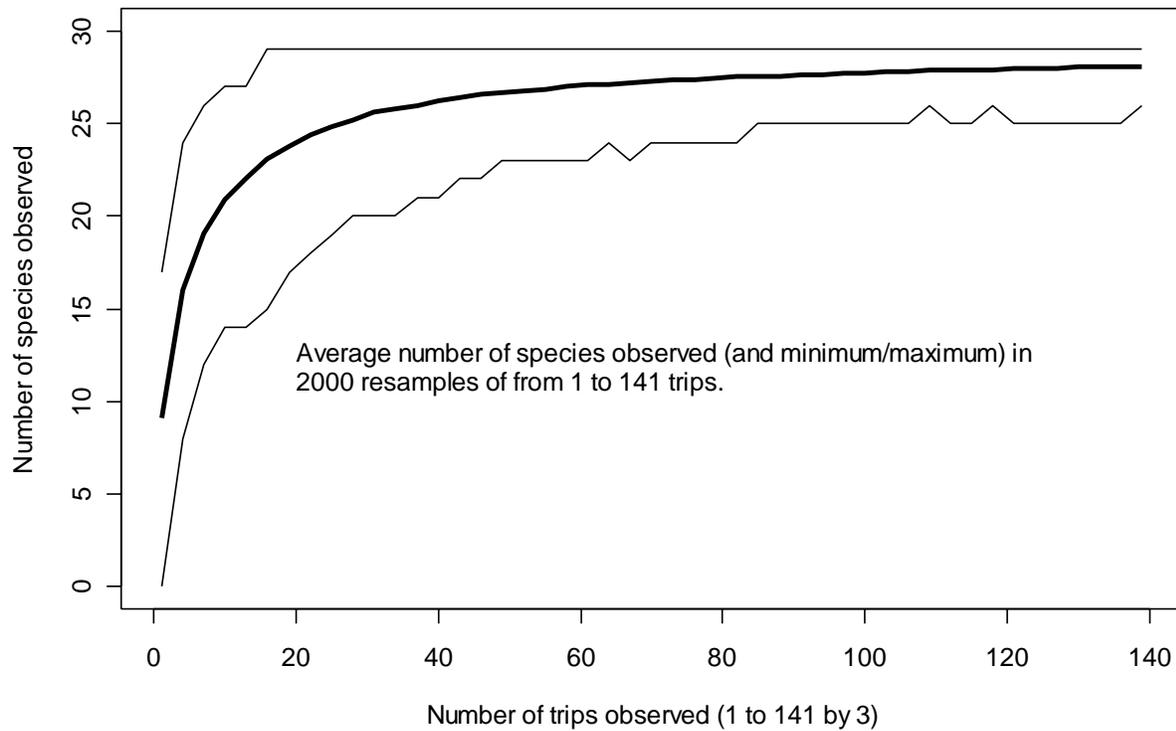


Figure 34. Rate of encounter, plotted as the cumulative number of species observed per total trips observed for the west coast pelagic longline (WCLL2) observer program.

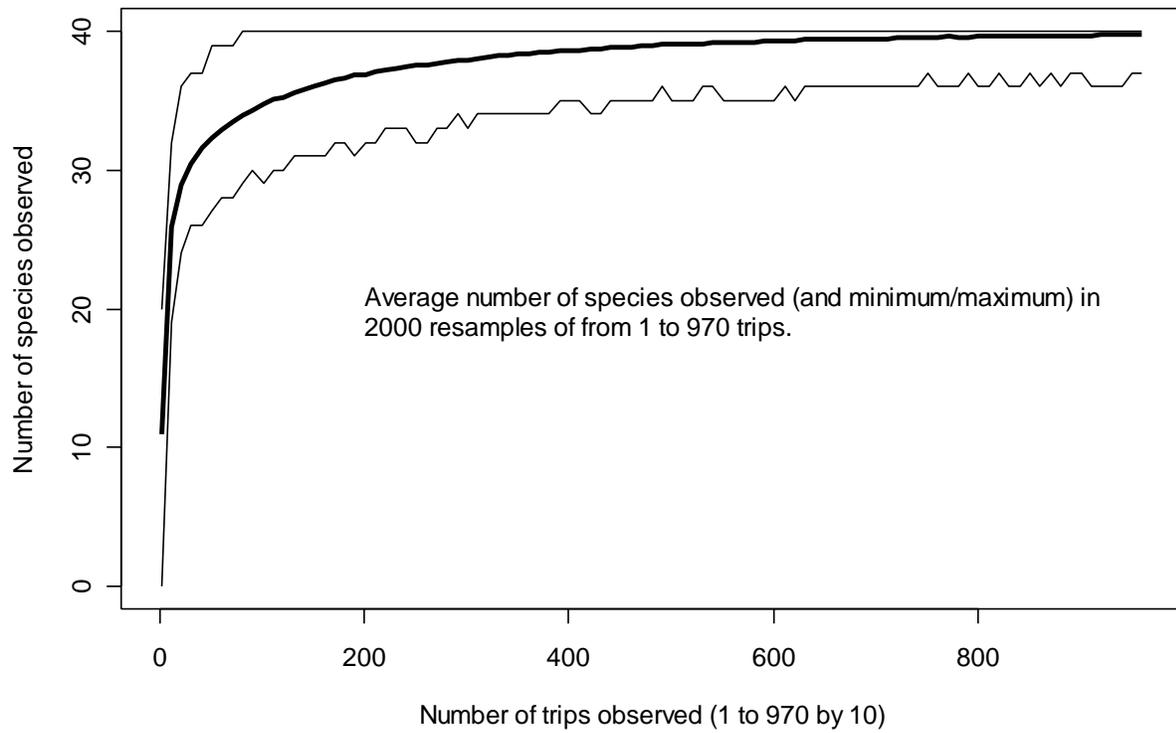


Figure 35. Rate of encounter, plotted as the cumulative number of species observed per total trips observed for Hawaii longline observer program.

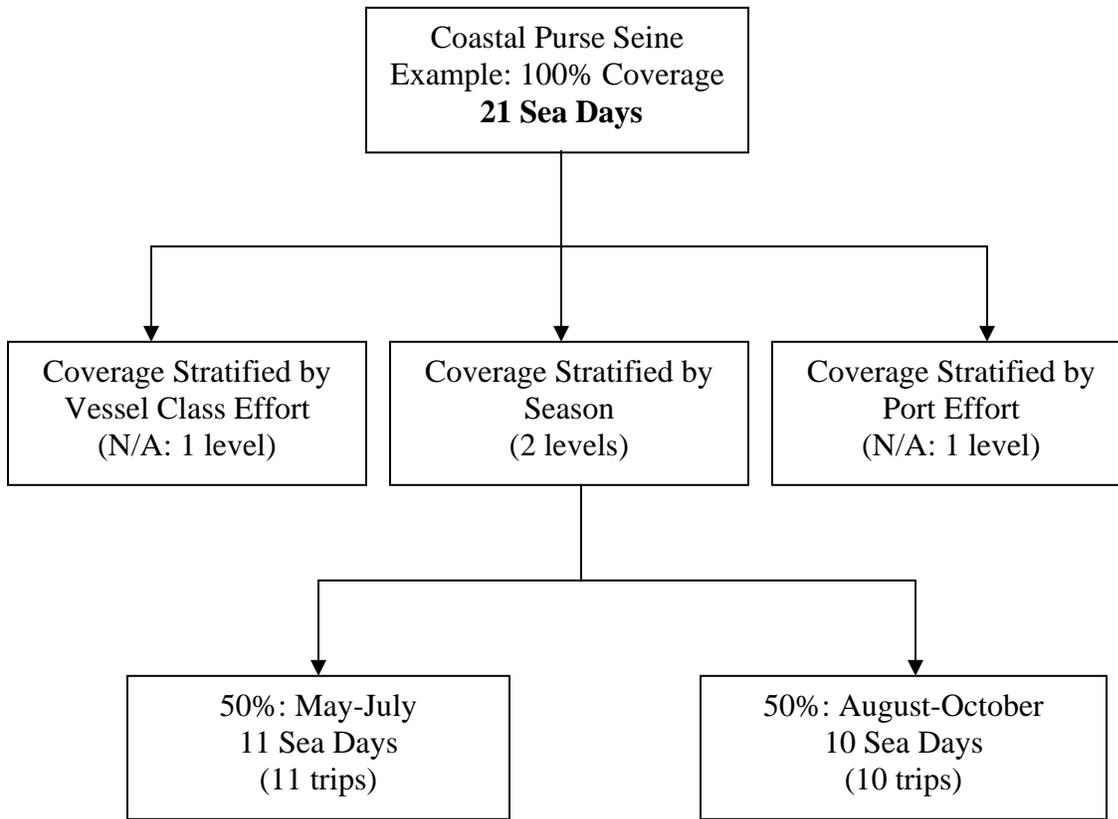


Figure 36. Flow diagram illustrating the stratification model for season, port and vessel class in the coastal purse seine fleet. For reference, observer effort (in days) was calculated for the 100% observation/coverage level.

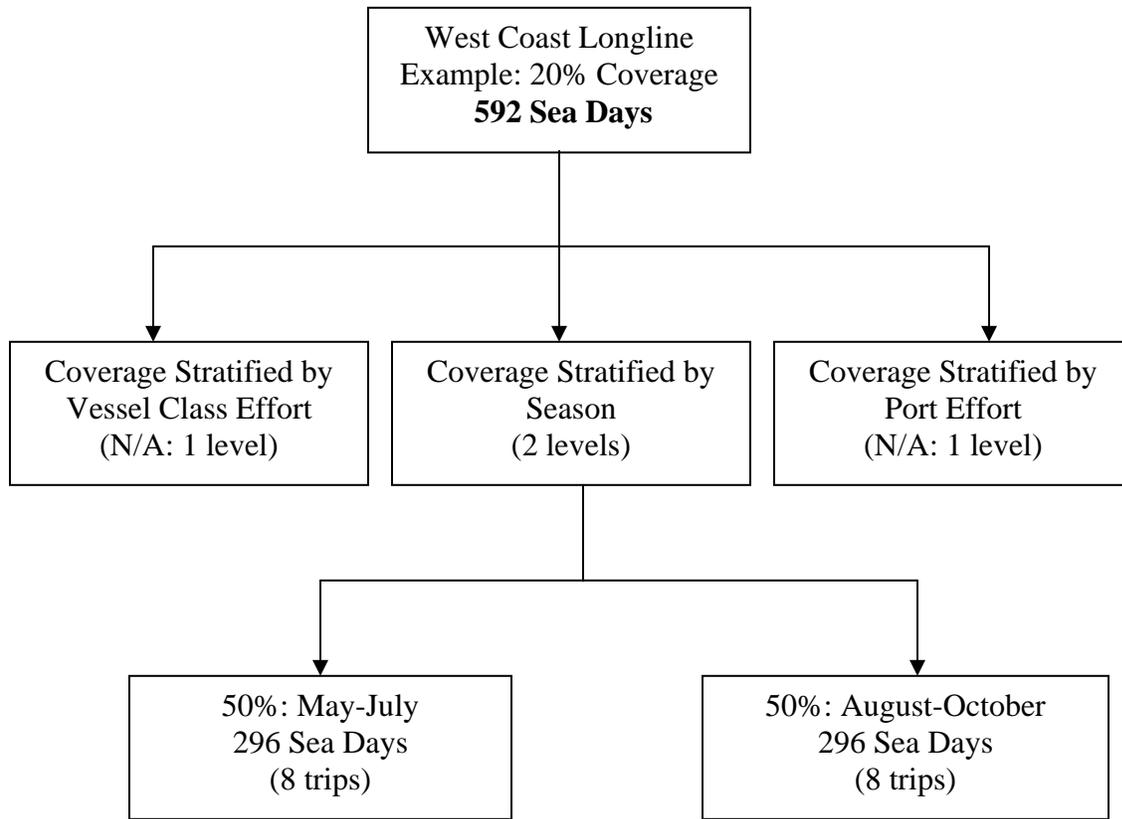


Figure 37. Flow diagram illustrating the stratification model for season, port and vessel class in the west coast longline fleet. For reference, observer effort (in days) was calculated for the 20% observation/coverage level.

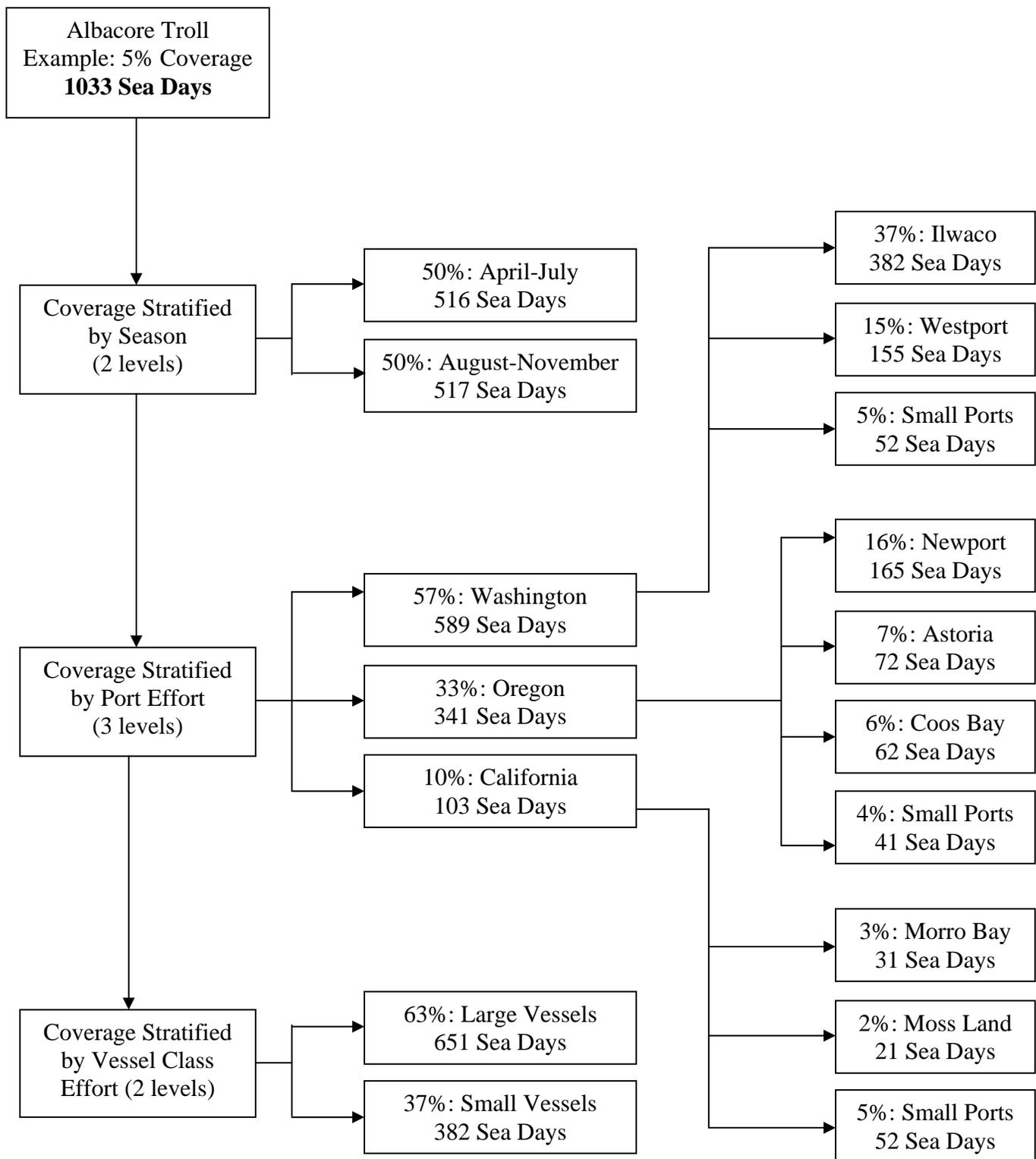


Figure 38. Flow diagram illustrating the stratification model for season, port and vessel class in the albacore troll fleet. For reference, observer effort (in days) was calculated for the 5% observation/coverage level.

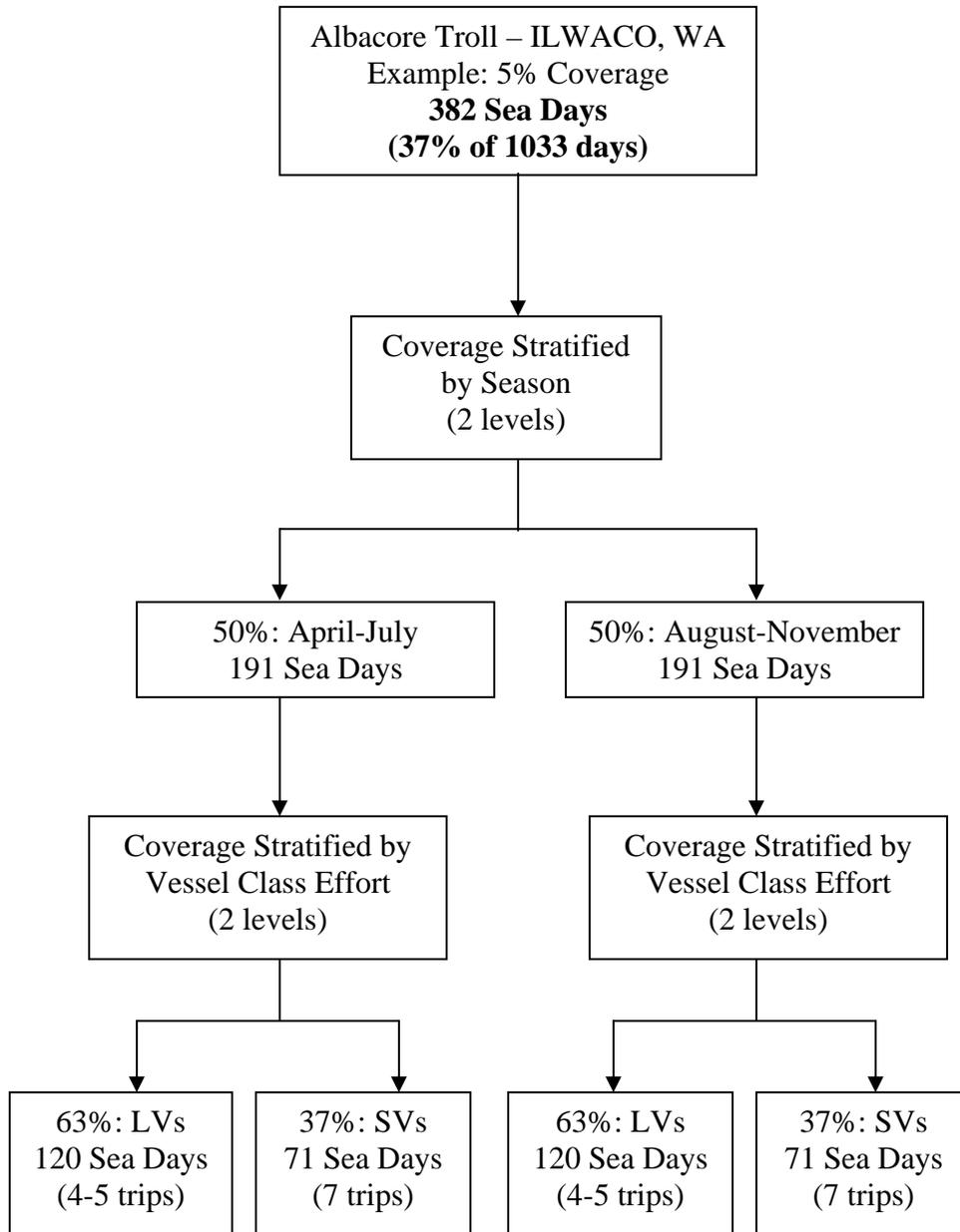


Figure 39. Flow diagram illustrating the stratification of observer coverage by season and vessel class for the albacore troll fishery based at Ilwaco, Washington. For reference, observer effort (in days) was calculated for the recommended 5% observation/coverage level. LV=Large Vessel, SV=Small Vessel

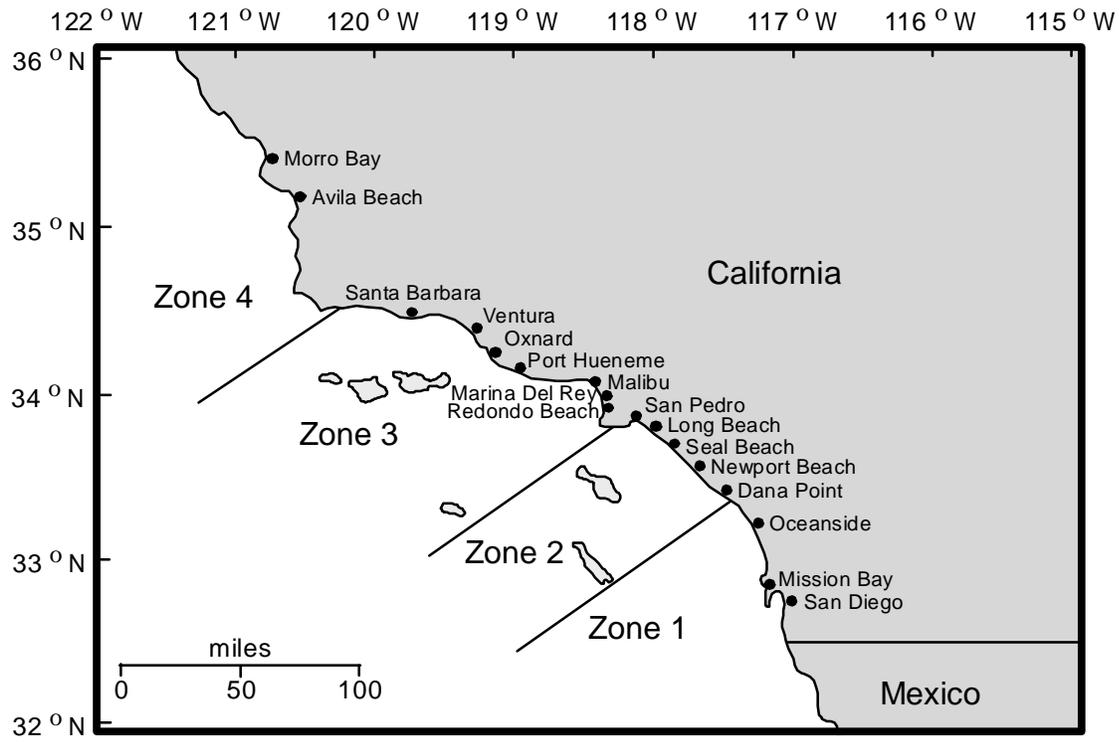


Figure 40. Regions fished by Southern California HMS CPFV fleet with major recreational ports and the four geographic zones illustrated.

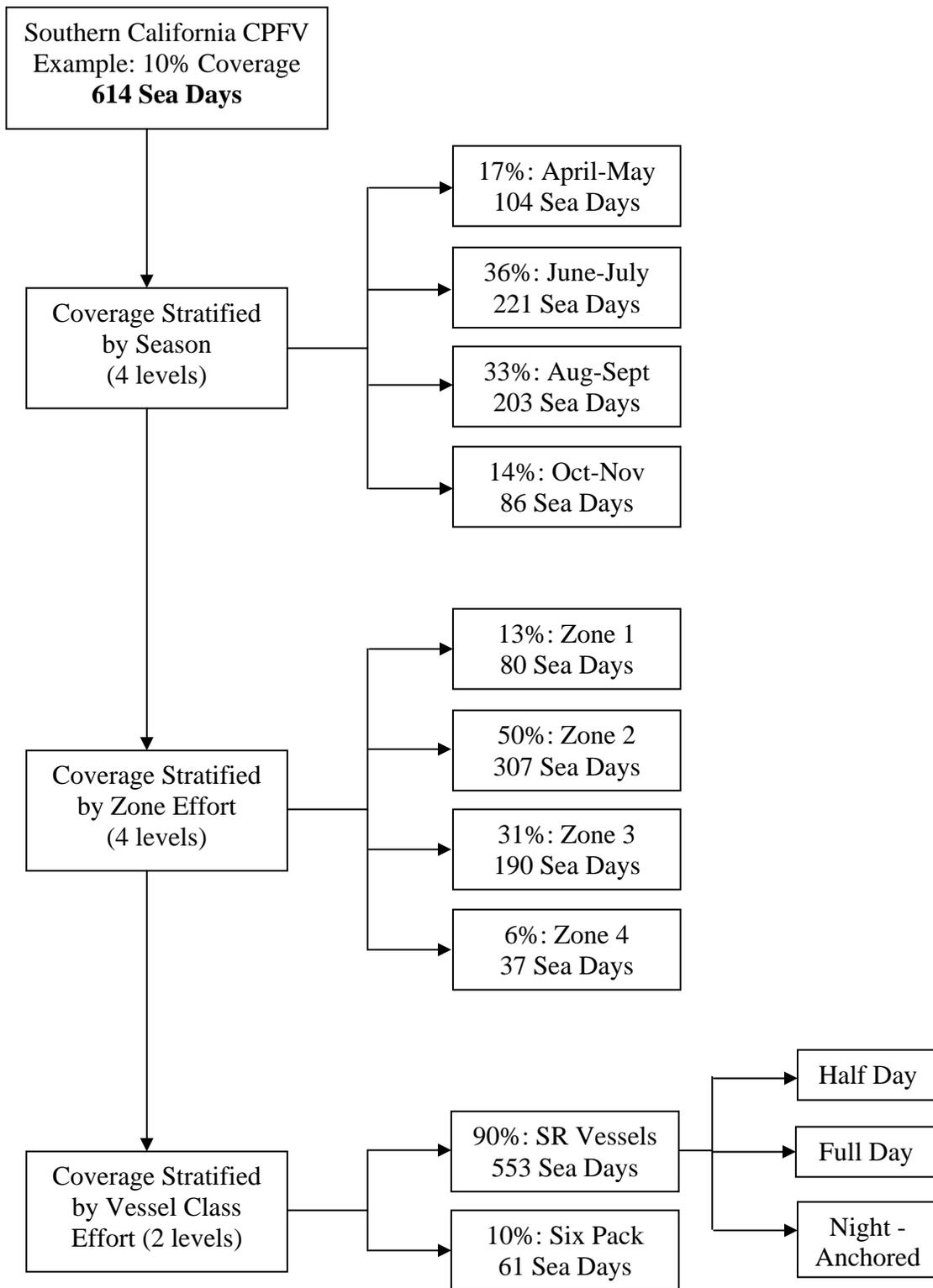


Figure 41. Flow diagram illustrating the stratification model for season, zone and vessel class in the Southern California CPFV fleet. For reference, observer effort (in days) was calculated for the 10% observation/coverage level.

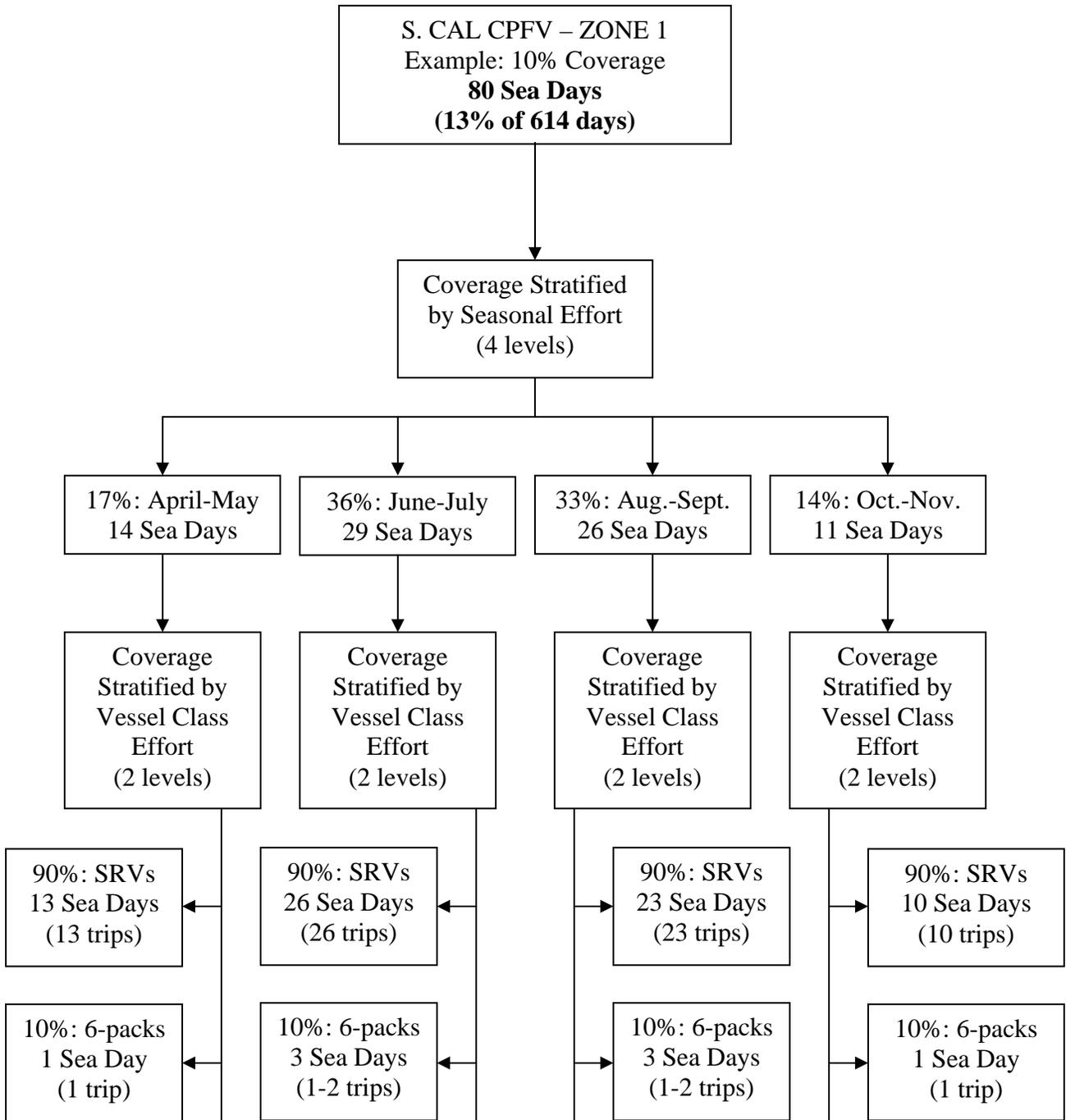


Figure 42. Flow diagram illustrating the stratification of observer coverage by season and vessel class within Zone 1 for the Southern California CPFV fleet. For reference, observer effort (in days) was calculated for the 10% observation/coverage level. Note: Diel fishing pattern within SR vessel class (i.e. half day, full day, night-anchored) is not shown.

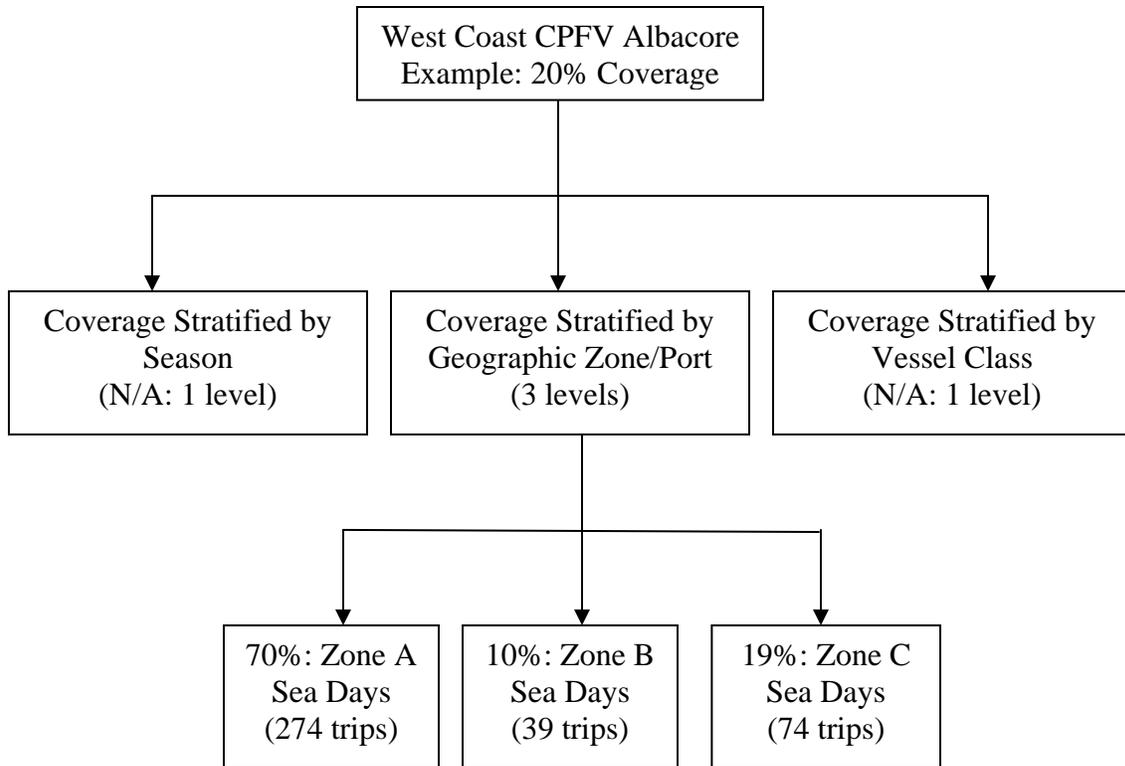


Figure 43. Flow diagram illustrating the stratification model for season, zone and vessel class in the albacore CPFV fleet. For reference, observer effort (in trips) was calculated for the 20% observation/coverage level.

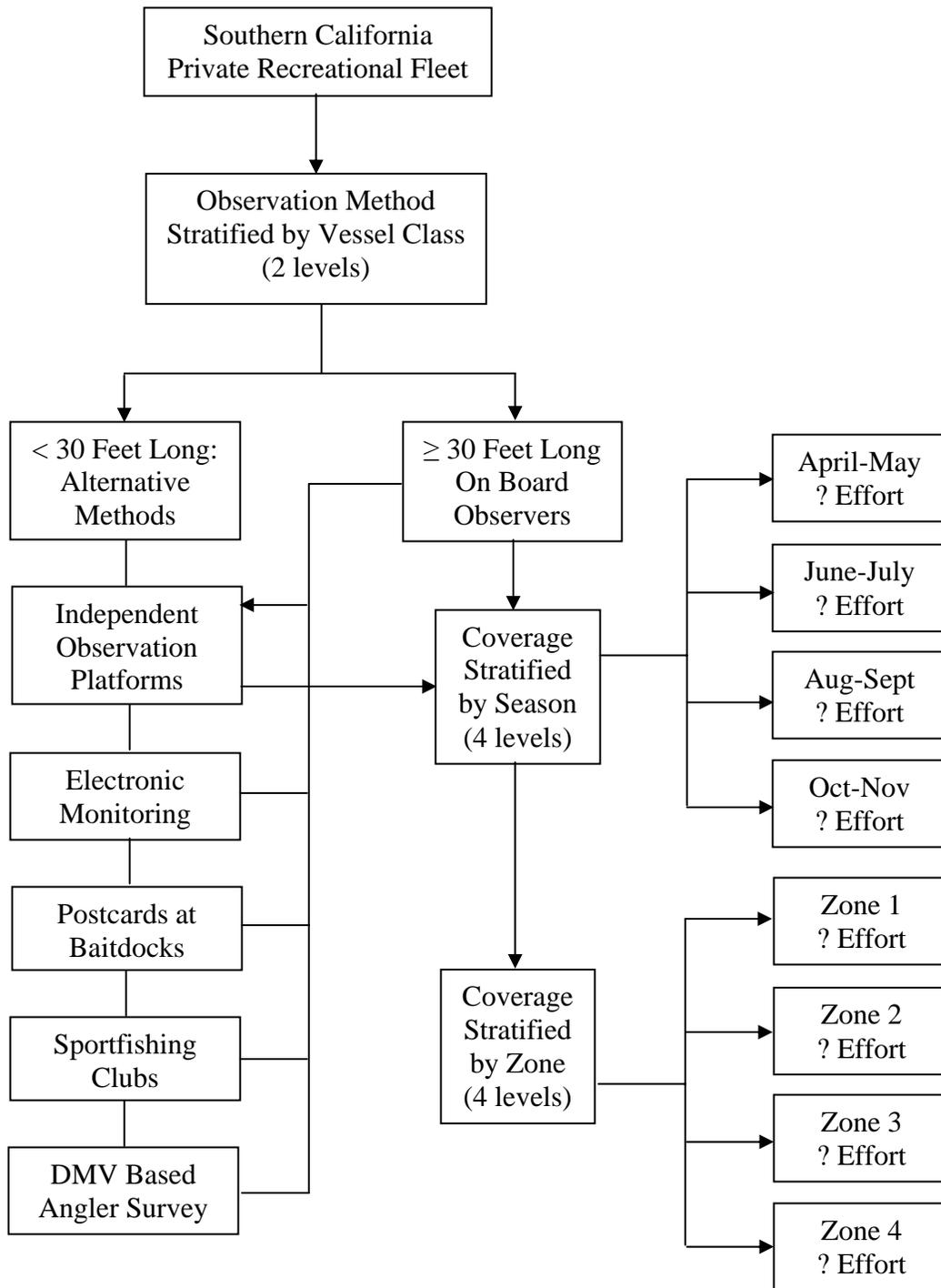


Figure 44. Flow diagram illustrating the stratification model for vessel class, season and geographic zone in the Southern California private recreational fleet. For reference, alternative methods that do not require on board observers are also presented.

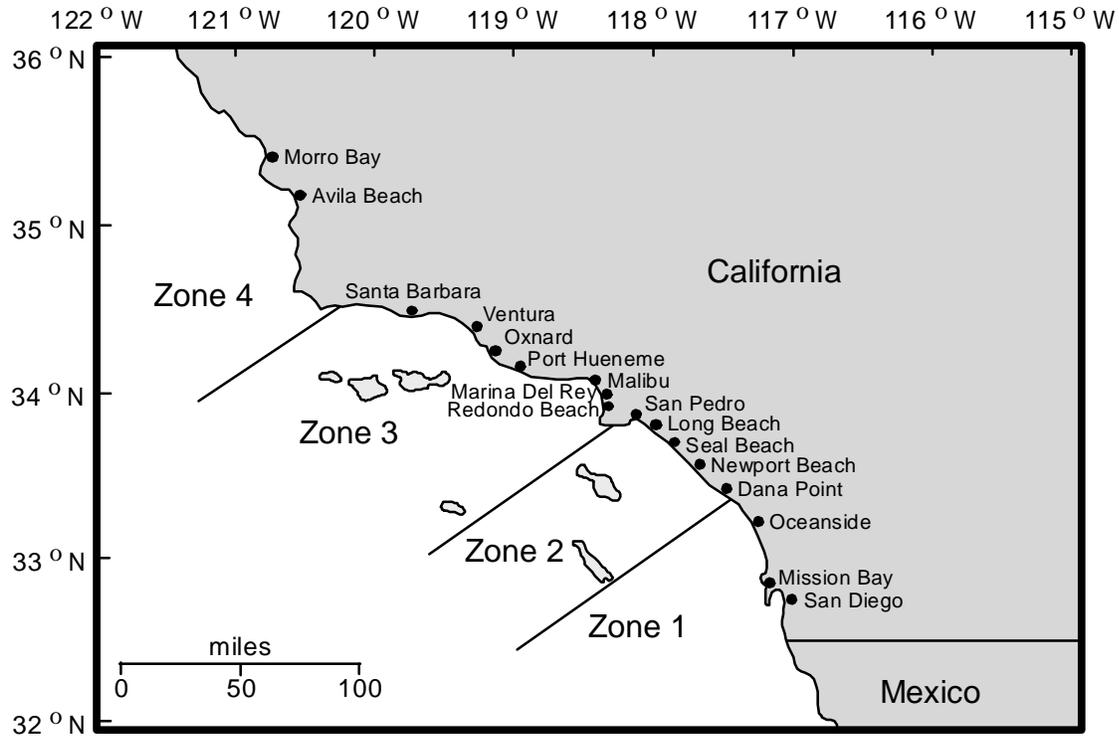


Figure 45. Southern and Central California regions fished by HMS private recreational fleet with major recreational ports and the four geographic zones illustrated.

APPENDIX A. Summary Table of Existing Observer Programs

	Vol/Mandatory	Funding	Observer provider	Target sp.	Bycatch	Incidental Catch	Active vessels	Effort	Percent Observed	Observers
Hawaii Swordfish-Tuna Longline Observer Program	Mandatory	NMFS	Contractor	Swordfish, tunas	Sharks, stingray, mackerel, escolar, oilfish, mola, manta ray, remoras	Turtle, seabirds, cetaceans	110	12,500 days annually	25%	35
West Coast Pelagic Longline Observer Program	Voluntary	NMFS	Contractor	Swordfish	Blueshark	Turtles, albatross, cetaceans	21	65 sets in 2003	12%	8
CA/OR Drift Gillnet Observer Program	Mandatory	NMFS	Contractor	Swordfish, shark	Blue shark, mola, pelagic ray, striped marlin	Cetaceans, pinnipeds, turtles	80	1650 sets annually	23%	20
SEFSC Pelagic Longline Observer Program	Mandatory	NMFS	NMFS certified contractors	Swordfish	Billfish, sharks, bluefin tuna, escolar	Marine mammals, turtles, seabirds	150-200	12,000 sets annually	2.5% to >5%	10
West Coast Groundfish Observer Program	Mandatory	NMFS	Contractor (PSMFC)	Groundfish	Groundfish		250	U/K	9%	40
Alaska Marine Mammal Observer Program	Mandatory	MMPA	Contractor	Salmon	Flatfish	Porpoises; 5 sp seabirds	559	86280 sets in 99 + 00	<5%	10-20 2002:11 obs
Offshore Pacific Whiting Observer Program	Voluntary	NMFS and Industry	Contractor	Whiting	Rockfish, salmon	Dolphins, porpoises, pinnipeds	28	251 days in 2003	100%	20

SER Shark Bottom Longline Observer Program	Mandatory	NMFS	Contractor	Coastal sharks	Turtles	U/K	643	6.2 million hook hours 94-01	2-4%	U/K
Southeastern Shrimp Otter Trawl Fishery	Voluntary	NMFS	Individual observers contracted	shrimp	snapper, groundfish, croaker, porgy	Dolphins, manatees, sea turtles	6,000	250,000 days annually	<<1%	1-30 currently 7
North Pacific & Bering Sea Groundfish Trawl & Fixed Gear Fishery Observer Program	Mandatory	NMFS	Contractor	Groundfish	Halibut, salmon, crab	Marine mammals, seabirds	350	N/A	30-100% by vessel length	500
SEFSC Shark Drift Gillnet Observer Program	Mandatory	NMFS	Individual observers contracted	Coastal sharks	Wide variety	Bottlenose dolphins, sea turtles	4-6	65 sets annually	100%	1-6
Northwest Atlantic Sustainable Fisheries Support	Mandatory	NMFS	NMFS and contractor	Groundfish, monkfish, flounder, squid, mackerel, scup, dogfish, weakfish, bluefish, croaker, sea bass, swordfish, tunas, scallops, lobster	Finfish, invertebrates	Dolphins, pilot whales, turtles, seabirds,	U/K	49,871 days	>1%	U/K

New England and Mid-Atlantic Gillnet Fisheries	Mandatory	NMFS	NMFS and contractor	Cod, pollock, flounders, dogfish, monkfish, croaker, weakfish, bluefish, menhaden, shad, spot, mackerel, striped bass	finfish	Cetaceans, pinnipeds, turtles	1,000	U/K	2-5%	U/K
Atlantic Sea Scallop Dredge Fishery - Georges Bank	Mandatory	NMFS and vessel owners	Individual observers contracted	Scallop	crabs, hake, flounder	None	185	3-6 trips per boat	U/K	U/K
Canadian Department of Fisheries and Oceans (DFO) Atlantic Region Observer Program	Mandatory	DFO and industry	Contractors	shellfish, pelagic fish, groundfish					5%-20% by fishery	180
British Columbian Domestic Groundfish Trawl Fishery Observer Program	Mandatory	DFO and industry	Contractors	Groundfish	Halibut		75		100%	75