NORTHWEST FISHERIES SCIENCE CENTER
WEST COAST GROUNDFISH OBSERVER PROGRAM
INITIAL DATA REPORT AND SUMMARY ANALYSES

January 2003

Introduction

Goals of this Report.

This report is the initial compilation of 2002 data report gathered from a recently established section of the West Coast Groundfish Observer Program (WCGOP). This new section of the observer program collects data onboard the west coast groundfish fleet (excluding the at-sea and shoreside whiting feet.[1]) The program's goal is to collect information on the discard[2] of west coast groundfish to be used in assessing the total fishing mortality of a variety of groundfish species. This report includes preliminary data from the first year of observations of the trawl fleet. This report also includes some initial analyses of the information. More detailed analyses will be included in subsequent reports; these analyses will be facilitated by the availability of the 2002 logbook information.

The West Coast Groundfish Fishery

The groundfish fishery off the west coast of the United States is executed from the Canadian to Mexican borders. Multiple vessel types participate in this fishery. They range in size from 8' kayaks to 120' trawlers and fish in nearshore to offshore waters. The vessels use various types of gear including bottom trawls, midwater trawls, pots, longlines and other hook and line gear to catch over 80 species of marketable fish. Trawlers take the majority of groundfish. The catch can be incredibly diverse in species and fish size and overall catch size can vary widely as well. In many cases, a portion of the catch is retained and another portion of the catch, that may be of the wrong size,

[1] The at-sea Pacific whiting fleet is monitored by another section of the WCGOP. The shoreside Pacific whiting fleet retains all catch and that catch is monitored by state port samplers.
[2] In some cases the terms bycatch and discard have been used imprecisely. These terms are not interchangeable. Bycatch is defined as the total amount of unintended catch. Discard is defined as the amount of unintended catch, which is not retained on a vessel.

species, or is over management quota limits, is discarded at sea.

Active management of the fishery began in the early 1980's with the establishment of numerical Optimal Yields (OY's) for several managed species and trip limits for widow rockfish, the *Sebastes* complex, and sablefish. The objective of trip limits was to slow the pace of landings to maintain year-round fishing, processing, and marketing opportunities. Since the 1980's, management regulations generally have evolved to the use of cumulative 2-month catch limits.

Fisheries managers use state-issued sales receipts (fish tickets) and vessel logbooks to monitor catch. Fish ticket and vessel logbook data are transferred to the Pacific Fisheries Information Network (PacFIN) by state fisheries agencies in Washington, Oregon and California. The fish tickets are useful in tracking the pace of the fishery throughout the year. Trip limit quotas may be changed at any point based on this information. In order to comply with yearly total allowable catch limits (TAC's), managers also need information on the rate of discard of each species. One of the best ways to accurately estimate the amount of discarded catch is by at-sea observer programs.

Prior Studies of Bycatch in the West Coast Groundfish Fishery

During 1985-1987, a voluntary observer program was conducted primarily off Oregon (Pikitch et al. 1988; Pikitch, 1991). The total discard from all causes was determined to be from 16% to 20% of the total catch for species that were regulated by a trip limit. The same level of discard was assumed to be applicable during the 1990's even though the actual level of discard may have changed due to more restrictive but restructured trip limits. A second voluntary observer program was conducted during 1988-1990, which primarily assessed the impact of potential changes in codend mesh-size and shape in the west coast groundfish trawl fishery (Bergh et al., 1990). Pikitch et al. (1998) applied the data collected from these two observer programs to estimate bycatch of Pacific halibut and salmon in groundfish and shrimp trawl fisheries.

During 1995-1999, Oregon Department of Fish and Wildlife (ODF&W) administered the

Enhanced Data Collection Project (EDCP). The primary goal of the EDCP was to collect data on discard rates for groundfish species and to determine bycatch rates for prohibited species (salmon and Pacific halibut). Methot et al. (2000) used the data to estimate discard of sablefish, dover sole, and thornyheads. Wallace and Methot (2002) also applied the data to estimate Pacfic halibut bycatch mortality in IPHC Area 2A. Sampson (2002) applied the data to estimate average discard rates for the major species and determine the factors contributing to variability of discard rates.

Methods

West Coast Groundfish Observer Program

On May 24, 2001, NOAA Fisheries (NMFS) established the West Coast Groundfish Observer Program (WCGOP) to implement the Pacific Coast Groundfish Fishery Management Plan (50 CFR Part 660). This regulation requires all vessels that participate in the groundfish fishery to carry an observer when notified to do so by NOAA Fisheries (NMFS) or its designated agent. The observer program's goal is to improve estimates of total catch and discard. In the first phase of the program approximately 20 observers were deployed. Subsequently, with an increase in resources designated for the program, the number of observers was increased to as many as 40. These observers are stationed along the coast from Bellingham, WA to Santa Barbara, CA.

Vessel Selection Process

The initial sampling strategy for the West Coast Groundfish Observer Program aimed at providing, in the first year, observation of 10% of the coastwide landings (as reported in fish tickets) of the limited entry trawl fleet. An additional goal was to provide pilot observer coverage in the limited entry fixed gear sablefish and rockfish fisheries (Observer coverage plan: www.nwfsc.noaa.gov\fram\observer). Ports along the west coast were aggregated into "port groups". Limited entry permits in each port group were randomized and sequentially selected for observation for an entire two-month cumulative trip limit period. This selection process was designed to produce a reasonably proportional distribution of observations along the coast. Based on this design, it was

estimated that the observer program would cycle through the limited entry trawl fleet every two years.

In addition to the selection of trawl permits, some limited entry fixed gear permits initially were selected the same way. However, fixed gear permits are now selected for the entire sablefish season to ensure that the total quota fished on each selected permit is observed. The program now expects to cover all the limited entry fixed gear vessels within four years (2001-2004).

Selected permit owners receive written notification from the NOAA Fisheries (NMFS) about two-months prior to the beginning of observation period. Observer program staff then determines the vessel's intention to fish groundfish, confirm their primary port, and assign an observer to the vessel. During a preboarding meeting, the observer confirms that the mandatory safety gear is aboard, addresses any concerns of the vessel crew and captain and makes arrangements for sampling and berth space. Vessels are required to inform NOAA Fisheries (NMFS) or its designated agent 24 hours prior to the beginning of each fishing trip during the period to be observed.

Vessels that indicate that they do not plan to fish groundfish in the selected period are placed in a holding category. However, these vessels are required to notify NOAA Fisheries (NMFS) when they next plan to fish groundfish. In addition, vessels that are selected but do not get covered during a trip limit period are carried over to the next trip limit period. These vessels are then observed during next period in which they fish.

General Data Collections

The fisheries observers are trained professionals who monitor and record catch data on commercial fishing vessels, following the protocols in the West Coast Groundfish Observer Program Manual (NMFS, NWFSC, 2002, unpublished report). The data collected by the observers include:

- Start time, end time and location of tow/set
- Gear type and fishing strategy

- Estimated total catch weight (including tows/sets for which there is 100% discard)
- Weight of discard by catch category
- Reason for discard by catch category or species
- Species composition of discard by catch category
- Weight of fish retained by catch category
- Species composition of retained by catch category
- Document catch of prohibited species and incidental take of protected species
- Size composition, tags, and viability assessments for Pacific halibut
- Size composition of discarded fish (from randomly selected categories)
- Size composition of retained fish (from randomly selected categories)
- Basic taxonomic composition of non-fish bycatch
- Special biological collections (otoliths, maturity, food habits, genetic samples, etc.)

At-Sea Observations - Sampling on Trawlers

For each tow, the priorities of sampling are:

1. Prohibited species sampling
2. Estimate total catch weight
3. Estimate total discard weight
4. Species composition of discarded rockfish species
5. Species composition of all other discarded species
6. Species composition of retained species in mixed catch categories

These data are recorded on (1) Observer Haul Form (Appendix A), (2) Haul Deck Form (Appendix B), (3) Discarded Species Composition Deck Form (Appendix C), (4) Retained Species Composition Deck Form (Appendix D), and (4) Trip Discard Form (Appendix E).

a. Fishing effort data

To obtain fishing effort data on limited entry trawlers we obtain from the vessel's logbook the following: vessel name, US Coast Guard number, GF permit number, fish-ticket identification (i.e., FTID in PacFIN database), logbook identification (TRIP_ID in PacFIN database), date, time, and position (latitude and longitude), average depth of gear

deployment and retrieval, target strategy (Appendix Table I), and gear code (Appendix F). Observed trip data can be linked to sales records and management areas using US Coast Guard number, GF permit number, fish-ticket identification, and logbook identification.

Differences exist in the gear codes used by the WCGOP and those used in the state logbook data. Target strategies used by the WCGOP are listed in Appendix Table I and gear codes used are listed in Appendix F.

Limited entry fixed-gear vessels and open access vessels are not required to keep logbooks. Observers use captains' personal logs, vessel instruments (GPS, depth locators), and/or handheld GPS units to collect fishing operation information on these vessels.

b. Observed total catch

The methods of estimating the observed total catch (OTC) of a haul, listed preferentially, are: actual weight, volumetric estimate, visual estimate, retained + discarded weights, and vessel estimate. Observers follow these general rules when deciding which method to use:

1. If a catch is approximately 500 lbs or less and the species composition is relatively homogeneous, then actual weights are used.
2. If a catch is large and/or diverse, volumetric estimates are used. Volumetric estimates are made by taking length, width, and/or height measurements of a codend or trawl alley/bin to estimate total volume (m^3) of the total catch. A density measurement is obtained from a minimum of two baskets (with a predetermined volume) of randomly selected, unsorted catch. The estimated total catch weight (lbs) is the product of the volume (m^3) and the density (lbs/m^3).

There are two types of volumetric estimates:

   2.1. Bin/Trawl Alley Estimate - Used when the catch is dumped into a trawl alley or other measurable area.

   2.2. Codend estimate - Used when the full codend is not dumped into a trawl alley or other measurable area.

3. If actual weights and volumetric estimates are impossible, visual estimates are used

for OTC. Visual estimates are taken for every haul and recorded on the back of Observer Haul Form. The information can be used to check and compare the accuracy of visual estimates.

4. If basket density samples cannot be taken and if actual weight and visual estimate cannot be processed, then retained + discarded weights is used.
5. If none of the above methods can be utilized, then the vessel's estimate or hail weight is used.

c. Composition sampling

There are two steps in sampling for composition of the catch. The first step is estimating the weight of each catch category in the haul. During the second step species composition samples of some or all of the catch categories are taken.

i. Catch Category Sampling

Observers begin sampling once the crew has sorted the catch into retained and discarded fish. The crew separates the retained catch into catch categories while the observer sorts the discarded catch into catch categories. A catch category can be a single species or a mix of several species. Catch categories are determined by weight method, sorting method, and/or species composition. To ensure compatibility with landed catch information, observers record catch categories in PacFIN SPID complex codes. The weight methods for estimating catch categories are:

1. Actual Weight - If a catch category is less than 500 lbs and the total discard is less than 1000 lbs, actual weights are used. This is the preferred method and observers are encouraged to use it whenever possible.
2. Basket Volume Determination (BVD) - If a catch category can be put into baskets and thrown over, this method can be used. The observer places all of the catch in baskets before discarding. Randomly selected baskets are kept for average weight of baskets determination and species composition.
3. Bin/Trawl Alley Estimates - If a catch category is held in a bin or other measurable area, bin/trawl alley estimates are used. Observers measure the length, width, and height of the area to find the volume (m^3). Then, they take a minimum two basket

density (lbs/m^3) sample of the unsorted catch category. The volume is multiplied by the density to obtain an estimate of the catch category weight.

4. Visual Estimate - If an observer is unable to use one of the previous methods to estimate a catch category weight, this method is used. There are three ways to produce a visual estimate.

    a. Visually estimate the number of baskets it would take to hold the entire catch category. Multiply this number by an average basket weight to determine the weight of the catch category. Average basket weights are determined by weighing four or more baskets filled with unsorted catch from the catch category.

    b. Use temporal or spatial sampling frames. Temporal frames are used when an observer can estimate the total time it took to sort retained from discarded for a haul. Observers randomly select time units to take samples from and multiply the weight of the sample/time it took to take sample by the total time to sort. Spatial frames are used when as observer can estimate the proportion of area that the sample was taken from. They randomly select a proportion of the catch category to take a sample form. Then, they multiply the weight of the sample by the proportion to achieve a total catch category weight.

    c. Past experience. If the previous methods cannot be used, observer will do a visual estimate of the total weight of the catch category based on previous samples taken.

5. OTC - Retained - This method is used when none of the previous methods is possible. This is value is found by subtracting the summed total of retained catch categories from the overall total catch determined by the observer.
6. Vessel Estimates - Observers only use vessel estimates for the estimates of retained catch categories.

ii. Species Composition Sampling

Once the catch is sorted into catch categories, single or multiple basket species composition samples are taken. The priorities for species composition sampling are catch categories that contain:

1. Prohibited species: Pacific halibut, salmon species, Dungeness crab (north of Point

Arena.)

2. Discarded rockfish species
3. Species that are both retained and discarded.
4. All other discarded species.
5. Retained mixed rockfish.

d. Reason for Discard

Observers document the reason for discard based on reasons provided by the captain or crew for catch categories and/or species. The reasons for discard are categorized as 'prohibited', 'size', 'market', 'regulation', and 'other'.

e. Complications

Vessel size, catch size, and duration of hauls vary greatly along the West Coast. Because of these variations, observers require a number of options to complete the required sampling. Below is a brief description on how these factors influence sampling:

Vessel Size - Trawlers on the West coast range in size from 40 feet to 100 feet, with an average of 60 feet. The crews of these vessels usually use most of the deck space for retained species and sorting, leaving limited space for the observer to store and sort their sample.

Catch Size - Catch weight varies greatly, depending on vessel size and also target strategy. Large hauls may fill the entire deck, leaving little sampling space while small hauls may be sorted quickly and another catch brought up soon afterwards.

Duration of hauls - The amount of time between hauls as well as the number of hauls per day greatly influence sampling. As an example, when vessel hauls are of short duration, the observer must be conscious of finishing the previous sampling before the next haul is brought aboard. Observers must evaluate each vessel and devise a strategy that will allow them to take the largest sample size possible given the complicating factors. Many times, a small vessel will have a large tow or a small vessel will haul frequently, further complicating matters.

Revisions to Sampling and Collection Protocols

The West Coast Groundfish Observer Program held a workshop in July 2002. The purpose of the workshop was to review sampling protocols and obtain expert advice on the types of analyses that could be conducted with the data. Based on recommendations from this workshop, sampling protocols and training procedures were revised to ensure more consistency among the observer sampling methods. Also, during the first year of data collection, the most common method for estimating discard catch category weight was OTC (Observer Total Catch) - Retained. Observers are now encouraged to only use OTC - Retained when they are unable to sample the catch. Visual estimates are now the most common method for estimating catch category weights.

Data Flow

The fourteen steps of data processing prior to analysis are detailed below.

1. Data are collected at-sea by the observer following the protocols in the West Coast Groundfish Observer Program Manual (NMFS, NWFSC unpublished report).
2. Data are entered into the database system.
    a. During 2001-2002, the WCGOP used an onboard application, which included a Visual Basic graphical user interface. Observers used this to enter data into a Microsoft Access database located on laptop computers. Trip information contained in these Access databases is written to a file and transmitted via email as needed to a central data system located at the Northwest Fisheries Science Center (NWFSC).
3. Data aggregated in Oracle database.
    a. The central data system receives the trip data files and loads them into an Oracle database. Data within the Oracle database are then accessible via a web-based graphical user interface or by direct SQL queries from the database. For a list of data tables, see appendix G.
4. Quality Control (QC) of calculations and sampling methods.
    a. A debriefer or lead observer checks all computations made by the observer and reviews form to ensure that it is complete and that appropriate sampling methods were used.

5. Debriefing

a. Observers debrief after every two-month cumulative trip limit period. Debriefing includes:

i. Vessel Data - Observers complete a vessel survey for each vessel that explains vessel set-up and basic sampling methodologies.

ii. Logbook Review - Observers keep logbooks detailing the events of each trip, basic deck schematics, sampling methods used, communication logs, and confirmation of a current safety decal. Any hauls during which sampling problems occurred are documented in the logbook and reviewed during debriefing.

iii. Data Correction - Observer corrects all calculations and errors in data forms.

iv. Evaluation - Observers are evaluated on their performance.

6. Data checked and updated in database program.

a. Electronic data is compared to raw data to check for keypunch errors. Also, all corrections discovered during debriefing are updated in the database program.

7. Quality Control (QC) Queries

a. Queries are run to detect any data that do not fall within specified ranges or other inconsistencies.

8. Data updated in database system

a. The raw data of all entries that are pulled by the QC queries are reviewed and the electronic data is updated.

9. Volume estimate updated

a. Volumetric estimates are updated using a correction factor. Step 9 is necessary for all data collected from September 2001 - October 2002 due to correct the value used for the standard basket volume.

10. Data released to analyst team.

a. At this point, data are considered complete and ready for analysis.

11. Analyst(s) retrieve data from database and consolidate.

a. Data from the oracle database's vessel, trip, catch, and species composition

data tables are linked to form a new working file. The following information is included in each table:

i. Vessel - USCG identification number

ii. Trip - Start and end dates, start and end times, start and end latitudes and longitudes, depth, gear type, gear performance, total catch estimates, and weight method of total catch estimates.

iii. Catch - PacFin catch category based estimates of fish caught in each haul or set.

iv. Species Composition - Weights and counts of individual species occurring in the subsample.

12. Data Expansion

a. Because of the sampling procedure that derives the species composition, a tow-level expansion is needed to estimate the total amount retained and discarded of each species in the catch. Depending on the composition of a catch category, an observer may take a subsample from it, say j. Let y_j denote the total weight of the category j and x_{ij} denote observed weight of the species i in the category. The sampling ratio (R_j) for this category is

$$R_j = \left(\sum_i x_{ij} \right) \Big/ y_j$$

The tow-level expanded weight of the species i in the category j is

$$X_{ij} = x_{ij} / R_j$$

b. Tallying of X_{ij} of the species i across all categories j's within a tow would give the total landings of the species retained or discarded.

13. Observer Data merged with vessel logbooks and fish tickets.

a. Fish Tickets are trip-aggregated sales receipts for marketable species/categories. They are used as the basis for catch monitoring and stock assessment. Fish ticket information is loaded into the PacFIN database monthly and is subject to update frequently thereafter. Observer

data is linked to fish tickets by either direct fish ticket number(s) obtained by the observer or by comparing the return date recorded by the observer with the dates of fish tickets from the vessel. One complicating factor is that some trips have multiple fish tickets.

b. Vessel logbooks are only required in the limited entry trawl fishery. The logbooks contain tow-level information and the hailed weight (skipper estimated weight) of retained species/categories. The three state agencies have individually developed an adjusting procedure to reconcile the differences between fish tickets and logbook landings (Sampson and Crone, 1997). Attention should be paid when interpreting logbook data because the reconciliation may result occasional large differences between the hailed weight and adjusted weight for a species/category. The logbook data are not entered by all states into the data system until several months after the end of the calendar year. Therefore, at present, complete logbook data are only available for 2001. In addition, some fishers do not submit their logbooks to the state. The missing logbooks make it difficult to complete full statistical analyses. Vessel logbooks are linked to observer data through fish tickets.

14. Stratification of Data

a. Ideally, the observer data is a set of samples from a population defined by fish tickets and/or by logbooks although the sampling frame of the population can only be defined as the fishing season progresses. The temporal and spatial distributions of groundfish species associated with complex environmental conditions and the temporal changes of fisheries management are characteristic of the west coast groundfish fisheries. To address this consideration, the data need to be stratified into likely homogeneous components in order to obtain a minimum-variance estimate of parameters of interest. Due to the mobility of the fleet, treating a trip as a sampling unit would make it difficult to address the temporal and spatial

operation of the fishing industry. Therefore, individual tows are used to define sampling units. A finer stratification would lead to almost-homogeneous strata but leave an insufficient number of samples in the individual strata. Therefore, the following stratifications were used for these analyses.

Target strategy: Tows are classified as: (1) Pacific whiting, (2) DTS (Dover sole, thornyheads and sablefish), (3) Shelf rockfish, (4) Slope rockfish and (5) Flatfish according to the predominate catch in each tow. These categories are assumed to approximate the intended target strategy of the fisher when making the tow. The species/categories assigned to the strategies are listed in the Appendix Table 1, which is based on "species/market categories, complexes, management groups" on the website of PacFIN (http://www.psmfc.org/pacfin/codes.html).

Eight tows were assigned to the Pacific whiting strategy but this element of the WCGOP does not cover the shoreside or offshore components of this fishery so the tows were not included in these analyses. The shoreside whiting fleet retain their catch and the catch is sampled at the port of delivery by state port samplers. One hundred percent of the at-sea whiting fleet is observed by industry-funded observers and the data are summarized and reported elsewhere.

Depth Range: Bycatch is also expected to vary with depth. Therefore, three depth ranges are used in this analyses: (1) 0-100 FM, (2) 100-200 FM, and (3) >200 FM. The depth ranges (1) and (2) include the upper boundary.

Area: For these analyses the west coast is divided into North and South areas along the line of 40^{o} 10' N.

Period: The two month trip-limit period is used, (1) Sep-Oct, 2001, (2) Nov-Dec, 2001, (3) Jan-Feb, 2002, (4) Mar-Apr, 2002, (5) May-Jun, 2002, and (6) Jul-Aug, 2002. The observer program sent the first trawl observer on a trip that started before the end of few trips that started in August 2001 and ended in September 2001 so did not cover the entire trip limit period and therefore and not included in these analyses.

Tow: In order to accurately assign the data to an area the basic unit of observation for these analyses is tow.

15. Ratio estimators for discard and bycatch rates

In this report the ratio estimator technique (Cochran 1977) is used to estimate bycatch and discard rates for 23 selected species (Appendix Tables II, III and IV). The fish species selected are the all overfished stocks, prohibited species (salmon, Pacific halibut), and the other assessed stocks. The ratio estimates (R_{ijkl}) are calculated by area (*i*), depth range (*j*), target strategy *(k*), and period (*l*):

$$R_{ijkl} = \sum_t y_{ijklt} \Big/ \sum_t x_{ijklt}$$

where y_{ijklt} is the discarded or retained pounds of a species in the tow *t*. Three denominators (x_{ijklt}) are presented here: duration in hours of the sampled tow *t*, the cumulated catches in pounds of the target species that define the tow strategy, and the cumulated catches of all groundfish in the tow *t*. The first denominator is an un-standardized catch per unit effort for the area-depth-strategy-period stratum. The second and third denominators are used to provide different perspectives for these preliminary analyses. The variance of R_{ijkl} is approximated by using the following equation (Pikitch et al. 1998):

$$Var(R_{ijkl}) = \left(\frac{\bar{y}_{ijkl}}{\bar{x}_{ijkl}}\right)^2 \left[\frac{s^2(\bar{y}_{ijkl})}{\bar{y}_{ijkl}^2} + \frac{s^2(\bar{x}_{ijkl})}{\bar{x}_{ijkl}^2} - \left(\frac{s^2(\bar{y}_{ijkl})s^2(\bar{x}_{ijkl})}{\bar{x}_{ijkl}^2 \bar{y}_{ijkl}^2}\right)\right]$$

where $\bar{x}_{ijkl}$ and $\bar{y}_{ijkl}$ are the means of x_{ijklt} and y_{ijklt} over the tows and $s(\bar{x}_{ijkl})$ and $s(\bar{y}_{ijkl})$ are their standard errors. Note that *Var* (R_{ijkl}) is not 0 when $y_{ijklt} = 0$ for all tows because all x_{ijklt} values are not necessarily 0 or equal.

Results

Use of Logbook data

Because 2002 logbook data have yet to be completed, only 2001 logbook data from September to December 2001 period, can be used for analyses in this report. For these analyses, the mid-water tows that target Pacific whiting (total whiting catch / total groundfish catch > 0.6) are excluded since these tows were not part of sampling protocol. Eight tows that do not have groundfish landings are also excluded from the analysis. In order make logbook data comparable to the observer data, the analyses here are limited to the gears coded in the logbooks as 'GFS', 'GFL', 'GFT ', 'FFT', and 'MDT'. (See PacFIN website for full the description of these gear codes). Using these criteria, in this period September to December 2001, a total of 6,312 tows (Table 1) were fished over 1,527 trips and were recorded in logbook data (Note: In Table 2 the number of trips reported is 1,564. This number includes the 37 trips for which there were no matching logbook records.)

Due to the difficulty experienced in matching the trips and tows recorded in logbooks and those recorded in observer data, only 490 out of 739 observer tows can be matched with the logbook tows and 113 out of 150 observer trips can be matched with trips. Better matching with logbooks could occur with 100% logbook submission and more reliable logging of trip information.

Use of Fish Ticket Data

For the 618 observer trips recorded in the first year of the observer program, 15 trips do not have the associated Fish Ticket Ids (FTID's). For the remaining 603 trips, the fish tickets for 114 trips have yet to be submitted to PacFIN database. Interestingly, of these 129 trips without fish tickets, only five are in the most recent period analyzed for this

study. In contrast, there are 45 and 35 trips that do not have fish tickets in the earlier periods of Jan-Feb, 2002 and Mar-Apr, 2002, respectively.

In order to compare observers' tow-by-tow landing for each species/category with the landing obtained from fish ticket, the trip-aggregated fish ticket landings for each species/category are distributed proportionally across the tows using the following formula. Let x_{ik} be the observed landing of the species/category i in the tow k and y_i be the fish ticket landings of the species/category i. The adjusted landing is

$$C_{ik} = y_i \left(x_{ik} \Big/ \sum_k x_{ik} \right).$$

Figure 1 shows the comparisons between adjusted and observer-estimated landings for 16 selected species. There is general agreement for bocaccio (BCC1), chilipepper (CLP1), dover sole (DOVR), lingcod (LCOD), longspine thornyhead (LSP1), POP (POP2), petrole sole (PTRL), widow rockfish (WDW1), and yellowtail rockfish (YTR1) but discrepancies are found in arrowtooth flounder (ARTH), canary rockfish (CNR1), shortspine thornyhead (SSP1), and especially sanddab (SDAB) and skates (SKAT) as shown in Figures 2 and 3.

The observers were asked to suggest the reasons for the discrepancies of sanddabs and skates. The reasons found include possible after-market discard, use by processors of different names for the species/categories, retention of the landings for crab bait, and incorrect use of the product conversion factor for gutted fish. These reasons may also apply to the smaller discrepancies seen in other species.

Overall Coverage levels

The initial program design was implemented with the goal of covering a majority of the vessels in the fleet in the first two years. The observer program exceeded this goal, cycling through most of the limited entry trawl fleet in one year. There was a small number of boats that were not covered primarily because space on the vessel could not

accommodate an observer. [3] The program also was designed to attain an initial coverage of 10% of the landed catch as reported in the fish tickets. We have met that goal (Table 3).

Table 3 summarizes the total fish ticket landings of groundfish and groundfish plus sharks and skates by period and port group. For the six periods, the observer coverage ranges from 7% to 14% with 10% overall. Inclusion of sharks and skates do not affect the resultant percent coverage in landings. However, the landings of skates and some other species are not reported or under-estimated in the fish tickets (Figures 2 and 3).

Spatial Distribution of Observations

A total of 618 trips that used trawl gears were sampled during the first year of the observer program. Table 4 lists the distribution of observer trips by period, area, and port group. Sampling effort in Washington coastal and Columbia River ports, Santa Barbara area ports, Tillamook area ports, Brookings area ports, and Bodega Bay area ports are lower than the other ports. Considering the proximity of Washington Columbia River ports to Oregon Columbia River ports, and the proximity of Brookings area ports to Crescent City area ports the sampling effort in these regions is probably sufficient.

A total of 3,623 tows were taken during the 618 observer trips (one trip was abandoned after a few failed tows). The distribution of tows for 2001 and 2002 by port group, period, and depth range is shown in Table 5. Most of the tows are in the 0-100 FM depth zone. Comparison of tow locations between 2001 logbook and observer-sampled tows indicates that the majority of fishing effort is in this depth range (Figures 4 and 5, also see Table 6). There is evidence in these data of some difficulties in obtaining completely accurate location information. Since observers usually do not have independent GPS equipment, they must rely on vessel information for tow locations. In some cases data entry errors are apparent when tows are reported in unfishable locations. The

[3] The National observer program has provided funding for a workshop to discuss the issues of getting observer observations on small vessels. The results of this workshop may assist us in developing protocols for observing such vessels in the trawl fleet.

implementation of a VMS system in the west coast groundfish fishery in 2003 can make better location information available to the program.

An examination of tow locations from individual ports (Figures 4 and 5) reveals that in many cases fishing locations are clustered in a narrow band that extends offshore from the port. It is also clear that Oregon fleets are more mobile than the fleets in the other two states. This information can be useful in allocating sampling effort.

Coverage by Target Strategies

Table 6 describes how tows were categorized into the five target strategies. There are 103 tows categorized as non-GF (non-groundfish) strategy tows. They are categorized as such because none of the species that define the five target strategies are retained.

Fishing was closed in the period of October to December 2001 to harvesting of DTS species, slope rockfish, and lingcod (PFMC, 2002). The effect of the closure is reflected in the low number of tows occurring during this period.

Bycatch Estimates

The discarded and retained catches in pounds for 23 selected species by target strategy, depth range, and period are shown in Appendix Table II (north of $40^{o}10'$N) and Appendix Table III (south of $40^{o}10'$N). However, caution should be paid when examining data in Appendix Tables II and III. Some categories have a very small number of sampled tows. One should consult Appendix Table IV for number of tows.

Some patterns in bycatch can be discerned from a preliminary examination of these data. In the north and south areas, almost all Pacific whiting from all non-whiting target tows are discarded. The discards of sharks and skates are relatively high in both areas and for all strategies. In the northern area, the following patterns for other species are evident. For DTS tows, most of the discarded sablefish and shortspine thornyhead occurred in the 0-100FM and 100-200FM strata. For the shelf rockfish (RKF) strategy, most of discarded arrowtooth flounder is in 0-100FM stratum in the north area. Although most of

the discarded yellowtail rockfish is in the shelf rockfish (RKF) strategy in 0-100FM, the percentage discard is only 14%. For the flatfish strategy most of the discards of dover sole are in 0-100FM and 100-200FM strata, of darkblotched rockfish in the 100-200FM stratum, of lingcod in 0-100FM stratum, and of thornyheads in >200FM stratum.

In the southern area, most of the discarded poundage of the four species targeted by DTS strategy occurs in >200FM depth range. Most of the discards (in pounds) for sablefish, bocaccio, chilipepper, and lingcod for the shelf rockfish (RKF) strategy and the highest percentages discard are in 0-100FM.

Ratio estimators for discard and bycatch rates based on observer data

If observer data could be matched with logbook data, the observed tows could be viewed as a set of samples from the population defined by the logbook information. However, the entry of the some logbook information by the states can lag by more than a year. Therefore a tow-to-tow match cannot be performed on all of the data collected in the first year by the observer program. Therefore, the ratio estimators for discard and bycatch rates are calculated from the observer data alone. Three different ratio estimators for the 23 selected species by area, strategy, depth range, and period are presented here. The three estimators are: (1) discard and bycatch per hour towed, (2) discard and bycatch per pound of target species landed, and (3) discard and bycatch per pound of total groundfish landed. The results are listed in Appendix Tables IV.A (Northern area) and IV.B (Southern area).

The standard errors around the estimators are large, especially when the number of tows available for estimation is small. Because the information on the size of each stratum is not available, due to the unavailability of logbook data, the estimation of total discard and bycatch for the fleet cannot be completed at this time. Once the logbook data are available, this information will be calculated. When interpreting the rates presented here the reader should be aware that in some instances there are very small sample sizes. In part, this is because populations of some species are small, and thus, the encounters are rare.

Figure 6 shows the frequency distribution discard weights for three example species in the Northern and Southern areas. These figures illustrate a trend of very rare instances of large bycatches.

Discussion

The goal of this initial data report is to provide, in a timely fashion, the information from the first year of observer data collection. It is anticipated that by continually producing such reports when significant increments of data are available we provide timely adjustments to both the data collection and data analyses. In the second year of the program the number of observers has increased and the program has expanded the amount of coverage on other sectors of the fleet. Therefore, future data reports will not only include more observer information from the trawl fleet, but will include information on both the fixed gear and open access fleets.

Even in this initial report, some relevant patterns have emerged. In the absence of any *a priori* statistical data on the variability in bycatch, an initial goal of the program was to achieve 10% coverage of the landed catch by limited entry trawl fleet. This goal was attained. Of course, further analyses will determine if this continues to be an appropriate overall level of coverage. Moreover, while the initial coverage goals generally have been met, we can identify some areas where adjustments can be made. Information on the spatial distribution of the coverage indicates that there are some areas in Southern California that have fewer observer trips. Sampling effort can be improved in Santa Barbara area ports. In addition, while Los Angeles and San Diego area ports have little limited entry trawl effort, they could be added into the future sampling plans since they are important ports for the open access fishery. The analyses here also indicate vessels have high fidelity to certain locations around the ports (Figure 5). This gives us useful information that can be used to adjust the allocation of sampling effort. For instance, a lack of coverage revealed in one area can be easily remedied by adding coverage in a single port.

Unfortunately, the analyses that could be included in this report were limited by the lack of available logbook information from 2002. Clearly, if analyses that depend on logbook information are to be conducted in a more timely fashion, then resources must be in place to allow the information to be entered into the state systems more quickly.

There are other analyses that we have identified as a high priority that were not included here. For example it is clear to the program that an investigation of potential "observer effects" is one of the next analytical task that should be completed. These analyses should include examination difference in such things as: fishing ground, catch per unit effort, trip limit attainment, catch sorting and marketing and sale strategies on observed versus unobserved vessels.

Since this is the first year of data collection accumulated sample sizes are consequently low. Therefore, variability of estimates for discard and bycatch rates is high. These high variances are not only the result of low samples sizes, but are an accurate reflection of the high variances in the tow-to-tow catches of these populations. This is the same level of variability that causes imprecision in the results of resource surveys. Not only does this high variability cause an imprecise estimate of the mean rate, it also causes a very high imprecision in the estimate of the variance itself. As the data accumulate, these estimates will stabilize.

Populations of some species of groundfish are small (e.g. cowcod, bocaccio, canary) and therefore these species have a small probability of appearing in sampled tows. Therefore, it will be important to employ statistical modeling to understand the bycatch of these species, rather than depending on more traditional sampling techniques.

The "patchy" distribution of some of these species is clear from the frequency distribution of number of tows relative to discarded pounds (Figure 6). A further accumulation of data will allow us to study the spatial and temporal distribution of these high discard events. This may allow future re-distribution of observer coverage to better

sample these rare events. However, it is clear that optimization of coverage for every important species could be very difficult because spatial and temporal patterns of many of these species will differ greatly. In addition, the logistics of observer deployment make multiple, detailed, individual optimizations difficult.

We have attempted to estimate bycatch rates for some species using the current data. These estimates of bycatch must be viewed carefully and only in the context of the current fishing regulations. When trip limits were first implemented in the 1980s, the goal was to slow the rate of catch for particular species that were targets of the fishing effort. Because a fisher cannot control their catch exactly, overages of these trip limits resulted in discard. Pikitch's discard study in the late 1980s found an average discard rate of 16%. That is, the total fleetwide discard of widow rockfish was 16% of the total fleetwide catch of widow rockfish, accumulated across all strategies that caught widow rockfish. This 16% discard factor was used throughout the 1990s for other species as they came under trip limit management because there were no direct observations of trip limit induced discard of these species.

Beginning in 2000, draft rebuilding plans for overfished species resulted in extreme reductions in trip limits for these overfished species to essentially remove incentives for fishing activities that would target these species. The goal was to keep the total catch of these overfished species below the prescribed levels in the rebuilding plan. These overfished species were no longer subject to a significant target fishery (some like cowcod, and now bocaccio, were prohibited from being landed), but they still may be bycatch in fishing activities targeted on other species. In addition, some, most, or all of this bycatch could be discarded depending upon the regulations.

The analytical goal for both target species and bycatch species is to obtain the best estimate of total catch. For target species, most catch is retained so the analytical method of choice is to obtain a census of the retained catch from fish tickets and to inflate this level with the estimated discard factor. For bycatch species (non-target species), most catch may not be retained. Therefore, the analysis becomes a direct estimation of total

catch. This is done by estimating bycatch rates, which are defined as the ratio of the amount of catch (bycatch) of a particular species (for example canary rockfish) to the amount of catch for a target fishery (for example all nearshore flatfish). With these rates and a logbook-based calculation of the total catch of each target fishery, the total bycatch (for each depth strata) of the subject species can be estimated. It is important to recognize, that discard rates in the first method for target species area are completely different in concept than the bycatch rates in the latter method for the highly constrained and prohibited species. For the highly constrained species, the discard rate may now be nearly 100%, and the goal of the observer program is to determine whether the total catch is below the biological limit laid out in the rebuilding plan.

Finally, this observer program has taken a designed-based approach to determining bycatch rates. This is conceptually similar to the way in which past observer and logbook data were processed by Hastie (2003) to forecast bycatch rates for the 2003 fishery in a bycatch management model. It is unclear as yet if the first year of observer data are sufficient to update all the bycatch rates in the current groundfish bycatch management model. Some remaining steps are to: 1) Obtain the 2002 logbook data and use these data to validate if the observer data are representative of fleet-wide activity, 2) Investigate patterns of bycatch by season, depth, and target strategy to improve the basis for stratification of the bycatch management model currently in use, and 3) Calculate, where sample size is adequate, the bycatch rates from observer data for the stratification cells of the bycatch management model.

As this report is being written, the SSC of the council is meeting to review the bycatch management model and make recommendations on how best to transition to the use of the observer data. We look forward to using this advice. As the amount of observer data collected for any particular strata increases, it is a high priority to incorporate these contemporary data in the model used to guide west coast groundfish management.[4]

[4] For copies of unpublished manuscripts cited in this report or hardcopies of this report contact the West Coast Observer Program at NWFSC.observerprogram@noaa.gov

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